LIETUVOS RESPUBLIKOS KULTŪROS MINISTERIJA

Kurk Lietuvai

ArtTech – analysis of the current situation in Lithuania

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ArtTech - Opportunities for Lithuania's Cultural and Creative Industries sector

Analysis of the current situation in Lithuania

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This analysis is part of the project ArtTech - Opportunities for Lithuania's Cultural and Creative Industries, implemented for the Ministry of Culture of the Republic of Lithuania.

Beatričė Ceizarienė | beatrice.ceizariene@gmail.com
Ieva Gurklytė | ieva.gurklyte@gmail.com
Elena Ruikytė | elena.ruikyte@gmail.com

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Introduction

In the 21st century, digital transformation is part and parcel of every one of us, in the private and public sectors. It is transforming law (LegalTech), finance (FinTech), energy (CleanTech), education (EdTech), the public sector (GovTech) and promoting public engagement in democratic processes (CivicTech). However, with the advent of Industry 4.0 and 5.0, the emergence of new technologies such as artificial intelligence (AI), augmented (AR) and virtual reality (VR), the blockchain and their rapid development, there is a growing demand for digital transformation in other sectors. One such sector is the cultural and creative industries (CCIs).

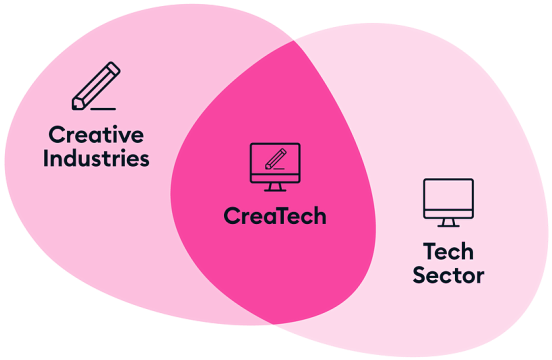


Figure 1. The interface between the cultural and creative industries and the technology sector, CreaTech. Source: TechSpark (2021)

ArtTech is a fast-growing ecosystem of innovation in the cultural and creative industries sector, where creators, cultural and arts organisations, start-ups, small and medium-sized enterprises (SMEs) develop innovative, usually state-of-the-art technology-based solutions to cultural challenges or integrate technology into creative processes.

The terms and abbreviations for the ArtTech ecosystem and state-of-the-art technologies, which are also used in this document, can be found in the authors' Concepts Guide.

Other results of the project "ArtTech - Opportunities for the Lithuania's Cultural and Creative Industries sector":

- An overview of creative chain transformations;
- A review of good practices in other countries.

Context

According to the **Culture and Creativity Development Programme for 2021-2030**[1], the cultural and creative industries sector in Lithuania has been one of the largest employers and one of the fastest growing sectors of the economy in recent years, contributing significantly to the creation of added value for the national economy. However, the insufficient and inefficient use of the potential of CCIs in transforming the economy and addressing social and environmental challenges was identified as early as 2015-07-31 in the Guidelines for the Development of the Policy for Culture and the Creative Industries 2015-

[1] Ministry of Culture of the Republic of Lithuania, Programme for the Development of Culture and Creativity 2021-2030, approved by the Government of the Republic of Lithuania on 29 September 2021. "On the Approval of the Programme for the Development of Culture and Creativity of the Ministry of Culture of the Republic of Lithuania for the period 2021-2030".

2021, approved by the Order of the Minister of Culture of the Republic of Lithuania No. ĮV-524[2]. It was found that CCIs were envisaged only as a resource for the development of other economic or social areas, and therefore no focused and coherent policy for the development of the CCI sector had been formulated, and no measures had been implemented that specifically responded to the needs of the CCIs and were oriented towards the development of CCIs.
It is important to note that current and relevant strategic documents recognise the importance of both creativity and culture and CCIs, and the need to develop them. Therefore, an analysis of the main strategic documents, main problems and its causes is provided further.

Lithuania's Progress Strategy "Lithuania 2030"[3] places particular emphasis on strengthening a society open to creativity, innovation and challenges, and building a flexible, globally competitive and innovation-driven economy. Key initiatives are in place to bring about change:

- Develop high quality cultural services across the country to ensure cultural diversity and accessibility;
- Promote partnerships between culture and different walks of life through creative products and cultural services;
- Increase the dissemination of culture in Lithuania and abroad, with a particular focus on digitisation of cultural heritage and contemporary cultural content;
- Creating the conditions for the integration of business, education, science and culture;
- To facilitate the development of the country's creative and cultural industries and its competitiveness in international markets.

The National Progress Plan for 2021-2030[4] (NPP), which implements the Lithuania 2030 Strategy, sets out 10 strategic objectives and progress targets to implement the horizontal principles. The goals and targets relevant for the ArtTech ecosystem are presented in Figure 2.

[2] https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/4a028c503a6f11e598499e1e1ba6e454/asr

[3] State Progress Strategy "Lithuanian Progress Strategy 2030", approved by the Resolution of the Seimas of the Republic of Lithuania No. XI-2015 of 15 May 2012 "On the Approval of the State Progress Strategy "Lithuanian Progress Strategy 2030""

[4] National Progress Plan 2021-2030, approved by the Government of the Republic of Lithuania on 9 September 2020. Resolution No 998 of the Republic of Lithuania of 9 September 2009 "On the Approval of the National Progress Plan 2021-2030".

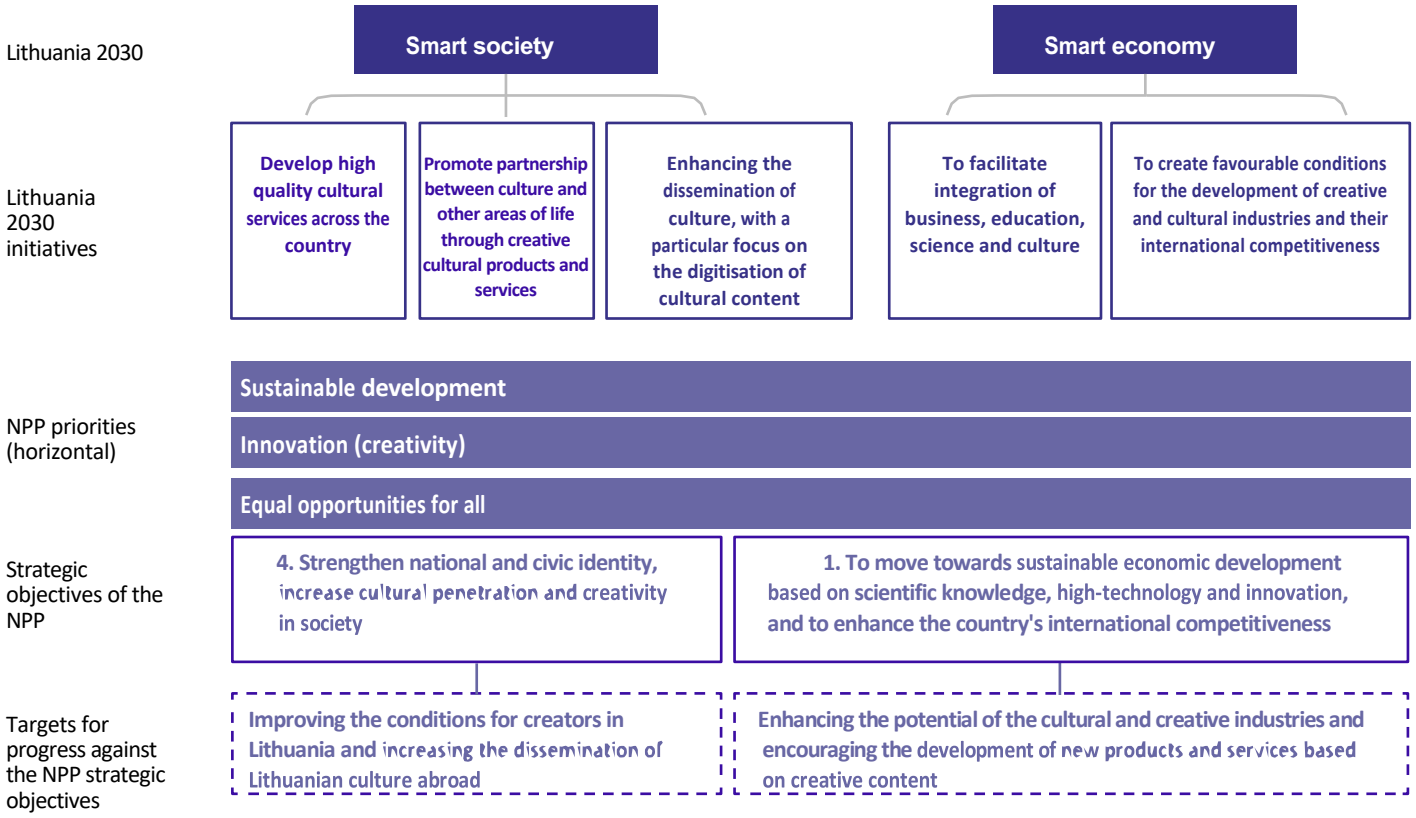


Figure 2. Priorities and objectives for the ArtTech ecosystem identified in the Lithuania 2030 Strategy and the NPP.

The strategic objectives of the above-mentioned documents and their relevance for the ArtTech ecosystem are also reflected in the **18th Programme of the Government of the Republic of Lithuania**[5] and in the **Implementation Plan for the provisions of the 18th Programme of the Government of the Republic of Lithuania** adopted in **2021**[6] (see Figure 3). One of the missions of the Government Programme is culture that transforms the quality of life of individuals and society, and a priority of this mission is the link between culture and education. This Government Programme places particular emphasis on the diversity, quality and accessibility of digital cultural content and services; empowering the cultural and creative industries to unlock their economic and creative potential; and enhancing the competitiveness of culture at national and international level.

[5] Programme of the Government of the Eighteenth Republic of Lithuania, approved by the Seimas of the Republic of Lithuania on 11 December 2020 Resolution No XIV-72 of 14 December 2007.

[6] Plan for the implementation of the provisions of the Eighteenth Programme of the Government of the Republic of Lithuania, approved by Government Resolution No 155 of 10 March 2021.

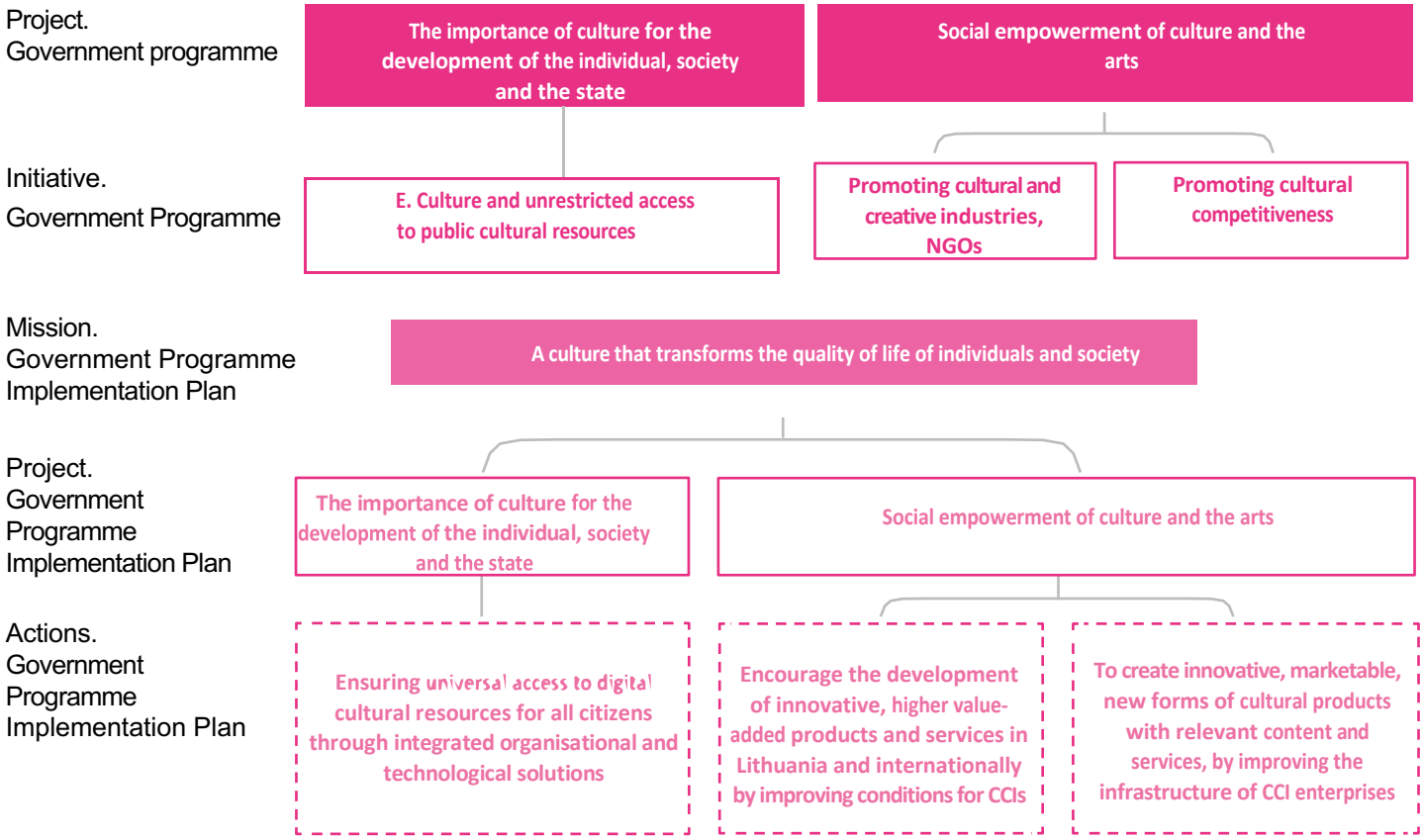


Figure 3. Projects, initiatives and actions relevant to the ArtTech ecosystem in the 18th Government Programme and Implementation Plan.

The 2021-2030 Culture and Creativity Development Programme[7] for NPP Objective 1.9 raises the **problem of the** untapped potential of CCIs to create a high value-added economy and innovative social services, without systematically and specifically nurturing the CCI sector itself.

The main causes:

1.1. Underdeveloped technological, organisational and infrastructural resources for CCIs in the face of globalisation, digitalisation and pandemic challenges.

1.2. Insufficient CCI networking, international and cross-sectoral cooperation does not ensure international competitiveness of CCIs.

1.3. Lack of competences and skills to effectively develop and exploit the potential of CCIs in terms of market knowledge, export development, innovation and business solutions.

1.4. Lack of sources of finance, including financial instruments (accelerator funds, venture capital, loans, guarantees, etc.).

[7] Ministry of Culture of the Republic of Lithuania, Programme for the Development of Culture and Creativity 2021-2030, approved by the Government of the Republic of Lithuania on 29 September 2021. 781 "On Approval of the Programme for the Development of Culture and Creativity of the Ministry of Culture of the Republic of Lithuania for the years 2021-2030".

One of the measures envisaged to address this problem is **the development of CCIs to promote competitiveness and value-added**. This measure aims to increase the growth of output in the CCI sector and private investment to complement public support (see Figure 4).

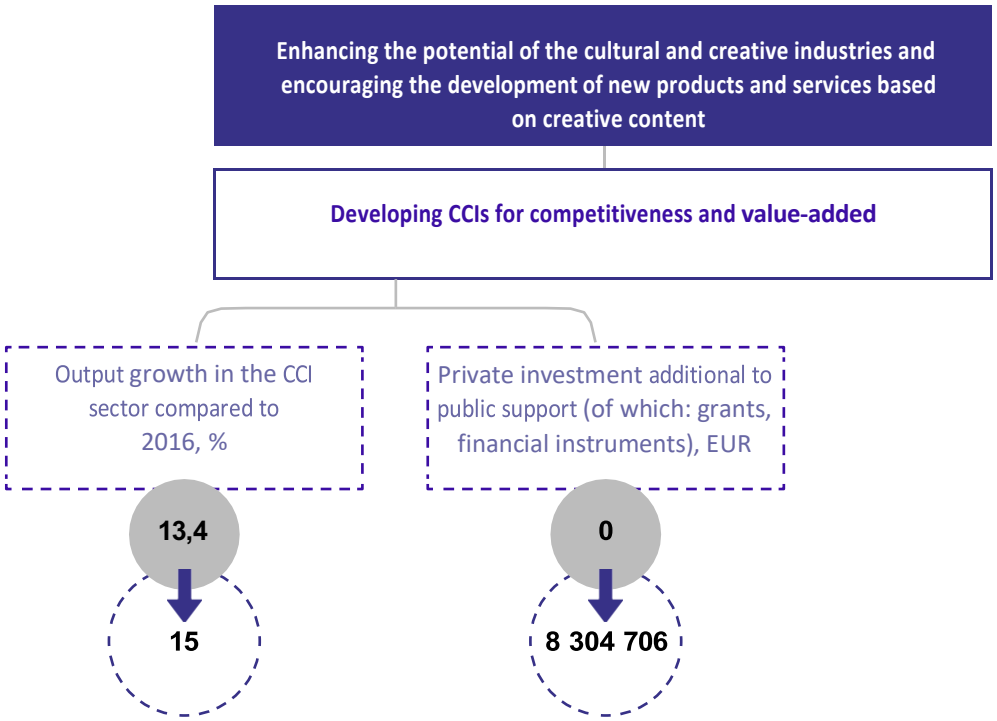


Figure 4. Measures and indicators relevant to the ArtTech ecosystem in the Ministry of Culture of the Republic of Lithuania's Culture and Creativity Development Programme 2021-2030.

The analysis of the main strategic documents in Lithuania shows that there are both long-term and medium-term strategic goals and activities that are relevant for the creation and empowerment of the ArtTech ecosystem in Lithuania. This analysis will seek to verify which and to what extent the causes of **the problem** raised in the **Culture and Creativity Development Programme 2021-2030**, "the untapped potential of CCIs to create a high value-added economy and innovative social services without systematically and specifically nurturing the CCI sector itself", are of relevance to the sector and should be prioritised for resolution.

Methodology

Objective. To provide an overview of the Lithuanian ArtTech ecosystem players: universities and research institutions; investors; consultants; accelerators; creators, startups, SMEs. To uncover the current situation of creators, startups, SMEs, to explore their main strengths and challenges and to make recommendations for the next stage of the ArtTech project – ecosystem empowerment.

Methods used. The analysis of the current situation of the Lithuanian ArtTech ecosystem is based on a qualitative approach, using qualitative research data collection methods. The main data collection methods were: analysis of publicly available secondary sources and semi-structured interview method.
The structuring of the research and the planning of the interview cycle took into account not only the actors of the ArtTech ecosystem (see Figure 5), but also the different fields of culture and CCIs, in order to grasp the issues and opportunities of the individual fields.

According to the STRATA study[8], although there is no internationally accepted classification of CCIs, the classification proposed by the United Nations Conference on Trade and Development (UNCTAD) is often used.[9] There is no single and widely available definition of CCIs in Lithuania too. The definition and classification of CCIs in the Ordinance on Cultural and Creative Industries Policy[10] is narrower than the one proposed by the National Association of Cultural and Creative Industries.[11] Therefore, for the purposes of this analysis, the CCIs, participants in the ArtTech ecosystem, are classified in the light of these documents and the classification is presented in Annex 1. The other ArtTech ecosystem actors are not further subdivided, but it should be stressed that this document will not analyse the needs, challenges and opportunities of these and the following ecosystem actors: society, consumers; public sector. The analysis of these ecosystem actors is foreseen for the continuation of the project.

Structure. This analysis is divided into several parts – an introduction, two main parts and recommendations. The introductory part introduces the relevance of the analysis, states the objective of the analysis, presents the research methods and describes the structure. The first main part presents the theoretical model of the ArtTech ecosystem and gives an overview of the players in this ecosystem in Lithuania. The second main part describes the methodology of the qualitative research and analyses the results of this study, a series of semi-structured interviews with participants in the Lithuanian ArtTech ecosystem. The recommendations section summarises the results of the analysis and provides recommendations for the continuation of the ArtTech ecosystem empowerment project.

[8] STRATA, Feasibility Study on the Economic and Social Value of the Cultural and Creative Sector, 2021 https://strata.gov.lt/images/tyrimai/2021-metai/20210930-kulturos-ir-kurybos-sektoriaus- study.pdf

[9] UNCTAD, https://unctad.org/system/files/official-document/ditc20082cer_en.pdf#page=[14]

[10] Order of the Ministry of Culture and Creative Industries of the Republic of Lithuania "On the approval of the development directions of the culture and creative industries policy for 2015-2021", 31 July 2015. No. ĮV-524

[11] Žilvinas Jančoras (et al.), Competitiveness of Lithuanian Creative Industries in Lithuania and Abroad, 2014, Appendix 1, p. 123

Lithuanian ArtTech ecosystem now

The analysis of the Lithuanian ArtTech ecosystem is divided into two parts:

- Based on the theoretical model of the ArtTech ecosystem developed by the authors (Figure 5), the participants of this ecosystem in Lithuania are reviewed.
- Based on the qualitative research – a series of semi-structured interviews with CCI representatives, a SWOT analysis of the ArtTech ecosystem is presented (page 24).

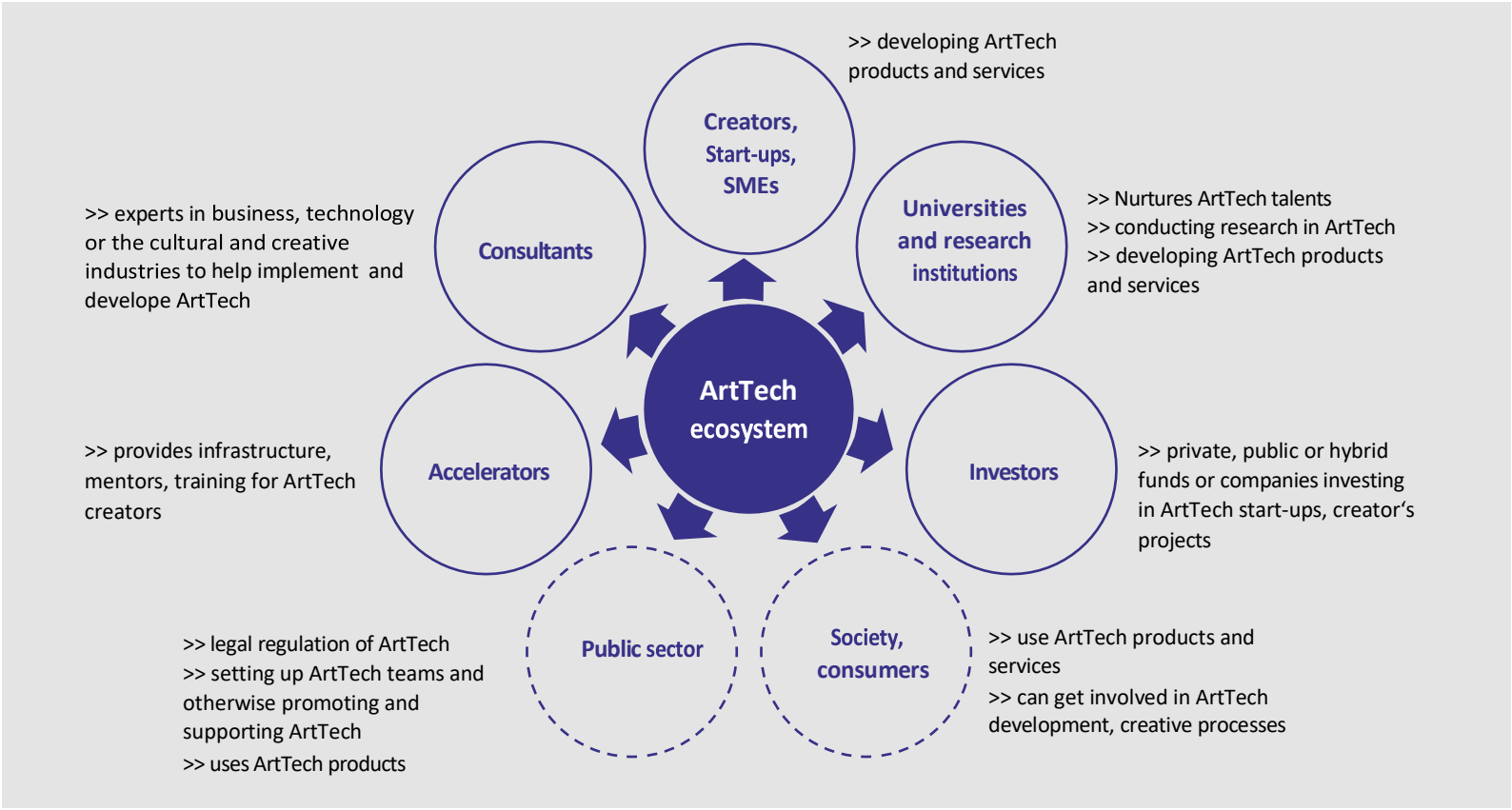


Figure 5. The ArtTech ecosystem. Source: Compiled by the authors based on Tanya Filer (2019); Alcor Fund (2021).

As mentioned in the introduction, this analysis focuses on creators, start-ups, small and medium-sized enterprises (SMEs), or CCIs, which are classified according to Annex 1. Therefore, the classification of CCIs is also taken into account in the overview of the actors in this ArtTech ecosystem. The other participants in the ArtTech ecosystem are not further classified.

Creators, Start-ups, SMEs

The ArtTech ecosystem combines cultural products/services and new technologies such as artificial intelligence, AR/VR, blockchain. Creators, start-ups, small and medium sized businesses are therefore an important part of this ecosystem when developing such products/services. Although it is argued that Lithuania has untapped CCI potential[12], this does not mean that there are no creators and businesses in the ArtTech ecosystem. The global pandemic of COVID-19 has forced many to look for new ways to reach consumers and monetise their creations in the digital space. As a result, Lithuania is seeing more and

[12] Ministry of Culture of the Republic of Lithuania, Programme for the Development of Culture and Creativity 2021-2030, approved by the Government of the Republic of Lithuania on 29 September 2021. "On the Approval of the Programme for the Development of Culture and Creativity of the Ministry of Culture of the Republic of Lithuania for the period 2021-2030".

more creators embracing new technologies, from paintings converted into NFTs to photo editing software based on artificial intelligence technology, which is already widely used worldwide.

An analysis of publicly available secondary sources shows that not all Lithuanian CCIs adopt and apply the new technologies in the same way. The most advanced, leading and developed CCIs in the ArtTech ecosystem in the country are **media** – new media, gaming, film and music, and **visual arts**. Therefore, below is an overview of specific examples of ArtTech ecosystem actors, creators and their activities. A detailed map of the Lithuanian ArtTech ecosystem with specific examples can be found here.

Heritage

In heritage institutions such as museums, the content is rather static. New technologies (e.g. VR/AR) can be tools to increase engagement and give exhibits a new lease of life. It should be stressed that digitised artefacts, with their photographs posted on the museum's website, are not an example of ArtTech. However, augmented reality technology and exhibitions based on it are gaining more and more attention from heritage institutions and museum professionals. There are not many examples of the use of VR technology in Lithuanian museums, but the most famous one is "Trail of Angels".

In 2018, director Kristina Buožytė and producer Vitalijus Žukas presented the artistic VR film **"Trail of Angels"**, based on paintings by M. K. Čiurlionis. 60 paintings were used to create the interactive experience. The authors aimed not only to transfer the paintings into virtual reality, but also to convey the emotion, what the artist wanted to convey through his work.[13]

Picture 1. Trail of Angels. Source: welovelithuania.com

[13] Trail of Angels. https://www.angelutakais.lt/#Apie

The Kaunas Archdiocesan Museum has opened the augmented reality exhibition **"Reality Expands".**[14] The museum invites visitors to see the treasures of the museum's collection from the first half of the 17th to the 20th centuries in an innovative and interactive way that has never been seen before.

Picture 2. A moment from the Kaunas Archdiocesan Museum exhibition "Reality Expands". Source: kamuziejus.lt

Visual arts

Unlike heritage, visual artists are among the first to try out all the new technologies. Creators in this field are usually curious, looking for opportunities to experiment, to discover new or interdisciplinary forms of expression. New technologies offer new ways of monetisation and a faster, easier access to international audiences. However, it is noticeable that in Lithuania many of the creators who have decided to try new technologies are self-taught. There are no opportunities for mentoring, consulting or supervision. Nevertheless, creators are presenting their work in the virtual space and actively joining international communities. It clear that galleries and museums will have to embrace not only AR, but also other new technologies in the near future in order to present today's works.

Painter **Andrius Zakarauskas** has created his first NFT – "Tape the Motion. Disco". It was sold at a charity auction during the international contemporary art fair “ArtVilnius”.[15]

Artist **Robertas Narkus** presented his AR exhibition "Träger". The artworks in the exhibition rtefacts, trophies and tools – side products, settings and props of this live drama with its particular philosophy, myths, culture, notional products and solutions. Using a special app, the exhibition offers "augmented reality" installations invisible to the naked eye. The artist's project aims at grasping a shift, a beginning of a new era, and enthusiasm and pessimism that follow the ongoing advancements of science, technology and economics.[16]

[14] https://www.kamuziejus.lt/parodos
[15] https://mo.lt/tinklarastis/irasai/nauji-mo-kuriniai-lapkritis/
[16] https://cac.lt/en/event/paskutinis-parodu-lankymo-savaitgalis-nesejas-tv-ateitys/

Picture 3. Moments from the exhibition "Träger" by Robertas Narkus. Source: cac.lt

Super how? is a privately held blockchain technology research and product development company, one of whose projects is SuperHow.art. It sold as NFT the painting "Head with Legs" by Russian painter Oleg Tselkov (Picture 4). The most common NFTs are digital or digitised works of art. In this auction, the original painting was sold, i.e. in physical format. The SuperHow.art project is ongoing and is currently developing an artwork platform for investing in artworks, exploring fractional ownership and other features of NFTs.

Picture 4. Oleg Tselkov, "Head with Feet". Source: artprice.com

Performing arts

The global pandemic of COVID-19 has shown that the performing arts via a screen is not the same as the experience in a theatre or other space. The creators believe that the digitisation of theatre is leading to a different art form – more like cinema. This is probably why the adoption of new technologies in this field has been timid and limited to single projects. However, there are pioneers of ArtTech in the performing arts in Lithuania whose work shows that there is a need for the development of the ArtTech ecosystem.

Kosmos theatre seeks new artistic forms by combining classical theatre with the achievements of modern science and technological innovation. They produce performances, installations, experiential platforms using 3D animation, virtual and augmented reality and other tools. By bringing together young artists and providing them with creative and educational platforms, Kosmos Theatre aims to become a centre of experimentation for contemporary art.[17]

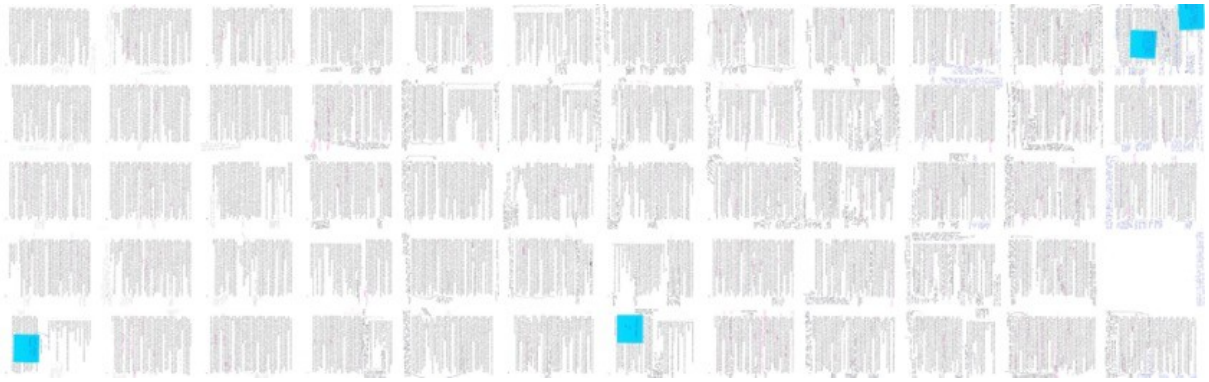
Picture 5. Kosmos theatre "Online (anti)utopia #Protest". Source: Kosmos theatre.

Media: books and publishing

The use of new technologies in books and publishing sector has so far been viewed with caution. Both global and Lithuanian publishing representatives identify a number of issues regarding copyright protection. In Lithuania, there are very few examples of the use of new technologies in books and publishing sector.

Monika Budinaitė is the first writer in Lithuania to implement NFT performance in literature. The writer sold a draft of a book she was writing as an NFT, thus giving the new owner of the work the opportunity to see the text with the critic's handwritten comments and, eventually, to appear in the novel as a "guest".[18] This example reflects the trends in the contemporary creative field, where the relationship between the creator and the audience is growing stronger, moving from feedback and critique to co-creation.

[17] https://kosmostheatre.com/manifesto/?_ga=2.97772695.908786853.1654262719-1203427366.1654262719
[18] https://lt.monikabu.com/



Picture 6. Monika Budinaitė's manuscript, sold as NFT. Source: Open Sea.

Media: audiovisual – music

The competitiveness of the Lithuanian music industry in the international market is still very low. According to the 2018 LATGA and AGATA statistics on the use of Lithuanian music abroad, only 102,000 EUR in remuneration was distributed through both associations to Lithuanian music authors (89,000) and performers and record producers (13,000).[19] New technologies open up wider and new export and dissemination opportunities, but there are not a lot of examples of their use in Lithuania either.

In the music market, young creators are more inclined to experiment and look for new ways to monetise. The producer **Vecera** has created an album of experimental electronica, StandArt, and released it on the OpenSea platform, where it can be purchased in cryptocurrency as NFT.

Picture 7. Album "StandArt". Source: fm.lt

[19] https://www.ltkt.lt/admin/ckeditor/fileman/Uploads/SAMS/ATASKAITOS/LKT%20ataskaita%20muzi- ka%20Pakarklyte.pdf

The use of new technologies in music composition is also not yet widespread, but there are already examples that are beginning and encouraging it.

Since 2010, the Lithuanian Academy of Music and Theatre has been home to the **Music Innovation Studies Centre (MISC)**, where innovations in digital music technologies and synergies for the development of national and international artistic, scientific and study programmes are focused.[20]

Back in 2015, sound artist **Aistė Noreikaitė** presented "The Experience Helmet", a helmet that allows you to hear the sounds of your brain. This way, music is created using brain waves, which also has a therapeutic effect.

Picture 8. Aistė Noreikaitė and "The Experience Helmet". Source: wired.co.uk

Since 2018, artist **Gleb Divov** has been offering an AI solution for composition based on blockchain technology. Users can upload various data to the platform, and Musical Blockchain converts it into a melodic sequence. The technology can also use images or text to create a melody. This unique solution is unparalleled in the world.

Media: audiovisual – cinema

The film industry in Lithuania is characterised by intense networking and collaboration. The former Vilnius Film Cluster, which brought together film production and related services companies, merged in 2021 with the Nebula Intersecting Media Cluster, which represented audiovisual content, cinema and gaming companies, to become the Baltic Film & Creative Tech Cluster. This cluster is an example of a successful industry alliance – the Lithuanian film industry has been able to attract and implement high-profile international film projects, which not only generate revenue for the state and other projects for the industry, but also promote Lithuania's name in the world, and contribute to the promotion of cultural tourism.[21]

[20] https://lmta.lt/en/padalinys/muzikos-inovaciju-studiju-centras/
[21] https://www.latimes.com/world-nation/story/2022-07-21/lithuania-stranger-things-netflix-hbo

There is not much national data on the film industry in Lithuania, but there has been a clear growth of the film industry in Lithuania since 2014. This growth has been significantly influenced by the state corporation tax relief, with investments in film production in Lithuania increasing from 250,000 EUR in 2014 to 11,200,000 EUR in 2020, i.e., investment has increased more than 40 times in six years.[22] The Lithuanian animation industry is also experiencing growth, with new studios and a growing number of animation creators.[23]

Media: new media

Lithuania has a small but progressive new media industry, including immersive content, software, computer games, etc. For the purposes of this analysis, we focus on immersive content, while games are discussed in the next subsection due to the specificity of the industry.

Immersive or XR content is characterised by its significant interdisciplinary nature, with intersections between media (cinema, visual arts, music, dance, etc.), advertising, education and training. Immersive content creators collaborate with museums and other CCIs to create artistic immersive or gamified interactive content. Commercial, promotional or educational content is also produced.

Gluk media is one of the leaders in XR and interactive content in Lithuania. One of their highlights is the VR film "The Stranger", created together with Kosmos Theatre. The work was part of the project "Knowledge and development of undeservedly forgotten people and places of importance to the local community through innovation" and is dedicated to the development of tourism in the Utena district. The film recounts the memories of Mariana Veriovkina, a Russian-born artist who spent her childhood in the Utena district, and invites the viewer to take a walk through it.

Picture 9. Interactive virtual reality film "The Stranger". Source: youtube.com

[22] https://www.lkc.lt/pelno-mokescio-lengvata/rezultatai

[23] https://www.lkc.lt/naujiena/lietuvos-animacijos-asocijacija-dalinasi-2017-2021-metu-animacijos-kata- logu-1027

Iron Cat is another player in the XR market in Lithuania, implementing various immersive and gamified content solutions, especially in Lithuanian regions. One of them is a VR game "Pramoninis Panevėžys" developed in cooperation with Panevėžys development agency Panevėžys NOW, which aims to introduce the history of the industry in Panevėžys.

MultimediaMark also produces a range of digital content, including XR content. One example of their work is the VR experience at the Lithuanian Railway Museum.

Among software developers, it is worth mentioning the **Pixelmator Photo,** a photo editing AI application developed by the brothers Saulius and Aidas Dailide, which allows professional photo editing for regular users. The app has received the prestigious Apple Design Award for its outstanding artistry, technological advances, and design of the user and app interface.[24] In the first month of the programme's launch, the company earned 1000000 USD.[25]

Picture 10. Photo editing app. Source: Pixelmator.

Media: new media – games

The Lithuanian games industry, although there is not much data on it, is a fast-growing industry:

Lithuanian games industry	Five-year growth (2013-2018)
Number of companies	+52%
Revenue	1410%
Staff	293%

Source: Lithuanian Game Development Industry 2019

[24] https://www.15min.lt/verslas/naujiena/mokslas-it/lietuviu-programa-pixelmator-photo-laimejo-prestiz- ini-apple-apdovanojima-1290-1159884
[25] https://www.delfi.lt/uzsakomasis-turinys/archive/lietuviu-inovacija-meta-issuki-adobe-photo- shop.d?id=75608789

Success stories from the games industry or closely related activities include:

- **Nordcurrent.** The oldest game development studio in Lithuania, founded in 2002.
- **GameInsight,** a Moscow-based games company founded in 2009, moved its head office to Lithuania in 2014 and was the highest paid start-up in Lithuania in the third quarter of 2022 (around 9,000 EUR).[26]
- **Wargaming**, a Belarusian game development company that emigrated to Lithuania in 2021 and currently employs over 600 people.[27]
- **Unity.** The world's most popular 3D, AR, VR content creation platform, launched in Lithuania in 2009.
- **Tutotoons.** Kaunas-based developers of mobile and educational games for children, with a 15-fold increase in profits in 2021.[28]

While the games industry employs scriptwriters, video and animation graphic designers, designers and music producers, a wide range of IT professionals are also needed to bring creative ideas to life. The products are reproducible, they can generate significant revenues for years after the product has been developed, the audiences are international and global from the outset, and the operating principles (AGILE, SCRUM, etc.) are specific to the IT sector. The specifics of the industry, the salaries of the workers, are very different from other creative industries.

Media: design

Design (graphic, fashion, interior, etc.) has been using technology for quite a long time due to its specificity, and is therefore among the first to try out the latest technologies. The use of technology in design not only offers new opportunities for creative expression, but also optimises work processes and opens up more creative possibilities. Using technology, designers can optimise the product creation phase, enable virtual "trying on" of a garment or object for the user with the help of a mobile application, create in virtual space, unconstrained by the limitations of the physical world.

In Lithuania, the use of new technologies in design is not yet widespread, but successful examples in both commercial and academic environments show that there is a strong interest in this direction, and it is only a matter of time and resources before we will have many more such examples.

Fashion designer **Valdemara Jasulaitytė** won the Young Designer Prize for her fashion collection "Creatures: between reality and simulation", which was a dual collection of virtual and three-dimensional clothing.[29] Valdemara modelled a personal 3D character and carried out three-dimensional experiments to create realistic clothing constructions. In this way, she created real and virtual clothing collections that represented the connection between reality and simulation, and presented virtual fashion as an innovative way of producing visuals that go beyond the physical world.

[26] https://www.15min.lt/verslas/naujiena/startup/rekordinis-ketvirtis-startuoliams-sumoketa-67-8-mln-eu- ru-mokesciu-867-1923756
[27] https://atvira.sodra.lt/imones/paieska/index.html
[28] https://www.vz.lt/inovacijos/technologijos/2022/06/27/svedu-tyliai-nupirkta-kauno-zaidimu-kureja-tuto- toons-ashy-augino-15-card
[29] https://jdp.lt/valdemara-jasulaityte/

Picture 11. Valdemara Jasulaitytė's collection "Creatures: between reality and simulation". JDP (2022)

Robert Kalinkin became the first fashion house in Lithuania to launch an NFT collection. The acquisition of NFT was open to everyone and NFT owners had the opportunity to use the digital creations, contribute to the creation of new collections, offer their own designs, and participate in virtual fashion shows. This is the first step in the transformation of a physical fashion brand into a digital one, which is planned to become a hybrid – operating in both physical and virtual worlds. According to the designer, the opportunity to create in a virtual world opens up unprecedented possibilities, due to the laws of physics that do not exist there.[30]

Picture 12. "House of Kalinkin" NFT. Source: L'officiel.

[30] https://www.lofficiel.lt/mada/kalinkino-madosnamai

Universities and research institutions

The roles of science and research institutions in the ArtTech ecosystem include: development of higher education programmes; talent development; research and other scientific activities in ArtTech. There are no programmes in Lithuania yet to train professionals in this specific field. There is also the problem of a lack of competent experts, academics and/or practitioners in CCIs and technology. However, it is possible to identify a few higher education institutions that are expected to move more boldly into ArtTech in the near future. It should be stressed that institutional collaboration and/or joint/exchange programmes between universities, or other engagement with the ArtTech ecosystem and its community, is also important.

Vilnius Academy of Arts

Vilnius Tech

Lithuanian Academy of Music and Theatre

Vytautas Magnus University

Kaunas University of Technology

In the Multimedia Laboratory of Vytautas Magnus University, Faculty of Informatics, researchers and students study and apply the latest multimedia technologies in practice. The laboratory works on creating three-dimensional models, designing and programming interactive 2D and 3D games, creating simulation and virtual reality environments.[31] Students engage in these activities in their free time, contributing to projects on their own initiative. Such subjects and modules are not yet available in the curricula.

The Centre for Music Innovation Studies has been operating at the Lithuanian Academy of Music and Theatre since 2010. The Centre focuses on digital music technology innovation and synergies for the development of national and international art, science and study programmes.

Kaunas University of Technology, Faculty of Informatics has a Virtual Reality Technology Laboratory **"VRLab"**. One of the examples of the lab's work is an educational virtual reality game, the aim of which is to put together a human skeleton from the bones scattered around.[32]

[31] https://metaverse.if.vdu.lt
[32] https://ktu.edu/news/edukacini-virtualios-realybes-zaidima-sukurusiam-autoriui-ktu-alumnu-stipendija/

Investors

Investors in the ArtTech ecosystem can be private, public or hybrid funds or companies investing in ArtTech start-ups and creator's projects. The traditional art market in Lithuania is small and new technologies are still in their infancy, so there are not many investors being attracted so far.

The Lewben Art Foundation, a private organisation that maintains a collection of 20th century Lithuanian modernist art and Lithuanian and international contemporary art from 1990 to the present day, can be partially included in this category. The Lewben Art Foundation presented artworks in NFT format that complemented their collection at the ArtVilnius International Contemporary Art Fair in 2021.

Accelerators

In recent years, the number of accelerator programmes for the start-up ecosystem has grown rapidly in Lithuania.[33] The aim of an accelerator is collaboration, sharing of experience and interdisciplinary solutions. It also focuses on entrepreneurial development and potential product commercialisation. These programmes help early-stage start-ups to grow faster on a global scale and add value to the community. For growth-oriented early-stage startups, accelerators provide expertise, access to a network of mentors and funding. Typically, an accelerator programme is run in groups of 10-15 start-ups and lasts for a defined period of time, usually 3 months.
There are no accelerators dedicated to the ArtTech ecosystem in Lithuania yet. However, already in 2017, during the project "Developing the Creative Industries Ecosystem" implemented by "Create Lithuania", the question was raised: "*are art incubators an acceleration of creative start-ups or just a cheap rent of premises?*".[34] According to the document of the Development Directions of the Culture and Creative Industries Policy 2015-2020[35] (Order of the Minister of Culture of 31 July 2015, No. ĮV- 524), arts incubators are defined as:

Arts Incubator – a legal entity whose one of the objectives is to use the available infrastructure (premises, equipment, etc.) to bring together artists of different kinds, groups of artists and those involved in art-related businesses (belonging to the CCI field) in one space, thus enabling artists to create and present their work to the public, to set up their own business, to develop art-related businesses, to encourage the community to participate more actively in cultural life, and to contribute to the conservation of cultural heritage.

According to this definition, arts incubators are not accelerators, but merely spaces that allow creation. It is not acceleration or even pre-acceleration, it does not include any type of mentoring, etc. Everything is left to its own and to organic collaboration.

[33] https://bznstart.lt/verslas/startuolis/kas-yra-startuoliu-akceleratorius-ir-kaip-jis-veikia/
[34] https://www.facebook.com/KurkLietuvai/photos/meno-inkubatoriai-tai-kūrybinių-startuolių-akseleravi- mas-or-just-cheap-housing/1222483101210392/
[35] https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/4a028c503a6f11e598499e1e1ba6e454?jfwid=-3ltgvaizd

In order to achieve a breakthrough in ArtTech, it is essential to ensure not only a range of financial instruments but also the emergence and implementation of comprehensive accelerator programmes in the country. It would be appropriate to review the activities of art incubators in Lithuania, their plans and the general definition of art incubators. It is important to identify to what extent the key insights raised during the above-mentioned "Create Lithuania" project are relevant today.

The creative industries ecosystem lacks human resources and competences.	Artists and creative start-ups based in incubators do not get the services and skills they need to grow and develop their products and services.	Arts incubators generate little income, often not enough for even minimal expansion.

Figure 6. Key insights from the Creative Industries Ecosystem Development project, the Lithuanian Arts Incubators Review.

Consultants

Consultants are experts in business, technology or the cultural and creative industries who help ArtTech projects. In this new field, consultants are often creators, investors or entrepreneurs themselves. One such example is ArtxChange Global, an art market agency that provides, among other things, consultancy services on the art NFT and NFT market.

Strengths, Weaknesses, Opportunities, Threats (SWOT) of the Lithuanian ArtTech Ecosystem

Goal

To deepen and complement the information gathered by other methods on the situation of Lithuanian ArtTech ecosystem participants – creators, start-ups, SMEs, in order to find out the main strengths and problems, as well as to provide recommendations to address them.

Method

Qualitative research methodology, semi-structured interviews. The researchers conducted 32 semi-structured interviews, which were conducted remotely on the MS Teams platform or in informal settings in different locations. The questionnaires were structured according to the relevant groups in the ArtTech ecosystem and consisted of questions specific to that group as well as to the CCI. The main blocks of questions are: respondents' activities; motivations; challenges; benefits experienced; risks; cooperation; future; role of the state. The semi-structured interview questionnaire is presented in Annex 2.

Target group

Creators, experts, organisations and other participants in the ArtTech ecosystem working and/or living in Lithuania (see Figure 5), excluding the society, consumers, and the public sector. A total of 32 respondents were interviewed during the survey. The group of creators, start-ups and SMEs was divided according to the CCI classification (see Annex 1) and at least 2-3 representatives from each CCI group were interviewed.

Time of the survey

The study was carried out between May and July 2022.

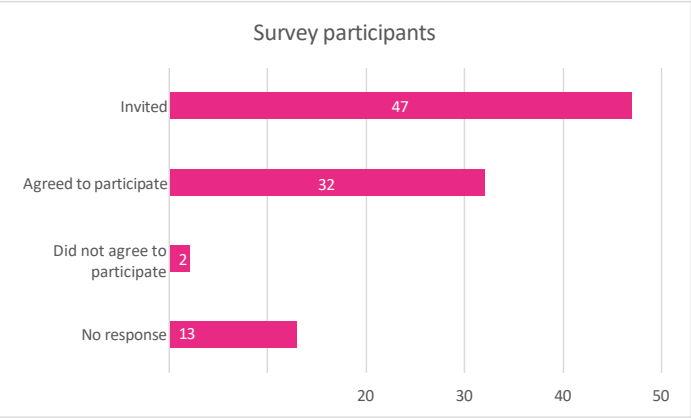


Figure 7. Survey participation.

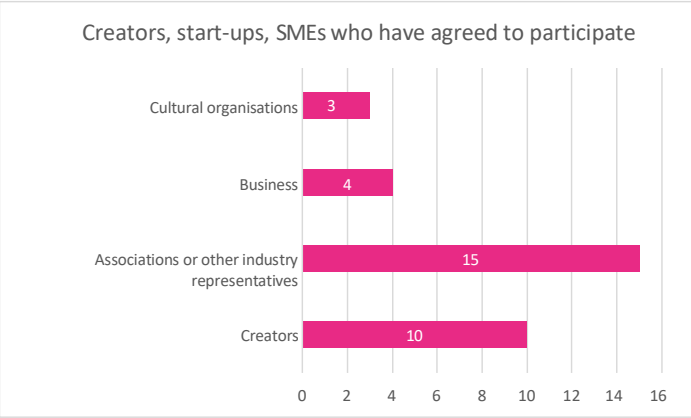


Figure 8. Distribution of respondents by field of activity.

Heritage – Museums

The interviews with CCIs, heritage and museum representatives focused on: respondents' activities; motivations, challenges, benefits and risks experienced in the ArtTech ecosystem; collaboration; the future; and the role of government. A total of 4 heritage and museum representatives were interviewed: museums, private businesses, associations.
The table below shows all the strengths, weaknesses, opportunities and threats mentioned by respondents. The number of mentions is in brackets.

STRENGTHS

- Reaching new audiences who were not interested in the content of the museum and in general in culture.
- The result of an ArtTech project is not static, so it is more engaging and impactful.
- International dissemination and global promotion of the original creator.

WEAKNESSES

- There are no funds available for digitisation processes, at best there are enough funds available to take pictures, scan content – this is not Industry 4.0 or 5.0. [2]
- Purchased equipment is not being used due to lack of expertise (e.g. 3D scanning). [2]
- Museum content is static.
- Cooperation with foreign partners and tech companies is necessary but lacking.
- Cooperation with technology companies is directly linked to finances, as their services are paid for.
- Digitisation of museum content is not compulsory, even if all the tools are in place, so museums are not motivated to do so.
- Lack of creative content and artistic mentoring in the art NFT market and in metaverse.
- The need for extensive preparation for entering the metaverse.

OPPORTUNITIES

- New technologies (e.g. VR/AR) are becoming tools to increase inclusion.
- Commercialisation of museum collections, enabling better development of other museum activities.
- Within 5 years, the content of museums will become more and more inclusive, and within 20 years, museums will be a reality in the metaverse.
- Long-term cooperation between the tech and cultural sectors.

THREATS

- Public funding is insufficient to acquire high quality business services for innovation or to implement high quality ArtTech projects. [3]
- Lack of highly skilled creators with experience in inclusive content (directors, producers, artists, etc.) in Lithuania. [2]
- Low artistic value inclusive ArtTech products that cheapen original works of art.
- Rapidly changing and rapidly outdated technologies.
- In Lithuania, non-commercial culture is promoted, and popular, commercial culture suffers as a result.
- There is no digitisation policy.
- Business performance is also assessed in funding competitions, which reduces the chances of non-profit organisations winning tenders.

The museum professionals interviewed note the changes in culture and museums brought about by the digital transformation, the **need to add immersive content to static museum collections,** and are familiar with the concept of metaverse and other innovations. However, the **implementation of technologically advanced projects in museums** is sporadic and **severely constrained by limited financial resources.** Also, only projects with a high artistic value, which will not outweigh the original works, are to be implemented, but there is a lack of high originality and innovative creators (directors, scriptwriters, artists, etc.) in Lithuania. This is also reflected in the attitude towards the **metaverse** and **art NFT** – **these innovations are viewed with caution** due to the lack of mentoring. The **attitude towards immersive** (AR/VR) content as cultural education content, attracting new and/or very young audiences **is unequivocally positive**.

They also mention that there is no digitisation policy in Lithuania. However, it is worth noting the difference between the terms digitisation vs digitalisation. Digitisation is the transformation of objects into digital form, while digitalisation is the transformation of systems into digital form and the application of information technology.[36] It is not clear whether museums distinguish between these terms and use them accordingly in the context of the Fourth Industrial Revolution.

Representatives of other CCIs working with museums point out that most museums **lack** not only financial resources, but also the **knowledge and skills to** use advanced digital technologies. Advanced equipment purchased, such as 3D scanning equipment, is under-used or obsolete over time. Often, museum professionals are not aware of the full potential of technology.

Museums are still dealing with early digital transformation – upgrading internal IT systems, digitisation of collections, IT competences of staff and similar issues. **Museums are not yet ready for late digital transformation.**

Next steps for the overall development of the sector:

- **developing** staff IT **competences** to make full use of existing technologies;
- **educating** staff on the opportunities offered by digitalisation and technology;
- **feasibility studies for** innovations such as the Metaverse museum, etc;
- **sources of funding for** ArtTech projects of high artistic value;
- sources of funding for cooperation with the business sector and for building partnerships abroad;
- **nurturing creators of** high expertise and originality in **other fields.**

[36] https://www.vlkk.lt/konsultacijos/528-skaitmeninti

Visual arts

The interviews with CCIs and visual arts representatives focused on: the activities of the respondents; motivations, challenges, benefits and risks experienced in the ArtTech ecosystem; collaboration; the future; the role of the state. A total of 5 visual arts representatives were interviewed: individual creators, associations.
The table below shows all the strengths, weaknesses, opportunities and threats mentioned by respondents. The number of mentions is in brackets.

STRENGTHS

- Monetisation of creativity, allowing for more creative rather than commercial outsourcing. [3]
- Low fees for NFT art sales and sales platforms compared to traditional intermediaries (galleries, auctions). [2]
- The opportunity to interact with and receive feedback from art collectors. [2]
- Bypassing traditional intermediaries and strict curation.
- The opportunity to profit from secondary sales.
- Copyright protection.
- Registration of works.
- Dissemination of works to an international audience, helping to obtain commercial orders from abroad.
- Smart contracts and their functionality.
- Creating a new form of artistic expression.

WEAKNESSES

- Lack of reliable, clear, and regularly updated information in Lithuanian. [2]
- Lack of financial literacy, lack of understanding of how cryptocurrencies and crypto tokens work. [2]
- Lack of knowledge on how to sell NFTs and build a community, lack of knowledge on the financial aspects of NFTs (taxes etc.). [2]
- Lack of onboarding and information.
- Lack of generic knowledge about the technology and how to use it.
- Lack of programming knowledge of creators required to use AI.
- Insufficient or poor cooperation between artists, the state and traditional arts institutions. [2]
- Lack of a community of Lithuanian creators in NFT and inability to exchange information.
- Low cooperation between Lithuanian NFT creators. Everybody is playing on the international market without knowing anything about each other.

OPPORTUNITIES

- Growing collaboration with other developers.
- Young people, especially today's teenagers, are very interested in technology and see the NFT as an opportunity to earn money, so they start making art. For them, it is a path to financial independence and self-expression.
- The use of AI technologies in art will require less and less programming skills.
- Technology is evolving very quickly and its functionality is changing, but in 5-20 years' time, AI will remain a creative tool.
- In the future, AI will allow people without a traditional artistic background to express themselves, without being limited by their painting skills, for example.

THREATS

- Crypto market speculation and instability. [3]
- Unclear regulation (copyright, taxation), and taxation of NFTs. [3]
- Immaturity of NFT technology, making its future use unpredictable. [2]
- Theft of works of art [2] and resulting loss of revenue.
- In Lithuania, non-commercial culture is promoted, and popular, commercial culture suffers as a result.
- There is a lack of a clear state position on NFTs for the arts.
- Lack of funding for experimentation.
- NFT CO2 footprint.
- Information changes very quickly and is mostly only available in English.
- AI is still very new, so it is difficult to predict what will happen in a couple of years.
- Low availability of AI technologies.

The visual artists interviewed note the changes brought about by the digital transformation, and are looking for new ways to monetise and present their work, reach new audiences and protect their copyrights. Those who create or sell their work digitally are interested in and experimenting with NFT technology. This is due to the COVID-19 pandemic, the sudden rise of NFT in the 2020s and the availability of this technology due to low or negligible initial capital.

They are open to innovation, are not afraid to experiment, strive for creative and financial independence, and **see advanced technologies as an important tool for their work**. Digital art creators also recognise the importance of physicality and want to present their work in traditional spaces. They **see a synergy rather** than a conflict **between digital and physical art**, and want to engage other artists with the possibilities offered by technology and encourage them to acquire new skills (e.g. programming, 3D modelling, etc.).

As the majority of visual artists are individual creators, the realisation of their creative and commercial potential requires intensive networking, market introduction and reliable information sources. Even small investments in ArtTech development in this CCI can pay off very quickly through the empowerment of individual creators, so this creative industry is ready for the late digital transformation.

Actions to develop the ArtTech ecosystem:

- Promoting **cooperation** between creators, culture and public authorities;
- Promoting **cross-sectoral collaboration and networking** between visual artists, other creatives, programmers and other IT professionals;
- **artist education** on ArtTech topics, mentoring programmes and technological competences;
- **a clear stance of the public authorities** towards art NFTs and a positive public discourse.

Performing arts

The interviews with CCIs and performing arts representatives focused on: the activities of the respondents; motivations, challenges, benefits and risks experienced in the ArtTech ecosystem; collaboration; the future; the role of the state. A total of 6 visual arts representatives were interviewed: individual creators, theatres, associations. The table below shows all the strengths, weaknesses, opportunities and threats mentioned by respondents. The number of mentions is in brackets.

STRENGTHS

- New artistic expressions and innovative works are recognised with awards in Lithuania and abroad.
- Different, new accessibility of content through immersive technologies, e.g., performances for people with disabilities or special needs.

WEAKNESSES

- Lack of finances: technology adoption requires investment in hardware, software, new knowledge and skills; high production costs for VR products. [3]
- Currently working with IT specialists who are working with the theatre for altruistic reasons.
- Renting space for filming in innovative spaces is expensive or unaffordable.
- Showing VR performances require physical spaces. Lack of infrastructure with technologies.
- Lack of specialists, e.g. VR filmmakers or light artists, etc. [2]
- The dissemination of VR projects is low, as very few people have VR glasses yet.
- Cooperation between NGOs, business and the public sector is weak.
- Technology cannot yet be relied on to work.
- Becoming dependent on hardware and complexity in implementing ideas.

OPPORTUNITIES

- Culture houses across Lithuania could be more standardised, universal and technically advanced. This would allow technologically innovative contemporary performances to be shown in the regions, which due to technical limitations are now only shown in the cities.

THREATS

- There is a lack of funding focused on the ArtTech field and specifically immersive content.
- When trying to obtain public funding, evaluators are often incompetent or uninterested.
- The public funding received is often 50% less than the amount needed to implement the concept, which leads to products of medium quality.
- To make partnerships between NGOs, business and foreign partners equal, there must be significant funding for co-productions.
- The attitude of the public authorities is that there is no need to support those who make a living from their activities.
- Digitalisation in theatre is leading to a different kind of art – more cinema than perdorming arts.

Physicality is a core element in the performing arts, so performing arts practitioners see both opportunities and threats in digital transformation. While technological progress enables new forms of artistic expression, there is a risk of becoming too dependent on technology. These are not yet sophisticated enough to be fully reliable, which makes the implementation of performances complex and, in venues that are not technically advanced, difficult or impossible. This widens the divide between cities and regions, where not all performances can be performed. Technology is also blurring the boundaries between the performing arts and other art forms, for example making theatre more like cinema, raising questions about preserving the authenticity of performing arts.

There are successful examples of ArtTech and late digital transformation in the Lithuanian performing arts, but they can be treated as interdisciplinary art or as products of new media, which will be discussed in more detail in the sub-section "Media: new media".

The technologies required for contemporary performing arts are more related to advanced hardware than digital software, so there is no need to prioritise further digitisation in this sector.

Next steps for the overall development of the sector:

- **Funding for** advanced technical equipment for theatres and performing arts spaces;
- **Equipping cultural centres with more advanced technical equipment,** enabling people in the regions to see technically advanced plays and performances;
- **Increasing the accessibility of performing arts** for those who cannot attend live (e.g. people with disabilities) through VR technology.

Media: books and publishing

The interviews with CCIs, books and publishing representatives focused on: the activities of the respondents; motivations, challenges, benefits and risks of being part of the ArtTech ecosystem; collaboration; the future; and the role of government. A total of 3 books and publishing representatives were interviewed: individual creators, associations, other organisations.
The table below shows all the strengths, weaknesses, opportunities and threats mentioned by respondents. The number of mentions is in brackets.

STRENGTHS

- Increased availability of content in digital formats, both e-books and audiobooks.
- The use of state-of-the-art technology to protect copyright instead of piracy caused by digital technology.

WEAKNESSES

- The application of Industry 4.0 and 5.0 (blockchain, AI, VR/AR) technologies in publishing is limited or unknown.
- Limited cooperation with public authorities on the problems faced by publishers as a result of digitisation.
- Research is needed to shed light on the cultural content consumption and reading habits of today's society.
- Publishing is not a field where new technologies are quickly adopted.

OPPORTUNITIES

- All written content will be available in digital format.
- International dissemination.

THREATS

- Illegal content and copyright infringement are key threats to publishing from digitisation. [2]
- The digital divide, especially between younger and older people, which is presumably inevitable to a certain extent.
- Lithuania promotes non-commercial culture, and popular, commercial culture suffers as a result.

The publishing industry interviewees point to the accelerating digital transformation and the problems it poses, in particular the proliferation of illegal content and the lack of copyright protection. The changing habits of readers as a result of the pandemic and the growing popularity of audio and e-books are also noted.

Books and publishing are still in the early stages of digital transformation and the application of Industry 4.0 and 5.0 technologies in the sector is limited or unknown. In publishing, new technologies are not quickly adopted, so it is **still early to promote late digital transformation.**

Next steps for the overall development of the sector:

- **ensuring copyright protection**, especially for digitised content;
- **research on** readers and **content consumption patterns** in general, enabling publishers to respond to changes in the market;
- greater **listening to the sector and trust** from public authorities;
- **strengthening inter-institutional cooperation** between the Ministry of Culture, the Ministry of Science, Education and Sports, and other institutions working with libraries;
- **ensuring that legal content is available** to students in libraries.

Media: audiovisual – music

The interviews with music representatives focused on: the activities of the respondents; motivations, challenges, benefits and risks experienced in the ArtTech ecosystem; collaboration; the future; the role of the state. A total of 7 music representatives were interviewed: individual creators, associations, other organisations.
The table below shows all the strengths, weaknesses, opportunities and threats mentioned by respondents. The number of mentions is in brackets.

STRENGTHS

- New forms of expression, opportunities to realise previously unrealisable ideas. [3]
- Optimising non-creative processes (audio editing with advanced technologies, etc.), leaving more time for creation and experimentation.
- Lithuanian composers, producers and other music industry players are technically proficient and produce works of high artistic value.

WEAKNESSES

- Lack of information and education on the potential of advanced technologies, especially AI and NFTs, for music creators. [3]
- There is a lack of physical innovation space with modern equipment where people from different fields can come together. [2]
- AI is expensive or requires programming skills.
- There is a perceived lack of publicity about creative products of new technologies in Lithuania.
- Insufficient cooperation with research institutions, incubators and creative industries associations.
- Participation in an international community is essential to learn how to work with technologies.
- Unorganised metadata of Lithuanian musicians, reducing their discoverability on platforms (e.g. Spotify, etc.) and lack of knowledge about metadata among musicians.

OPPORTUNITIES

- It is impossible that Lithuania's investment in ArtTech will not pay off – Lithuania is full of innovative ideas. [2]
- Monetisation and commercial success. [2]
- Music innovation can be used in a wide range of fields (e.g. education, therapy, life sciences, etc.). [2]
- The Web 3.0 enabled maker economy will change the traditional monetization models and the relationship between creators and consumers.
- Many technologies will become more and more accessible.

THREATS

- Lack of encouragement for innovation in music. [2]
- Lack of national level data on the music industry and other CCIs. [2]
- Intellectual property protection and the uncertainty of the changes brought by new technologies (legal regulation of AI works, NFTs and copyright, etc.). [3]
- Insufficient involvement of public authorities to ensure fair pay for artists in the country, both on platforms (Spotify, etc.) and in other sectors using creative products.

- Entertainment will extend to all areas of culture, including music and its composition.
- Completely new musical instruments based on AI or sensor technologies will emerge, which will require completely different skills (e.g., programming).
- Blockchain technology will become a tool as widely used as music platforms (e.g., YouTube, iTunes, Spotify, etc.).

- NFT as a technology is not yet mature and it is difficult to predict how it will be used in a few years' time.
- High-quality equipment used in creative works is not always readily available, while cheap equipment is not fully developed and changes quickly, requiring frequent upgrades.
- Society is not fully prepared for innovative and unexpected solutions.

The use of new technologies in music **composition is not widespread.** This is due either to **a lack of financial resources** or to a **lack of knowledge of** how to use them. Technologies such as AI are not cheap, and if they are cheap or free, they require special skills. Music production and post-production already use a range of advanced tools to optimise non-creative processes. However, **there are too few spaces for** Lithuanian music composition students **to use advanced techniques.**

Music sharing and streaming platforms such as Spotify are seen as a positive development towards legal content consumption, but the rewards paid to creators on these platforms are low. **There is** also **a general lack of understanding among Lithuanian creators about these music streaming platforms**. The disorganised metadata of Lithuanian artists makes it difficult to pay royalties to associations. Artists do not know how to increase their discoverability on the platforms, which reduces the internationalisation of Lithuanian music and their commercial success.

The interviewees point out that while digital transformation is intensifying and people are spending more and more time in virtual spaces, the COVID-19 pandemic has shown that **physicality remains very important**. A large part of musicians' income comes from live performances. They are also wanted by a society hungry for social life, concerts and dancing. There is a noticeable decline in live music venues in cities and a shortage in new neighbourhoods and development projects.

The early digital transformation was particularly damaging to the music industry in Lithuania, as well as worldwide, due to illegal copying and distribution of music. While legal music consumption is growing, musicians are becoming dependent on digital platforms, their fees and their not always clear algorithms. These AI-enabled algorithms are among the signs of the late digital transformation.

Leaving the late stage of digital transformation to its own will not allow the Lithuanian music industry to further exploit its creative, commercial and international dissemination potential. To avoid this, the **music sector should be prioritised**.

Actions to develop the ArtTech ecosystem:

- **Setting up a new physical music and other CCI innovation space with advanced equipment;**
- **Fostering cross-sectoral collaboration and networking** between musicians, other developers, programmers and others;
- **Publicising and researching music innovation;**
- **Setting up accelerator and prototyping programmes;**
- Setting up **international and cross-sectoral exchange programmes**;
- **Educating music professionals on ArtTech, new technologies, metadata and other issues;**
- **Inter-institutional cooperation with the Ministry of Culture, the Ministry of Science, Education and Sports, and other institutions to use music innovations in health, education and other areas.**

Next steps for the overall development of the sector:

- **Systematisation and analysis of national data on the music industry;**
- **Increased focus by public authorities on promoting a commercial culture;**
- **Including live music venues in new development projects.**

Media: audiovisual – cinema

The interviews with film industry representatives focused on: the activities of the respondents; motivations, challenges, benefits and risks experienced in the ArtTech ecosystem; collaboration; the future; the role of the state. A total of 4 film industry representatives were interviewed: clusters, associations, other organisations.
The table below shows all the strengths, weaknesses, opportunities and threats mentioned by respondents. The number of mentions is in brackets.

STRENGTHS

- Lithuanian non-commercial cinema is appreciated abroad.
- Lithuanian film industry professionals are exceptionally competent.
- Many of the film industry's professionals working with the latest technology or advanced equipment are self-taught, but their skills are second to none.
- Projects of international popularity and high calibre (e.g. Stranger Things, Chernobyl) attract other projects and make Lithuania's name known in the world, becoming a tool for cultural tourism.
- In film production and post-production, new technologies are quickly adopted to maximise optimisation.

WEAKNESSES

- There is no, and there is a desperate need for, cooperation between NGOs and the public-private partnership (*PPP)* sector.
- Lack of large physical spaces with advanced technologies.
- Lack of specialists for less skilled work on the film set.
- Animators needed by the film industry are moving to the games industry for higher salaries.
- Lack of knowledge about the opportunities offered by technology in the film industry – only a part of the sector sees not only the threats but also the opportunities. The film industry is more conservative than other CCIs.

OPPORTUNITIES

- By investing in the infrastructure of the film industry (technically advanced and spacious pavilions and studios), there are real opportunities to attract high-calibre and profitable international projects – to film several seasons in Lithuania instead of just a few series.
- Co-productions and international projects with studios such as Netflix and HBO raise the profile of Lithuania and promote cultural tourism.
- The younger generations of today and those who will follow will spend more and more time in digital worlds. The trend in the amount of visual digital content consumed today confirms this.

THREATS

- Mistrust of the film industry by public authorities. [2]
- Significant initial investment is needed for technically advanced pavilions, and currently low funding is not enough to make a breakthrough.
- The tax relief for cinema is too low compared to successful examples in other countries – it should be increased from 30% to 35%-40%.
- There is no film school in Lithuania or courses at the Lithuanian Public Employment Service to train lower-skilled film industry workers.
- Lack of national-level data on the film industry and other CCIs, which makes lobbying challenging.

- Advanced digital and other technologies are a tool for implementing the Green Deal - e.g. The dunes of Nida can be recreated virtually and filmed in the pavilion without disturbing the local ecosystem.

- The evaluation of innovative projects is hampered by the lack of updated funding categories for interactive or VR cinema (VR cinema is currently in the same category as animation, although it can be anything - fiction, animation and documentary).
- There is a lack of public knowledge about how to use digital content and how and what to do in the digital space.
- Society is not fully prepared for innovative and unexpected solutions (e.g. VR cinema).
- Being digital-only. The sector needs live contact with the consumer.
- International fairs show that it is not yet clear whether the film industry will move towards VR/AR, AI.

The interviewees point to the changes brought about by digital transformation and technological progress in the film and other creative industries, but argue that the **potential of this sector in Lithuania is not being exploited.**

It is stressed that the **film industry in Lithuania is ready for growth**, but the **lack of advanced infrastructure is the main obstacle to a breakthrough**. The lack of large and technically advanced pavilions in Lithuania makes it difficult to implement projects with high commercial potential and significant international attention. **Funding for** Lithuanian filmmakers **is too low** to allow for co-productions with foreign partners. The same is true for VR cinema – there is no advanced and spacious enough VR film pavilion in Lithuania, and limited funds for co-productions in the sector, which reduces the opportunities for export and international dissemination (more on VR cinema production will be discussed in the "Media: new media"). The need for cooperation between the public, private and non-governmental sectors is also highlighted.

Although the Lithuanian film industry is competent, the majority of its employees are self-taught. Some **professionals**, especially those with lower skills, **are in short supply**, while others, especially those with IT skills, move to other industries such as gaming. The film industry still **lacks knowledge of** the possibilities offered by technology, but despite this, new technologies are being adopted quickly in film production and post-production.
Equally important is the attitude of the state towards the film industry – **there is a lack of trust in** the sector **from the state institutions** and a general lack of attention to the sector. There is a lack of national data on the contribution of film and other creative industries to the country's GDP. The sector's commercial, international dissemination and cultural tourism potential is underestimated. There is a misconception that the sector is not profitable, and at the same time, non-commercial culture is promoted the most, thus neglecting commercial culture.

Some interviewees see digital transformation and technological progress as both opportunities and threats, and note the conservatism of the film industry. The **issue of legal content** and its **accessibility remains** particularly **acute**. In contrast to the music industry, where illegal content consumption is declining due to the growing number of legal platforms and affordable prices, legal consumption of films and TV series is growing slowly. This is due to a lack of public education and a poor choice of content, especially Lithuanian movies, on legal platforms. COVID-19 forced film festivals to go virtual, but it is difficult to bring audiences back to the cinema halls – consumption of digital content remains high even after the pandemic.

The film industry in Lithuania is still experiencing the negative consequences of the early digital transformation. Meanwhile, the transition to the next stage of development, both technologically and commercially, is challenging, requiring large initial investments in infrastructure. However, the **sector is also characterised by the maturity needed to achieve a breakthrough**.

Actions needed to develop the ArtTech ecosystem:

- **funding for a spacious and technically advanced filming pavilion;**
- **private-public partnerships;**
- increased **funding for interactive cinema projects**;
- **promoting immersive technologies and innovation in film industry.**

Next steps for the overall development of the sector:

- organising and analysing national data on the film industry;
- Increased **focus by public** authorities on promoting **a commercial culture**;
- increase in the tax relief for the film industry from 30% to 35-40%;
- more higher education programmes to train professionals for the film industry;
- **educating the public** about the legal consumption of content.

Media: new media – games

The interviews with representatives of the games industry focused on: the activities of the respondents; the motivations, challenges, benefits and risks of operating in the ArtTech ecosystem; collaboration; the future; and the role of government. A total of 3 representatives of the games industry were interviewed: individual developers, associations. The table below shows all the strengths, weaknesses, opportunities and threats mentioned by respondents. The number of mentions is in brackets.

STRENGTHS

- The gaming industry is growing and there is an opportunity to reach global audiences. [2]
- New technologies such as VR has been actively and successfully used in gaming industry for about a decade.
- There are already important players in the gaming market in Lithuania, such as Wargaming or, most importantly for XR programming, Unity.

WEAKNESSES

- Insufficient cooperation with public authorities, universities and research centres.
- For some specialities, there is a shortage of game developers in Lithuania, or they are only self-taught. [3]
- Lack of knowledge and the necessity to learn how to use cutting edge software and other equipment.
- The NFT community in Lithuania is small - there is a need for live meetings, events, hackathons in cooperation with other market players.

OPPORTUNITIES

- Games are and will continue to permeate a wide range of experiences and content consumption - a changing society wants gamified content, so more and more content will be delivered in the form of games. [2]
- There will be more touch points with educational content and EdTech in general.
- The metaverse, Internet 3.0 and the creator economy are very close future.
- Play-to-earn games will replace conventional games and the commercial potential of these games is huge.

THREATS

- The gaming industry receives little or no attention from public authorities, and the sector is not being promoted or targeted for growth.
- The contribution of the gaming industry to the national economy is not known, as there is a lack of data on this and other CCIs. [2]
- Cost, (un)availability and (un)ubiquity of hardware (VR glasses, etc.) among ordinary users.
- Negative public discourse on NFTs in Lithuania.
- Unclear or too strict regulation of cryptocurrencies, which creates unfavourable conditions for the development of NFT games or the establishment of companies in Lithuania.

Interviewees from the games industry point out that the games industry is very different from other creative industries. It **is one of the youngest creative industries** and its emergence and growth is directly linked to digital transformation. The commercial, educational and export development **potential of** this sector **is not yet exploited**. The game industry in Lithuania is growing and commercially successful, but the **breakthrough lacks talent and systematic attention from public authorities**. As in other CCIs, there is a lack of state-level data on the games industry.

As a highly dynamic and technologically advanced sector, the professionals working in it have to continuously learn how to work with new software, and some are self-taught. **Cooperation with universities and research centres is ongoing but not yet sufficient.**

Little is known about the NFT gaming market in Lithuania. This is due to the **unclear regulation of NFTs and cryptocurrencies** and the small size of the Lithuanian NFT community. However, it is speculated that NFT technology will have a greater impact on the games industry than on the visual arts or music.
All interviewees see a natural synergy between games and immersive VR/AR technologies. Although the availability of VR technology to the general public is still low, the technology is improving and getting cheaper, so it is expected that this will not be an issue in a couple of years. The rise of gamification in all areas of life is highlighted by all. Consumers are demanding more engaging, interesting and dynamic content and younger generations are no longer interested in static content. Cultural and other education will be delivered through games, and in the future people will be able to play-to-earn.

The games industry is unequivocal in its recognition of the advent of the metaverse, Internet 3.0 and the maker economy, and foresees a key role for the industry in the late digital transformation. **It is one of the most technologically advanced, if not the most advanced, creative industries and its development should be prioritised.**

ArtTech development actions:

- **Promoting cooperation** between the public sector, research centres and universities**;**
- **Promoting hackathons and general networking** between game developers, the NFT community and other market players;
- **Promoting cross-sectoral and inter-institutional cooperation** on cultural education, education and co-produced content;
- **Training professionals in XR and other technologies.**

Next steps for the overall development of the sector:

- **organising and analysing** national **data on the games industry**;
- increased **focus on the games industry by public** authorities**.**

Media: new media

The interviews with new media representatives discussed: the respondents' work; motivations, challenges, benefits and risks of being part of the ArtTech ecosystem; collaboration; the future; the role of the state. A total of 4 new media representatives were interviewed: business, clusters, associations.
The table below shows all the strengths, weaknesses, opportunities and threats mentioned by respondents. The number of mentions is in brackets.

STRENGTHS

- Exclusivity – Immersive technology projects are still a novelty in Lithuania and therefore attract a lot of attention.
- New forms of artistic expression and experimentation.
- XR content and VR filmmaking can also be successfully pursued by small companies. This is in contrast to the film industry, where production costs are very high.
- Cultural content delivered in a new way through immersive technologies attracts new audiences.
- Cooperation between XR content creators and cultural organisations is effective. It is often initiated by XR content creators and successfully implemented in joint projects.

WEAKNESSES

- Shortage of XR technology talent, as well as CCI managers, programmers, producers, etc. [3]
- Lack of education for traditional artists and cultural institutions.
- Lack of funding for projects of high artistic value. VR production, although cheaper than e.g. film production, is still expensive.
- Lack of physical space with advanced equipment for VR filming and collaboration with other CCIs.
- Lack of cooperation and partnerships with tech representatives and businesses.
- Local partnerships between ArtTech creators and businesses are not forming due to the lack of funding for joint projects.
- Foreign partnerships are based on unequal relations, as Lithuanian businesses cannot bring adequate budgets for co-productions and become just cheap labour for foreign projects.
- Small project budgets lead to a closed market and a lack of partnerships (especially abroad).
- There is an overlap between the XR content (audiovisual, installation, etc.) and games industries, so good professionals go into the games industry, where salaries are more competitive.
- Lithuanian XR companies cannot compete significantly with foreign companies because the quality is mediocre and the prices of services are high due to the high cost of maintaining employees in Lithuania.
- The proliferation of mediocre projects does not raise the competence and motivation of staff to develop high value products.

OPPORTUNITIES

- Staying ahead of a changing world.
- The advertising industry, which produces a lot, is likely to soon apply and use AI for scriptwriting.
- AR will become very popular in the near future as hands-free AR equipment (AR goggles, other devices) becomes affordable and of high quality. [2] It will transform our lives in a similar way to what smartphones have done, creating a huge interactivity with added physicality.
- The younger generations will learn in a different way – through gamified content.
- Gamified content for culture and education is growing in popularity.
- As Lithuania is small, this makes it easy to disseminate XR content regionally through good examples.
- Partners in the cultural sector (e.g. museums) have little awareness of innovation and technology opportunities, so partnerships are supported by education from the business side.
- XR links with EdTech are significant.

THREATS

- Low visibility of interactive cultural content among the public, cultural organisations and funders.
- No dedicated funding source for interactive content. [2]
- There is a perception among funders that project estimates do not reflect real costs, so funding is half of what is needed to implement concepts. This leads to the production of products of mediocre rather than high artistic or creative value. [2]
- XR project clients from the public sector often don't know what they want because they don't know what the opportunities of the technology are, and if they do, they don't have the money. This limits the delivery of high quality projects.
- XR's artistic and gamified cultural solutions are not eligible for funding from the Lithuanian Council for Culture, as they are treated as a game and not as cinema.
- Physicality will remain important, XR will not become the main form of content delivery.

New media is defined here as immersive, interactive, XR content creators, whose work is usually highly interdisciplinary (combining visual art, cinema, theatre, games, any static content, etc.). **Digital transformation and Industry 4.0 and 5.0 technologies are an essential part of these creative industries' activities.** The biggest **challenges for** new media **are the lack of funding, infrastructure and talent.**

XR projects are funded by both the Lithuanian Film Centre and the Lithuanian Council for Culture (LCC). It is noted that the **LCC often provides only half as much funding**, as there is a perception that project estimates do not reflect real costs. **This makes it impossible to realise projects of high artistic value** or leads to a reduction in functionality. Small budgets **also limit the scope for co-productions with foreign partners and international dissemination**. This leaves Lithuania as a country of cheap labour, i.e. production rather than creation.

There is a shortage of tech specialists, programmers, CCI managers and XR producers. Some professionals are moving to the games industry because it is more competitive. There is also a lack of knowledge and education about the potential of XR for other CCIs and traditional art forms.

This creative industry, together with the games industry, is one of the most technologically advanced CCIs and has a high degree of interdisciplinarity, which provides opportunities for other, more traditional arts, and its **development should be prioritised**. Young audiences are consuming more and more audiovisual content and gamified, immersive content may be the only way to reach them in the future. XR content can be used both in cultural education and in training for various professions.

ArtTech development actions:

- **funding for the creation of a VR film studio with advanced technology or an ArtTech innovation centre;**
- **networking and collaboration between XR and the rest of the tech sector, other businesses promotion;**
- **training XR specialists and CCI specialists with immersive content skills;**
- **allocating a separate source of funding or more funding from existing sources;**
- **additional evaluation points for the use of new technologies in LCC competitions;**
- **education of public authorities providing funding for cultural XR projects on the benefits of XR projects;**
- **raising public awareness and dissemination of ArtTech.**

Media: design

The interviews with design industry representatives covered: respondents' activities; motivations, challenges, benefits and risks experienced in the ArtTech ecosystem; collaboration; the future; and the role of government. A total of 3 design representatives were interviewed: individual creators, associations, other organisations.
The table below shows all the strengths, weaknesses, opportunities and threats mentioned by respondents. The number of mentions is in brackets.

STRENGTHS

- Creating a new form of artistic expression.
- New opportunities for self-expression.
- Creators in co-operation with tech the sector, they outsource all the technical work to them. In this way, they spend more of their time on creation, generate more or higher quality creative content and sell it successfully.

WEAKNESSES

- There is a perceived lack of education and training in the use of new technologies in creative work. [2]
- There is a lack of sufficient equipment to allow experimentation and testing of different technologies.
- Available technological tools do not always support high quality content.
- Lack of infrastructure for collaborative projects.

OPPORTUNITIES

- New ways to monetise. [2]
- It is financially attractive to develop ArtTech projects, as the financial return can be significantly higher than for traditional artistic/cultural projects.
- New technologies are very relevant for young creators.
- There may be a niche for professionals performing specific services, e.g. perhaps a designer, a developer - creating, generating ideas, while VR/AR or other tech specialists move the creation to where it is needed.

THREATS

- There is no funding for the development of digital products (e.g. virtual exhibitions, fashion design collections in the metavisata, etc.).
- In Lithuania, non-commercial culture is promoted, but popular, commercial culture suffers.
- The use of new technologies has so far reduced accessibility, including for consumers. [2]
- New technologies (e.g. blockchains, NFTs) are underdeveloped topics in higher education.
- There are no specialists and mentors in Lithuania for the use of new technologies in design.
- It is not clear how to preserve and protect digital art. There is no clear IP regulation. [2]
- Lithuania has an unclear tax system. For example, the concept of NFTs does not exist in the State Tax Office, making it impossible to declare income correctly.
- Sustainability, CO2 footprint.
- The value of artworks/virtual art can be artificially created by manipulating the system of a free unregulated market.
- The unstable situation of cryptocurrency in the world.

The interviewees **point to the changes brought about by** the digital transformation, especially the **new opportunities for artistic expression and monetisation**. The **biggest challenges for ArtTech development in** the design sector **are the lack of education, infrastructure and funding.**

Few designers are yet fully aware of the various new technologies, although interest is growing, especially in blockchain and NFT technology. The latter, by enabling the ownership of virtual objects, offers a new way to monetise virtual design works. Creating for the virtual world frees us from the constraints of the physical world, but there is still a lack of skills for this in Lithuania, which is why more education on ArtTech topics in higher education institutions is needed.
There are many similarities between the insights of visual artists and designers, and many artists create both art and design products. However, it can be noted that the **designers interviewed are more cautious about new technologies**. This may be due to the fact that, unlike visual art, design is a form of applied creativity, which generates a higher and/or more stable income than visual art. Visual artists have fewer monetization options and are therefore more willing to learn to use new technologies and experiment.

The design sector is highly digitised and technologically advanced, but its interest in the latest technologies is in its infancy, as existing business and creative models work relatively well.

Next steps for the overall development of the sector:

- **Education and mentoring for** creators on the opportunities offered by new technologies;
- Incorporating ArtTech modules into university curricula;
- **Raising public awareness** and dissemination of design innovation;
- **Networking and collaboration** between developers and the technology field **promotion**;
- **Educating funding bodies on** the potential of new technologies;
- **Funding** for technologically innovative projects and/or additional points in competitions.

Summary of the creators, start-ups, SMEs SWOT analysis

The analysis of the strengths, weaknesses, opportunities and threats of Lithuanian ArtTech ecosystem creators, start-ups, SMEs revealed that the most advanced, leading and developed CCIs in the ArtTech ecosystem in the country are the **media** – new media, gaming industry, film industry, music industry and **visual arts**. These industries are highly interdisciplinary, able to attract international projects, and new technologies offer new possibilities for expression, optimisation of non-creative processes and new ways of monetisation. Therefore, in order to ensure the development of the Lithuanian ArtTech ecosystem, it is appropriate to prioritise these CCIs and their development.
Below is a summary analysis of the strengths, weaknesses, opportunities and threats of the priority ArtTech industries. The most recurrent, relevant statements in these industries have been selected and the number of mentions is indicated in brackets. The weaknesses have been grouped according to the causes of the **problem** raised in the **Culture and Creativity Development Programme 2021-2030,** "the untapped potential of the CCIs to create a high value-added economy and innovative social services without systematically and specifically nurturing the CCI sector itself".

Both weaknesses and threats point to areas that should be prioritised in order to foster the development of the ArtTech ecosystem. The priority areas that have received the most attention are: **competence and skills development; networking and collaboration; public strategy and legal framework; financing; technological and infrastructural resources.**

STRENGTHS

- New forms of expression, the possibility of using the latest technologies to implement ideas that were previously impossible to achieve. [4]
- Many music and film industry professionals are technically proficient and produce products of high artistic value. [3]
- Monetisation of creativity, allowing for more creative rather than commercial outsourcing. [3]
- Optimising non-creative processes. [2]
- Different, new and wider access to content, reaching new audiences. [2]
- Dissemination of work in Lithuania and abroad. [2]
- Low fees for NFT art sales and other sales platforms compared to traditional intermediaries (galleries, auctions). [2]
- The opportunity to interact with and receive feedback from art collectors. [2]
- The gaming industry is growing and there is an opportunity to reach global audiences. [2]

WEAKNESSES

COMPETENCES AND SKILLS:

- There is a lack of general knowledge about new technologies (AI, NFT, AR, VR), as well as a lack of education and training in their use in the creative arts. [8]
- Lack of specialists, e.g. lack of talent in XR technologies, including CCI managers, programmers, producers, etc. [3]

- For some specialities, there is a shortage of specialists in Lithuania or they are self-taught. [3] There is also a shortage of specialists for less skilled jobs. [2]
- Professionals needed for the various CCIs are moving to the games industry for higher salaries. [2]
- Lack of financial literacy, lack of knowledge of how cryptocurrencies and crypto tokens work, how to sell NFTs, lack of knowledge of the financial aspects of NFTs (taxes, etc.). [2]
- Lack of reliable, clear and regularly updated information in Lithuanian. [2]

NETWORKING AND COOPERATION:

- Insufficient or poor cooperation between artists, the state and traditional arts institutions; Non-existant but much needed public-private partnership between NGOs and the public-private sector (PPP). [3]
- Insufficient cooperation with public authorities, universities and research centres, incubators and creative industries associations. [2]
- There is a lack of collaboration between ArtTech creators, partnerships with tech representatives and businesses; these partnerships are not formed because of a lack of funding for joint projects. [3]
- Cooperation with foreign partners and tech companies is needed but lacking; small project budgets lead to a closed market and a lack of partnerships abroad. [2]
- The NFT community in Lithuania is small, there is no exchange of information and skills – there is a need for live meetings, events, hackathons in cooperation with other market players. [2]

TECHNOLOGICAL AND INFRASTRUCTURE RESOURCES:

- There is a lack of physical innovation space with modern equipment, where people from different fields can come together to collaborate, try out different technologies and experiment. [4]
- There is a lack of physical spaces with advanced technology to showcase creative products, e.g. VR performances, etc. [3]

FUNDING:

- Lack of finance: technology adoption requires investment in hardware, software, new knowledge and skills; high costs for projects with high artistic value, production of products using the latest technologies (VR, AR, AI). [2]

OPPORTUNITIES

- Games are and will continue to permeate different domains, experiences and content consumption – a changing society wants immersive and gamified content, so more and more content will be delivered in the form of games. [5]
- Many technologies will become affordable. [4]
- New ways of monetisation and commercial success. [3]
- The younger generations will learn in a different way – through gamified content. The XR and EdTech interfaces are significant. [3]
- It is financially attractive to develop ArtTech projects, as the financial return can be significantly higher than for traditional art/culture projects. Therefore, it is impossible that Lithuania's investment in ArtTech will not pay off – Lithuania is full of innovative ideas. [2]
- Growing cross-sectoral cooperation. [2]
- Growing international cooperation, attracting international projects. [2]
- Music innovation can be used in a wide range of fields (education, therapy, life sciences) etc.). [2]
- New technologies are a highly popular topic among young developers. [2]

THREATS

PUBLIC POLICY AND REGULATION:

- The contribution of the games industry to the national economy is not known, as there is a lack of data on this industry, as well as on other CCIs (e.g. music industry, film industry). [5]
- Intellectual property protection and the uncertainty of new technological developments (legal regulation of IP works, NFTs and copyright, etc.). [4]
- Unclear regulation (copyright, taxation), regulation and taxation of NFTs. Unclear or overly strict regulation of cryptocurrencies also creates an unfavourable environment for the development of NFT games. [4]

FUNDING:

- There is a perception among funding bodies that project estimates do not reflect real costs, so funding is half of what is needed to implement the concepts. This leads to the production of products of mediocre rather than high artistic or creative value; and incompetence on the part of project evaluators. [3]
- Lack of funding focused on the ArtTech field and specifically immersive content or for the development of digital products (e.g. virtual exhibitions, fashion design collections in the metaverse, etc.); no updated funding categories for interactive or VR film. [3]

NETWORKING AND COOPERATION:

- Mistrust of the film industry by public authorities. [2]
- The gaming industry receives little or no attention from public authorities, and the sector is not being promoted or targeted for growth. [2]

OTHER:

- The speculative and volatile nature of the crypto market; the immaturity of NFT technology, which makes its future use unpredictable. [5]
- The cost, (un)availability and (un)ubiquity of hardware (VR glasses, AI tools, etc.) among mainstream users. [3]
- Society is not fully prepared for innovative and unexpected solutions (e.g. VR cinema); low awareness of interactive cultural content. [3]
- Rapidly changing and rapidly outdated technologies. [2]

Conclusions and recommendations

A review of the Lithuanian ArtTech ecosystem participants shows that:

- In Lithuania, the potential of the ArtTech ecosystem is not being exploited due to a **lack of ecosystem players such** as: **investors; accelerators; consultants**. These actors are not numerous or their functions (e.g. accelerators ≠ arts incubators) do not match the needs of the ecosystem. There is also a perceived need for research and academic institutions to step up their ArtTech activities.
- Creators, start-ups, SMEs use and understand new, Industry 4.0 and 5.0 technologies depending on the sector they represent. In the country, the most advanced, leading and developed CCIs in the ArtTech ecosystem are **media** - new media, gaming, film and music, and **visual arts**.

Based on the analysis of secondary sources, a review of the Lithuanian ArtTech ecosystem participants and the results of the qualitative study of the Lithuanian ArtTech ecosystem, the following **suggestions and recommendations** are made to the public sector **for the empowerment and development of the ArtTech ecosystem**:

- It is important to realise that investing in the whole CCI sector does not bring the same high added value. The study revealed that the most advanced, leading, most developed and highest priority areas for the development of the ArtTech ecosystem are:

Visual arts | Media: music | Media: cinema | Media: games | New media

- In order to use the potential of ArtTech and CCIs to create a high value-added economy, it is recommended to prioritise the following weaknesses and threats identified by the sector:

SWOT analysis of ArtTech ecosystem participants, creatives, startups, SMEs: priority problem areas	**The causes of the problem raised in the Culture and Creativity Development Programme 2021-2030 (CCDP)** "the untapped potential of CCIs to create a high value-added economy and innovative social services without systematically and specifically nurturing the CCI sector itself"
developing competences and skills	1.3 Lack of competences and skills to effectively develop and exploit the potential of CCIs in terms of knowledge of markets, export development, innovation and business solutions.
networking and cooperation	1.2 Insufficient CCI networking, international and cross-sectoral cooperation does not ensure international competitiveness of CCIs.

public strategy and legal framework	*The problem is not mentioned in the CCDP*
funding	1.4 Lack of sources of finance, including financial instruments (accelerator funds, venture capital, loans, guarantees, etc.).
technological and infrastructure resources	1.1 Underdeveloped technological, organisational and infrastructural resources for CCIs in the face of the challenges of globalisation, digitisation and pandemics.

Table 1. Causes of the 2021-2030 CCDP problem and ArtTech's main problems.

- It is recommended to draw on the experience of foreign countries to address the weaknesses and threats identified by the sector:

	Recommendations
Strategy and action plans	• It is important to choose a country's ArtTech focus and define what is considered ArtTech. Based on the experience of foreign countries, two directions can be seen, of which in the Lithuanian context the more relevant is the choice of Arts and Tech or Culture x Tech concepts from the Far East (South Korea; Hong Kong; Taiwan), which define the possibilities of application of cultural content in the field of technology and innovation. Western countries (UK; Denmark) choose CreaTech, which defines the transformation of CCIs through technology and the growth of new business models, start-ups and investments. • Long-term objectives and performance indicators for a cross-sectoral ArtTech policy are needed. It is important to collect data on the contribution of CCIs to the national economy.
Funding	• In the short term, it is recommended that innovation promotion programmes diversify the type of projects supported. Extend the funding guidelines to include and encourage applications for creative and innovative projects and services. It is important to take into account the need for funding for immersive content and digital product development (e.g. virtual exhibitions, fashion design collections in the meta-university, etc.); there is a need to update the categories of funding for interactive or VR film.

Infrastructure	It is recommended to create (or initiate the creation of) a creative innovation (research) infrastructure for testing new ideas, experimentation, experience and knowledge sharing. Key criteria for the infrastructure, its operation: • research and development (R&D) • encouraging creativity and innovation • promoting applicability of innovations • pre-acceleration, acceleration • public involvement. Existing ArtTech infrastructures, e.g. in universities, can be strengthened to meet the more holistic needs of industry. In order to achieve a breakthrough in ArtTech, it is necessary to ensure the emergence and implementation of pre-acceleration and acceleration programmes in the country. It would therefore be appropriate to review the activities of art incubators in Lithuania, their plans and the general definition of art incubators. It is important to ensure that the activities of arts incubators are relevant to today's needs and that they accelerate rather than merely incubate creators.
Networking and building skills, competences	It is recommended that a study be carried out on what tools can meet the needs of the sector and act as a networking, information, knowledge and best practice sharing function between CCIs and other sectors. Continuous improvement of digital competences is also important. It is proposed to explore whether the existing arts incubators in Lithuania could fulfil these functions, together with infrastructure and (possibly) partial funding.

Recommendations for the continuation of the project "ArtTech - Opportunities for Lithuania's Cultural and Creative Industries Sector" by "Create Lithuania":

- To provide an overview of public sector institutions, their role and functions in the Lithuanian ArtTech ecosystem;
- Taking into account the needs of the market, i.e. creators, start-ups, SMEs, and the main issues raised, review to what extent the plans (long, medium and short term) of the concerned public sector institutions are in line with this;
- To investigate whether art incubators operating in Lithuania can fulfil the function of ArtTech incubators and accelerators. It is advisable to review the activities of arts incubators in Lithuania, their plans and the general definition of arts incubators, to see to what extent their activities are in line with today's needs.

Annexes

1 Annex

Classification of the creative industries according to the UNCATD and CESE classifications.

UNCTAD classification of CCI			**CCI activities according to the Classification of Economic Activities**
Traditional cultural activities	Heritage	Cultural sites	Libraries and archives
			Museums
			Operation of historic sites and buildings and similar tourist attractions
		Arts and crafts	Specialised retail trade services of souvenirs, works of art and religious goods
			Production of ceramic household and decorative products and goods
			Cutting, shaping and processing of stone
			Production of artificial jewellery and similar products
			Production of games and toys
			Production of jewellery and similar goods.
		Traditional cultural expressions	Amusement and theme park activities
			Other amusement and recreation activities
			Excursions and tours
	Arts	Visual arts	Photography activities
			Artistic creation
		Performing arts	Staging activities
			Stage construction service activities
New creative industries activities	Media	Publishing and printed media	Book publishing
			Newspaper publishing
			Publishing of directories, catalogues and address books
			Publishing magazines and periodicals
			Other publishing
		Audiovisuals	Sound recording and music publishing
			Screening of films
			Production of films, videos and television programmes
			News agency activities
			Radio broadcasting
			Television programming and broadcasting
			Distribution of films, video and television programmes
			Public relations and communication activities
		New media	Publishing of computer games
			Computer programming activities
			Other software publishing

			Internet gateway services activities
		Design	Artistic design of produced films, videos and television programmes
			Landscaping
	Applied creative services	Creative services	Retail sale of antiques
			Architecture
			Representation to media
			Engineering activities and related technical consultancy services

Table 2. Source: compiled by the authors based on Žilvinas Jančoras (et al.) 2014; UNCTAD 2008.

2 Annex

Interview questionnaire