

Advanced Technologies for Industry – Sectoral Watch

Technological trends in the creative industries

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Introduction

This sectoral report has been prepared in the framework of the 'Advanced Technologies for Industry' (ATI) project, initiated by the European Commission's Directorate General for Internal Market, Industry, Entrepreneurship and SMEs and the European Innovation Council and Small and Medium-sized Enterprises Executive Agency.

It analyses trends in the generation and uptake of advanced technologies, related entrepreneurial activities and skills needs in the creative industries. It interprets data from a list of data sources compiled to monitor advanced technologies and their applications in industry across Europe and key competitor economies.

The starting point of this analysis has been sixteen advanced technologies that are a priority for European industrial policy and that enable process, product and service innovation throughout the economy and hence foster industrial modernisation. Advanced technologies are defined as recent or future technologies that are expected to substantially alter the business and social environment and include Advanced Materials, Advanced Manufacturing, Artificial Intelligence, Augmented and Virtual Reality, Big Data, Blockchain, Cloud technologies, Connectivity, Industrial Biotechnology, Internet of Things, Micro and nanoelectronics, Mobility, Nanotechnology, Photonics, Robotics, Security.

The relevance of these specific technologies in the creative industries has been explored through patent analysis and data on private equity investments, skills and technology uptake. The full methodology behind the data calculations is available here: <u>https://ati.ec.europa.eu/reports/eu-reports/advanced-technologies-industry-methodological-report</u>.

This report is structured as the following:

- The first section sets the industrial context.
- The second section analyses technological trends in advanced technologies applied in the creative industries.
- The third section presents findings about private equity investment and startup/spinoff activity.
- The fourth section explores the supply and demand of skills related to advanced technologies in the creative industries.
- The fifth section concludes with a short future outlook.

1. Setting the scene: industrial context

Key messages

Creative industries are crucial for the European economy, they employ around 7.4 million people in the EU27. The work of these **creative professionals is not only relevant from an economic perspective but it is important in the promotion of Europe's diverse cultural identity and European values**.

Digitalisation has transformed the processes of the creation, production, distribution and the consumption of content. Culture is increasingly accessed through dedicated platforms, applications, social media and aggregators.

However, the digitisation of culture has created 'winner-takes-all' market places, where a small number of creative industry professionals are benefiting from lower barriers to entry and a higher marketshare.

The Covid-19 pandemic has further driven the digitalisation of the creative industries and has forced actors most hit by the pandemic to experiment with a range of new technologies and to launch new tech-based products and services.

1.1 Pillars of creative transformation

Creative industries are crucial for the European economy. They employed 7.4 million people across the EU27 in 2019, which represented 3.7% of all employment ¹. In 2017, there were 1.1 million cultural and creative enterprises in the EU27, generating \in 145 bn of value added². The work of creative industry professionals is not only relevant from an economic perspective but it is important in the promotion of Europe's diverse cultural identity and European values including equality, democracy and sustainable development³.

The year 2021 was declared the **International** Year of Creative Economy for Sustainable Development⁴ by the the United Nations General Assembly. Creative industries such as music, arts, architecture and design transmit cultural and environmental values and are powerful agents for social change.

Creative industries can be defined as "those industries which have their origin in individual creativity, skill and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual property" ⁵. Creative activities are based on cultural values, or other artistic individual or collective creative expressions. The definition of creative industries are changing country by country. For the purposes of this report, we consider the following creative industries:

- Video games, gaming
- Music
- Film
- News media, Publishing
- Museums
- Architecture
- Visual art
- Performing arts
- Design

The unique contribution of creative industries to innovation and economic transformation has been acknowledged for many years ⁶. Creative industries provide not only direct inputs to the rest of the productive system, but they have important spillover effects on the economy and society through an overflow of ideas, skills and knowledge⁷.

The **creative industries and culture have also the power to faciliate transformations** of institutions, communities and cities. Creative people and artists are key because they develop ideas, metaphors and messages and help to drive social development and experiences⁸.

https://ec.europa.eu/eurostat/statisticsexplained/index.php?title=Culture_statistics_-

_cultural_employment ² Eurostat, 2020, cultural statistics

³ https://unctad.org/system/files/officialdocument/ditcted2018d3_en.pdf

⁴ https://undocs.org/pdf?symbol=en/A/C.2/74/L.16/REV.1

⁵ DCMS, 2001 Creative Industries Mapping Documents

⁶ See for example Nesta, 2008

⁷ Boix Domenech R and Rausell-Köster P, 2018

⁸ European Union Open Method of Coordination

Expert Group on Cultural and Creative Industries

The cultural and creative industries generated around €509 bn per year, representing 5.3% of the EU's total GDP in the EU⁹. The value of the global market for creative goods has exponentially increased since 2002. These trends coincided with the digitisation of the creative economy and the digitisation of artistic and creative works including music, video and publishing.¹⁰

One particular characteristic of creative industries is that they are constituting a large share of freelancers and micro-companies. Some 32% of the creative workers in the sector are selfemployed ¹¹, which is more than double the average observed for the whole economy.

As the recent report of the European Investment Fund ¹² pointed out, **European creative** industries are world leaders in many ways:

- World leading brands include: Universal, Bertelsmann, Pearson, LVMH, Gucci, Sotheby's, Rovio, Pathé, Nordisk, Spotify, KING, Supercell
- Many European creative activities have achieved a significant market share such as TV Film, programme, Animation, Music, Publishing, Art market and Fashion
- Europe hosts a thriving, agile and highly creative independent sector e.g. film, music, publishing, games
- Europe is renowned for excellence in arts management and live events, festivals and museums
- European Art and Design schools rank among the best in the world such as Aalto in Finland and Politecnico di Milano in Italy.
- Europe has some of the most visited museums in the world and exports live performances around the world, with European cities dominating the UNESCO's index of cities of literature.

1.2 Digitalisation trends

The digitalisation of culture and the creative industries has transformed the processes of creation, production, distribution and consumption of culture. However, it has also dramatically affected the profitability of traditional creative practices and businesses.

For already a decade, a new audience for creative and cultural content has been growing up as being digital native, living much more in a virtual world, absorbing information in an ever-faster pace.

Culture is increasingly accessed through search engines, online platforms and social media.

The digitisation of creative works has lowered the costs and consequently the barriers to production for artists and creators. This has led to an increase in artistic production and more creative works are produced, distributed and published than before.

While the digitisation of culture has resulted in more people creating and consuming digital culture, the cultural access and participation Eurobarometer survey¹³ showed already in 2007, that there has been a decline in participation in cultural activities across the EU. This might be linked to the cost associated with cultural consumptions at a time where the majority of Europeans use 'free' and low cost digital services to access cultural content.

Research indicates that the growth in volume and availability of digital creative works has created a 'winner-takes-all' market place, where a small number of creative professionals and artists are benefiting from lower barriers to entry and that this small number of benefiting artists is shrinking¹⁴. This trend is evidenced by global music sales indicating that as the market for digital tracks grows, the share of titles that sell far too few copies to be lucrative is growing as well.

The music and the media industries were among the first creative industries to be impacted by the spread of digital technologies. While these shifts created new opportunities and customer value, they also raised the threat of piracy¹⁵ and also caused privacy violations. The recorded music industry had to develop new distribution channels, business models and payment schemes in order to adapt. The internet amplified the desire to access content immediately which could be easily satisfied by digital media. Digital technologies also enabled the birth of entire new creative ecosystems for instance around video streaming, online and mobile games, e-books and immersive content.

In the new era of the digital platform economy, the concentration of actors highlights the dominant position of big non-EU players against the smaller EU creative industry organisations¹⁶.

Digitisation has disrupted the traditional value chains of creative industries and led to more complexity ¹⁷. New actors such as streaming platforms and tech startups entered the scene and created new creative ecosystems (see Figure 1 on the next page).

explained/index.php?title=Culture_statistics_-

¹³ Special Eurobarometer 278, 'European Cultural Values',

European Commission, 2007

- ¹⁴ Elberse, A., 2013
- ¹⁵ European Commission, 2020
- ¹⁶ European Parliament, 2019 ¹⁷ European Commission, 2019

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⁹ European Commission, 2018

¹⁰ UNCTAD, 2015

¹¹ https://ec.europa.eu/eurostat/statistics-

cultural employment#Self-employment

¹² https://www.europecreative.be/images/culture/Pdfs/ccsmarket-analysis-europe_fei2019.pdf

1.3 Growth prospects in times of Covid

The Covid-19 pandemic has had a severe impact on creative industries all around Europe. The location-based sectors that had to close down their operations such as museums, performing arts, live music, festivals, cinemas and creative retail, have been the hardest hit by social distancing measures. It is unclear if the world after Covid-19 will return to the way it was before.

Trends that were already underway before the pandemic have accelerated. The crisis' significant short-term consequences for the sector have been addressed with emergency actions and safety nets at different levels.

On the other hand, the Covid-19 lockdowns have boosted user engagement for instance with video games and e-sports. Revenues for many gaming companies and platforms have increased during the pandemic¹⁸. The impact of the Covid-19 outbreak on the recorded music industry has been less dramatic than on the live sector. The crisis has illuminated several trends ongoing in the creative industries already before the pandemic¹⁹. The lock-down reinforced the digital transformation of creative industries and shifted the attention to online cultural activities. Certain online platforms have even profited from the increased demand for cultural content streaming.

Lock-downs and the shift to internet-based communications proved also that digital platforms can become a lifebelt for communities to stay in contact and to collectively pursue and share in cultural and creative activities at distance.

The emergence of advanced technologies will further drive the digitisation of the creative industries. Some sectors will be impacted more then others, and some actors will significantly gain while others are likely to see there business models and income disappear. The remainder of this report intends to provide an overview of these trends.





Source: Technopolis Group, 2021

¹⁸ https://www.weforum.org/agenda/2020/05/Covid-19taking-gaming-and-esports-next-level/

¹⁹ https://ec.europa.eu/culture/news/europeancommission-support-recovery-music-ecosystem

2. Technological trends

Key messages

The creative industries have been mostly influenced by the emergence of the following advanced technologies: Augmented and Virtual Reality (AR/VR), Artificial Intelligence (AI), Cloud and Blockchain technologies. Other non-digital technologies such as Advanced Materials, Nanotechnology and Micro-and nanoelectronics have also affected various creative segments such as visual arts or gaming hardware.

Various use cases highlight the spread of advanced digital technologies across the different sectors of the creative industries. Video games is a creative segment with the highest rates of technological adoption. News media is being highly affected by AI and museums by AR/VR. Music industry is now being transformed by AI with many potentially disruptive use cases of Blockchain technologies.

AR/VR enables new immersive experiences for live games and live performance. AI enhances the distribution and access of creative content and is now also harnessed to produce generative content and synthetic media. Blockchain technologies enable services to protect, manage and track intellectual property and royalty micropayments.

Nevertheless, the adoption of advanced technologies is raising **critical questions about ethical design**, **privacy protection**, **monopolisation and the economic impacts**, **the value of copyright**, **and the boundaries of human-machine interaction** within the creative process itself.

2.1 Technological transformation in the creative industries

As the various use cases demonstrate, the creative industries have been mostly influenced by the advancements of specific technologies including: Augmented and Virtual Reality (AR/VR), Artificial Intelligence, Cloud and Blockchain technologies.

This new digital environment in which creative professionals have to navigate has become increasingly complex ²⁰. For instance, digital platforms contributed to the rise of the 'amateur content creator' and gave space for new actors and at the same time new types of competition. The possibilities to monetise content has changed and new business models emerged.

While digitalisation is transforming our society fundamentally with more and more tasks being automated, creativity has shown itself to be resilient and less prone to automation²¹. Creative industries offer tools and inspiration in terms of visual expression and storytelling that has important spillovers to other sectors in the new digital world.

Besides digital transformation, technological progress in other areas have also influenced the creative industries even if their impact is less visible. For example, Advanced Materials and Nanotechnology have been made use of in the visual arts, design, architecture and the film This trends analysis explores the uptake of advanced technologies by the various creative industries. It is based on a literature review and existing use cases as presented in the subsections below.

Figure 2 on the next page displays an assessment of the level of adoption differentiating between high, medium and low level of technology use. Video games is naturally the sector with the highest rates of overall advanced technological adoption. News media is being highly affected by AI and museums started to adopt AR/VR. The music industry is now making use of AI and Blockchain, with other creative industries such as visual art, performing arts or architecture naturally less prone to digital transformation.

2.2 Immersive technology for a better experience

Augmented, virtual and extended reality has empowered the film, the video games, media and design industries with new kinds of immersive experiences. The capability of these technologies has substantially increased since 2014 with the launch of the first prototypes of Oculus VR and Samsung Gear VR headsets.

²¹ https://www.weforum.org/agenda/2020/11/aiautomation-creativity-workforce-skill-fute-of-work/

sectors. Micro- and nanoelectronics also contributes to the development of AR/VR headsets.

²⁰ KEA, 2020



Figure 2: Adoption of AR/VR, AI and Blockchain in creative industries

Source : Technopolis Group, 2020, based on assessment of use cases

In the video, online and mobile games segment Augmented and Virtual Reality technologies offer an **improved user experience for gamers by creating realistic fully immersive experiences.**

4 out of 10 gamers agree that augmented reality gaming will be more interesting with better and more immersive games , lower-cost AR glasses and better batteries²².

The technological enablers behind the use of AR/VR are motion tracking, 3D effects and interactive graphics²³. As the strength of AR/VR lies in bringing together the real and virtual creating a dreamlike experience, the capacity to add digital information and real-time in one will be the game-changer for game designers²⁴.

Back in 2015, it was the US market that accounted for the largest revenue share in AR/VR in gaming, however, China has emerged by now as the

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leading global player and the key regional market in Asia²⁵.

Immersive media could transform the experience of reading news by bringing an event closer to the viewer²⁶. With the use of AR/VR, people can encounter a news story as a first person. The applications overlay digital information on real objects and create the illusion to be on site where the news are happening.

The concept of immersive theatre shows offer a new way of collaboration between theatres, museums and the gaming industry.

The use of AR/VR in museums and galleries has been increasing for a while as many created AR/VR apps to attract more visitors. In the times of Covid-19 virtual reality enhanced tours can enable users to visit a museum virtually from any location. Putting on a VR headset, the visitor can be 'teleported' into a museum space and investigate any exhibition object in 3D²⁷. For example, the Almeida Theatre in the UK has been working together with the Natural History Museum, the Science Museum Group, the University of Exeter and creative company called Factory 42 to create what is described as a mixed reality experience. The show is using the Magic Leap mixed reality headsets and allows audiences to play a detective game at both the Natural History Museum and the Science Museum. The game allows users to interact with digital characters that range from androids to velociraptors. The project aims to bring the worlds of dinosaurs and cutting-edge science to life for new audiences²⁸.

The US film industry has made use of AR/VR since the 90s. Virtual reality film-making provides a new way of experiencing video content as viewers are placed within the story. AR/VR is also used in the film production process. For instance, virtual cameras can create realistic camera movements and film digital models of objects, allowing for a natural camera motion bringing the audience into a scene.

Cannes XR is a 3-day event dedicated to immersive entertainment²⁹ that is an alternative solution for the famous Cannes festivals in the times of Covid. The Marché du Film, Tribeca, Kaleidoscope, the Museum of Other Realities and Veer VR have partnered in 2020 in order to adapt to the particular international situation and to

²² https://www.ericsson.com/4ab1a3/assets/local/reportspapers/consumerlab/reports/2019/gaming_report_cl_scree n_aw.pdf

²³ https://www.grandviewresearch.com/industryanalysis/virtual-reality-in-gaming-market

²⁴ https://www.mageplaza.com/blog/how-ar-vr-transformgaming-industry.html

²⁵ https://arvrtech.eu/blog/vr-film-and-gaming-the-nextsteps/

²⁶ https://www.forbes.com/sites/solrogers/2020/02/06/isimmersive-technology-the-future-of-

journalism/?sh=675b06c07e30

 ²⁷ For instance Google Arts & Culture works with cultural institutions and artists and makes culture available online.
 ²⁸ https://www.whatsonstage.com/london-

theatre/news/rsc-almeida-punchdrunk-virtual-realitygovernment_48278.html

²⁹ https://www.marchedufilm.com/programs/cannes-xr/

reshape an event online and in virtual reality notably the Cannes XR, a programme dedicated to immersive technologies and works, in connection with the art of storytelling and the film industry.

Non-location-based entertainment enhanced by virtual reality offers audiences high-end full immersion experiences. Concerts with the use of AR/VR are still rather pilots, several bands such as Maroon5, Coldplay or U2 relied on this technology to enhance the event effects. In China, by the end of 2016, there were more than three thousand VR arcades, many of them in shopping malls. China also hosts the world's first VR theme-park which opened in 2018.

Immersive technologies are also gamechangers of product design and for architecture. Virtual prototyping helps developers reduce time and cost and accelerate commercialisation ³⁰. AR/VR opens up new avenues for architects to communicate about their plans to build a new building or change a city landscape³¹, as they can digitally overlay data on a construction site. With AR/VR architects can also transfer model data to the construction site for verification and better monitor progress with construction.

After the spread in gaming, design, films, media and entertainment, the availability of creative tools has made **AR/VR accessible for artists** and tools such as the Tilt Brush, a Paint-like tool that has been launched to create art in threedimensions. Another example is Quill a new app and software that facilitates animating 3D art in real-time by manipulating these objects in physical space³².

Despite the exciting use cases, **the proliferation** of **AR/VR** in the creative industries brings up a range of ethical and societal questions. For instance, immersive media can cause issues, as AR/VR in news can create a bias or transmit unwanted emotions ³³. Physical and cognitive discomfort linked to the prolonged use of headsets are among the key risks that pose a barrier in the video games industry, with most high-end devices prohibitively expensive and require the user to also own a games console or an appropriate highend PC³⁴.

2.3 Artificial Intelligence in creative industries

Although many claim that creativity is a uniquely human trait that no algorithm can replace³⁵, AI is now impacting the creative process and the production of creative works. AI has been used for many years to drive distribution through recommendations and targeted ads. With the advancement of AI, machines are now used to generate new and tailored content.

In recent years, AI techniques have become popular tools applied to the creation and production of cultural works. This recent surge in the use of AI for the production and creation of culture follows ³⁶ the availability of advanced AI techniques, algorithms and programming libraries for free or open source.

In music, AI can be used not only for the distribution of music but also as an automated producer. AI powered music recommendation engines, such as Spotify's, use implicit information such as user interaction, song similarity and natural language processing to recommend songs and keep the users engaged.

In film, AI and generative networks are being used to produce visuals and inform the scriptwriting process. AI can play a role throughout the value chain of the film industry from casting actors, composing music, from editing movies to promotion ³⁷. For instance, software from Cinelytic³⁸ can estimate the box office value of changing movie stars in the title roles. Another AI offerings in the film industry is Scriptbook³⁹ from Belgium that provides artificially intelligent script analysis, AI-driven content validation and automated story generation.

Robot journalism is already deployed in sports. A promising possibility for journalism is AI-powered analysis of large data sets and multiple information sources. In addition to solutions already in use in journalism that detect online trends, it will be valuable to look to more sophisticated systems in business intelligence and security intelligence, such as the Swedish company Recorded Future. Artificial Intelligence offers effective tools to address image retrieval from archives.

AI provides opportunities to harness the existing art collections of museums to draw

 https://www.cuningham.com/2020/01/15/immersivetechnologies-architects-position-themselves-success/
 https://www.theartnewspaper.com/analysis/extended ³⁵ https://www.weforum.org/agenda/2020/11/aiautomation-creativity-workforce-skill-fute-of-work/
 ³⁶ BOP Consulting, 2020

³⁰ World Economic Forum, 2018

reality-ar-vr ³³ Read more here:

https://er.educause.edu/blogs/2018/4/vr-and-ar-theethical-challenges-ahead ³⁴ BOP Consulting, 2020

³⁷ <u>https://www.allerin.com/blog/can-ai-automate-the-film-industry</u>

https://www.theverge.com/2019/5/28/18637135/hollywoo d-ai-film-decision-script-analysis-data-machine-learning ³⁹ https://www.scriptbook.io/#!/

out new interpretations and connections between collections and objects, to accelerate and scale the digitisation process of preserving and digitising culture and heritage, and to create new dynamic and personalised user experiences. For example, the Rijksmuseum in Amsterdam is using its digital collection and an AI algorithm to allow curators link works of art and look for connections and motifs more effectively.

Despite of the existing use cases, the use of AI technology is not straight-forward. Artificial Intelligence in the creative industries is often based on the availability of a body of existing creative works in the format of datasets on which AI can be trained. This raises many issues around copyright and the ownership of AI generated and informed content. AI can be nurtured by the creativity of artists but beyond all the promises and hypes it is still a question if it can become genuine on its own.

It is also difficult to automate the generation of musical content, which has highly complex structures. There is also a lack of large music datasets on which AI systems may be trained, as opposed to the plethora of image datasets available⁴⁰.

The use of AI in the creative process is raising important technical challenges including limited data resources, management and ownership. Many of the algorithms and data used and combined in AI are also typically derived from or draw on existing data, algorithms and programming libraries that are open-source. The success of deploying AI in the creative industries will be dependant on the availability of highquality and trustworthy data. Access to these data will be especially critical for smaller players and individuals that do not have the means to develop and access large data sets. As large sets of high-quality data are needed to train well-functioning AI but these sets can be expensive to gather, prepare and maintain. Creative sectors and businesses with ready access to well-organised data will have a lower barriers to maximise the use and potential of AI.

Creative industries such as video games, news media, the visual arts and film where large amounts of data are already being collected in a digital form, are better able to take advantage of AI. However, the ownership of that data, the intellectual property and related copyright around the usage of that data and how it informs new AI generated content is unclear.

There is also fear that the automated production of creative work will further deflate the cost of

⁴⁰ Baptiste Caramiaux, Fabien Lotte, Joost Geurts, Giuseppe Amato, Malte Behrmann, et al., 2019 producing content.⁴¹ This will in turn also lower the costs of licencing fees and royalty payments, especially in the case of content platforms that adopt a revenue share model e.g. Spotify, YouTube, Baidu. This is likely to further lower the income of practices artists.

2.4 Blockchain

Most use cases of Blockchain used in the creative industries are related to intellectual property management, platform management, fundraising and micropayments.

Blockchain technology can be instrumental in fighting piracy of creative content. One of the applications of Blockchain in the creative industries lies in the tracking of copyright. By allowing the registration of a creation into the Blockchain, this technology can offer a means of evidencing ownership at a reduced cost while enabling new business models for creative works. It is also possible to use this technology across all stages of the creative process and claim (international) protection⁴².

Micro-payment systems enabled by Blockchain technology enable pay-per-view payments instead of the higher cost subscription model. Blockchain can help the implementation of smart contracts and remuneration modalities for various creative industries⁴³.

The online rights management platforms that rely on Blockchain technology include for instance JAAK⁴⁴, a Blockchain powered network that allows the music and media industries to collaborate globally while enabling complex rights management, protection and payments.

Blockchain can be used to help fake news detection. It can authenticate information, although this solution would only work for news that has been already authenticated once by a trusted source. For instance, Comcast Corporation develops AI software that can predict customer issues before they occur. It is important that journalism remains verifiable by human editors.

The film industry has also started to experiment with Blockchain. It can support protection and royalty payments for artists and creatives across life cycle of a film. For instance, MovieCoin is developing a Blockchain technology solution consisting of its MovieCoin Platform and a new digital utility token that can be utilised by consumers for a variety of uses relating to

⁴¹ Lv, Lei, Zhixin Liu, and Yingying Xu., 2019 e0215366.

⁴² Renault et Gosse, 2018

⁴³ Renault et Gosse, 2018

⁴⁴ https://jaak.io/

consuming film and other content ⁴⁵ ⁴⁶. The importance of the technology is demonstrated by the fact that the recent Cannes Film Festivals hosted a 'Blockchain corner' as also other international film festivals in Berlin.

In gaming, Blockchain can be used to create decentralised digital games. For instance, a Blockchain trading card game is where cards are issued as non-fungible tokens⁴⁷. Cards are digital assets for players that can be purchased with the in-game currency or traded with other players.

In the design industry, Blockchain is used to help protect products against counterfeiting. Counterfeiting has been negatively affecting the fashion industry for long and retailers often do not trust the origin of the product. Some startups are experimenting with decentralised databases that securely store and exchange data related to new products and designs⁴⁸. This creates a secure way to buy, collect, sell and recycle authentic products.

2.5 Micro- and nanoelectronics, Advanced Materials and Nanotechnology

Other non-digital technologies such as Advanced Nanotechnology and Micro-and Materials, nanoelectronics have been also deeply affecting various creative segments such as visual arts or gaming hardware.

Conductive nanomaterials, carbon nanotubes and nanowires are key to developing new hardware not only for gaming but in design or architecture.

Gaming consoles are expected to emerge as the most favored devices for playing games equipped with various new non-digital technologies. This is enabled by efficient processors that are increasing their power continously in comparison to desktops and smart phones which may not match the immersive simulation experience provided by a console dedicated to playing games⁴⁹.

Interactive textile electronic devices can provide suitable platforms for AR/VR applications because of their performance and immersive features such as lightweight, handiness, flexibility, comfort and low strain. Textile-based systems offer a better experience in terms of sensory interactions than audio and visual interactions. Furthermore, textile devices enable the wearable AR/VR system to be smaller, softer and more comfortable⁵⁰.

metadata that distinguish them from each other." https://www.investopedia.com/non-fungible-tokens-nft-5115211

⁴⁵ https://www.forbes.com/sites/jamos/2018/08/01/willmoviecoins-Blockchain-technology-revolutionize-hollywoodfilm-production/?sh=3ca4baa71258

⁴⁶ Despite its novelty, MovieCoin had to face a recent lawsuit as it was accused of trying to pay a pledge in worthless https://variety.com/2019/biz/news/moviecointokens. ballet-worthless-tokens-1203198171/

⁴⁷ "Non-fungible tokens or NFTs are cryptographic assets on blockchain with unique identification codes and

⁴⁸ https://satoshi-studio.com/pages/Blockchain-solution 49 https://arvrtech.eu/blog/vr-film-and-gaming-the-nextsteps/

⁵⁰ https://www.nanowerk.com/spotlight/spotid=56766.php

3. Venture capital investment and startup creation

Key messages

The year 2020 saw **continued investment in design, digital gaming, music and media technology ventures**. However, many of these deals where decided pre-Covid. A downturn is expected and it is foreseen that investors will make fewer new deals and allocate resources to their existing portfolios.

New deals are very much technology-focused as investors are seeking new ventures related to online collaboration, digital solutions and Artificial Intelligence. VC investment in the music industry was focused on digital streaming platforms, innovation music production solutions, interactive apps and connected objects in 2020.

In the period from 2010 to 2020, private equity and VC investment in video games startups and scaleups was concentrated in Sweden, France, Ireland, Finland and Germany. Music industry has experienced the largest VC investment in Sweden, France, Germany, Ireland. News media and broadcasting funding are led by Germany, France, Sweden and Italy.

Games studio investment went into developing next-generation experiences, with 15% of startups focused on Augmented and Virtual Reality technologies and 3% Artificial Intelligence. Some 10% of the music industry startups have been engaged in Artificial Intelligence driven music services and 4% in Blockchain technology (as the analysis of Crunchbase and Dealroom data reveals). Media technology (related to news media) has been powered by Big Data and Artificial Intelligence.

3.1 Private equity and VC investment in startups an scaleups of the creative industries

Despite the importance of the creative industries for the economy, underinvestment has been a general problem for a long time. As many studies pointed out investors often do not have a full understanding of the creative ventures and are more cautious in putting money into such businesses. Creative industries are notoriously high risk for venture capital.

Cultural and creative companies face problems obtaining investment in new projects and this has been made more difficult during the Covid-19 pandemic.

The key issues that make investment harder for this industry include the following⁵¹:

- Lack of tangible assets to offer as collateral, dependence on intangible assets (e.g. copyright, licences)
- Lack of knowledge about how to assess the economic value of these intangible assets

- Perceived lack of business and managerial skills, dependence on public investment schemes in particular in the case of the performing arts, museums and visual arts sectors
- Uncertainty and size of the market, lack of market intelligence, digitalisation pressures.

In this context, the scale of venture capital (VC) and private equity investment was tracked using a combined set of Crunchbase and Dealroom data. From the joint database, companies were selected by filtering for specific industries⁵² and searching in the business decriptions of companies. Although many cultural and creative industries are dependant on public funding and do not make use of venture capital funding (eg. museum and performing arts), the analysis of these databases can reveal trends of startup firms developing technologies and addressing specifically the needs of creative industries. Crunchbase provides information on venture capital-backed innovative companies. Dealroom contains the same type of information but with a better coverage for Europe.

⁵¹ KEA & PPMI, 2019: Research for CULT Committee – Culture and creative sectors in the European Union key future developments, challenges and opportunities, European Parliament

⁵² See detailed methodology here: https://ati.ec.europa.eu/reports/eu-reports/advancedtechnologies-industry-methodological-report

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| | Creative industry | | | | | | | | | |
|----------------|-------------------|-------|-------|------------------|-----|--------|-----------------------|-------|-------------|---------|
| Country | Design | | | Video games | | News m | edia and broadcasting | 1 | Musi | c |
| Germany | €1.8 | 349M | €302M | | | €64 | 8M | € | 605M | |
| Spain | €1.74 | 12M | €103M | | | €60M | | €9M | | |
| Italy | €1.100M | | €200M | | | €108M | | €41M | | |
| France | €747M | | | €1.070M | | €299M | | | €802M | |
| Luxembourg | €633M | : | €1M | | | €4M | | €4M | | |
| Finland | €444M | | €4021 | N | | €46M | | €11M | | |
| Lithuania | €215M | : | €10M | | | €2M | | €0M | | |
| Netherlands | €195M | | €51M | | | €61M | | €4M | | |
| Denmark | €170M | | €28M | | | €68M | | €32M | | |
| Sweden | €125M | | | €1.611M | | €124M | | | | €2.379M |
| Ireland | €39M | | | €913M | | €65M | | €97M | | |
| Poland | €19M | - | €7M | | | €1M | | €0M | | |
| Portugal | €16M | - | €3M | | | €32M | | €4M | | |
| Estonia | €14M | | €3M | | | €0M | | €0M | | |
| Bulgaria | €9M | - | €4M | | | €5M | | €0M | | |
| Belgium | €8M | : | €4M | | | €89M | | €9M | | |
| Czech Republic | €7M | : | €17M | | | €6M | | €0M | | |
| Hungary | €6M | : | €5M | | | €14M | | €0M | | |
| Malta | €5M | | €41M | | | €0M | | | | |
| Latvia | €3M | | | | | €0M | | €8M | | |
| Austria | €2M | | €146M | | | €3M | | €58M | | |
| Romania | €2M | : | €0M | | | €0M | | €0M | | |
| Croatia | €2M | : | €0M | | | €0M | | €0M | | |
| Greece | €0M | - | €0M | | | €0M | | €4M | | |
| Cyprus | €0M | | €27M | | | €11M | | | | |
| Slovakia | €0M | | €1M | | | €0M | | | | |
| Slovenia | €0M | | €0M | | | €0M | | €10M | | |
| | €0B €1B €2B | €3B € | EOB € | 1B €2B | €3B | €0B €1 | B €2B €3 | B €0B | €1B : | €2B €3B |
| | Funding 2010-20 | 020 | F | unding 2010-2020 | | Fu | inding 2010-2020 | | Funding 201 | L0-2020 |

Figure 3: Venture capital and private equity investment in the creative industries in 2010-2020 (sorted by design)

Source: Technopolis Group based on Crunchbase and Dealroom, 2021

The investment figures presented in this section refer only to the funding rounds where a value has been disclosed.

The analysis based on Crunchbase and Dealroom data enables exploring the following subindustries as defined in these databases:

- Gaming, video and online games
- Music (automation of music sector)
- News media
- Architecture
- Visual arts
- Performing arts (theatre)
- Design

The year 2020 still saw a continued investment in design, digital gaming, music and online media ventures in particular. However, many of these deals were decided pre-Covid. Although the VC market has been impacted by Covid, startup investment still continued even if under different conditions. An overall slowdown is expected for 2021 as investors are more cautious, make fewer

new deals and allocate resources to existing portfolios.

The analysis reveals the hotspots of venture capital investment in the various creative industries as illustrated on Figure 3 above and Figure 4 on the next page. In the period from 2010 to 2020, private equity and VC investment in video games startups and scaleups was concentrated in **Sweden, France, Ireland, Finland and Germany.** Product design has been the highest in **Germany, Spain and Italy.** Music industry has experienced the largest VC investment in **Sweden, France, Germany, Ireland.** News media and broadcasting funding had peaks in **Germany, France, Sweden and Italy.**

As it would be expected, **VC investment was the highest in design** (product design and fashion), **video games followed by music, news media and broadcasting** in 2010-2020. VC investment was relatively lower in architecture, visual arts, performing arts, museum and the film industry. The low VC investment in the film industry can be explained by the fact that the film industry is

| Country | Film | Architecture | Fine art | Performing arts |
|----------------|-------------------|-------------------|-------------------|-------------------|
| France | €34M | €27M | €26M | €19M |
| Italy | €27M | €8M | €17M | |
| Belgium | €23M | €5M | €1M | |
| Sweden | €17M | | €12M | €7M |
| Spain | €15M | €5M | €6M | €0M |
| Poland | €10M | | €5M | |
| Denmark | €8M | €13M | €2M | |
| Hungary | €3M | | €0M | €0M |
| Cyprus | €2M | | | |
| Finland | €1M | €0M | | |
| Germany | €1M | €7M | €29M | €2M |
| Ireland | €1M | €103M | €12M | |
| Netherlands | €1M | €7M | €4M | €1M |
| Austria | | €33M | €1M | €1M |
| Greece | | €2M | | |
| Czech Republic | | €2M | €1M | |
| Lithuania | | €1M | €1M | |
| Croatia | €0M | | €0M | |
| Bulgaria | €0M | €OM | €0M | |
| Estonia | €0M | | €0M | |
| Slovenia | | €OM | | |
| Portugal | | €1M | | |
| Latvia | | €OM | €0M | |
| | €0M €50M €100M | €0M €50M €100M | €0M €50M €100M | €0M €50M €100M |
| | Funding 2010-2020 | Funding 2010-2020 | Funding 2010-2020 | Funding 2010-2020 |

Creative industry

Figure 4: Venture capital and private equity investment in the creative industries in 2010-2020 (sorted by film)

Source: Technopolis Group based on Crunchbase and Dealroom, 2021

financed by the big film companies and VC activity is less relevant for developing innovations in this particular industry. With the performing arts, museums and the visual arts reliant on public funding, grants and sponsorship.

Despite of the Covid-19 pandemic, **the video game industry managed to further thrive** given the fact that social distancing measures encouraged people to turn to online entertainment such as gaming. Deal flows remained strong. Nevertheless, there is concern for future investment opportunities given the fact that investors are becoming more cautious due to the economic uncertainty. Gamers might have less disposable income to spend if the pandemic continues that makes people more risk-averse. Creating new relationships is also harder since there are no physical events taking place (at the time of writing this report) where investors could meet startups.

As investors are expecting major disruptions in retail, **design companies** that are thinking omnichannel and think ahead of a new post Covid world are being favoured. The type of firms that obtained VC funding in 2020 include a range of design firms that are involved in e-commerce and digital development. Investors are interested in

companies that are spotting consumer trends coming out of Covid- 19^{53} .

VC investment in the **music industry** in 2020 was focused on digital streaming platforms, tech solutions for music production, interactive apps and connected objects dedicated to music. Music tech that equips musicians with new applications has been an attractive target including AI and cloud-based solutions. For instance, the French Newzik⁵⁴ is a digital sheet music reader tailored to meeting the needs of professional orchestras. Newzik lets musicians store thousands of parts in a digital library, organise them into setlists, create pieces with multiple parts to store different versions, and share music and annotations in realtime with others. Newzik is cloud-based and can be always accessible.

The creative industries will need to adapt to a post Covid-19 world with potentially less locationbased opportunities for creatives and consumers. For these reasons, investors are seeking new ventures that are more related to online collaboration, production, distribution and consumption using technologies such as

⁵³ Businessoffashion.com

⁵⁴ https://newzik.com/



Figure 5: Number of tech startups in creative industries in the EU (2015-2020)



Augmented and Virtual Reality and Artificial Intelligence⁵⁵.

3.2 Tech startups in creative industries

Startups play a key role in the dynamism of the creative industries and in accelerating technological and digital transformation. In this report, we focus on startups that have been founded after 2015 in order to capture the most recent activity in the various sectors.⁵⁶ In this section we focus in particular on creative industry startups with a technological angle and zoom into areas such as music tech or media tech.

Figure 5 below presents the number of startups across the EU27 countries related to three creative industries notably **video and online games, music tech and media technology** featuring the best performing countries on the top. Video and online games startups have been established most often in Sweden, Spain, Germany, the Netherlands and France over the period of 2015-2020. Music tech is thriving in Germany, France, Netherlands and Spain. Entrepreneurial activity in media technology has been the strongest in the Netherlands.

In video and online games, the highest share of startups (15%) relied on Augmented and Virtual Reality technologies. The hotspots of AR/VR

April 2021

powered games have been in Sweden, Germany and the Netherlands.

Some of the startups in particular in France are active in delivering games via cloud-based platforms. **Cloud gaming** enables consumers to play streamed games across devices, often without the need for expensive hardware⁵⁷. For instance, Gamestream is a French innovative cloud gaming solution established in 2015.

3% of the startups in the merged Crunchbase-Dealroom database develop **AI-based solutions** for the gaming industry. Examples include the German Fridai that offers a voice assistant for gamers, delivering the unique experience of undisrupted gaming sessions and personalised gaming. With Fridai, the gamer assistant provides voice enabled tools for gamers and transform the gaming experience seamless.

Chinese investors have been especially active in European startups in the past year. For instance, Tencent, a Chinese multinational technology conglomerate holding company, has bought a minority stake in France's video game maker Voodoo in 2020.

In the area of music, investors are looking for startups that offer novel solutions for the music

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https://www.forbes.com/sites/brianpenick/2020/06/22/mu sic-tech-investor-perspectives-during-the-pandemic-andrecession-david-dufresne-panache-ventures/

⁵⁶ For further information please see: https://ati.ec.europa.eu/reports/eu-reports/advanced-

technologies-industry-methodological-report

⁵⁷ https://www.brainbridge.be/news/cloud-gaming-20who-will-become-the-netflix-for-games

industry and can reinvent content creation, production and user engagement.

Some 10% of the startups have been engaged in **Artificial Intelligence powered music services**. These startups are headquartered mostly in Sweden, Germany and France. AI algorithms are used for discovering new and trending podcasts episodes and personalising podcast experience. Such solutions can train a speech-to-text algorithm through podcasting and provide a high-performance transcription at scale.

The Slovenian-based Viberate is a music network founded in 2015. The company is specialised in collecting and analysing information about musicians, venues, events and other music industry stakeholders. It uses Big Data analysis to calculate taste and define true popularity. This information is then used in a set of apps that help users discover new artists and events and also offers professionals an efficient tool to engage in business and accept data-driven decisions.

Some 4% of the music tech startups develop Blockchain technologies for the music industry and these startups are concentrated especially in Germany. For instance, Alissia Music is a **new Blockchain powered streaming service** based on the pay-as-you-go concept. We also find interesting startups in other countries such as Lithuania. Musical Blockchain was founded in 2018. Musical Blockchain is a AI based composer that composes music using data as a source of inspiration⁵⁸.

Blockchain Technology has been also used to improve revenues from music licencing. For instance, the Luxembourg-based ANote Music developed a stock exchange for Music Royalties, accessible via a proprietary trading platform. They provide liquidity to music owners and a high-yield, uncorrelated asset to investors.

ANote created an online exchange for music rights where right owners -such as artists, record labels and publishers- are able to sell their future royalty flows to investors for a defined number of years, or for good. Collecting this anticipated liquidity, music creators are able to invest into new projects and foster their careers. Investors have access to a primary and secondary market to buy into shares of copyrights which hold a solid track record and generate royalties regularly.

Technology startups in other creative sectors such as performing arts, visual art, museums or architecture are much more limited. This is likely due to the reliance in these sectors on public funding and grants.

⁵⁸ https://musicalblockchain.com/musicalblockchainwhitepaper.pdf
⁵⁹ https://bookrkids.com/ The publishing sector has witnessed the emergence of startups in the area of ebooks such as the Hungarian BOOKR Kids⁵⁹ that develops interactive books and applications for children, publishing houses, companies and educational institutions, and produces digital versions of fairy tales and stories previously only available in print.

Some startups also addressed the Covid-19 pandemic with new solutions. Level 8 in the Netherlands provides unique rave experiences at events by documenting the interactions between DJs, singers, fans through a reality TV series featuring electro-house with an online news content show to promote their music by allowing the public to get to see what is going on backstage. Another startup, Low-Fi is an online marketplace that brings music lovers together for intimate concerts in peoples very own homes. Currently, they are active in several cities including Copenhagen, Berlin, Paris, New York and Santiago. Their vision is to help create an open source and fair music scene that allows musicians, audiences and hosts to get to knoweach other on a much more intimate scale which benefits all parties.

3.3 International outlook – VC capital concentrated in the US

Internationally, venture capital investment in the creative industries has been highly concentrated in the United States, followed up by China. The respective EU27 investment is lower.

US startups have been more active that their EU counterparts in setting up key platforms ranging from games, music to films. In the US, the world of gaming has been disrupted by the emergence of Roblox a powerful platform and a YouTube-like ecosystem that offers rewards to its millions of user-creators. Roblox has raised a total of €270 m in funding over 8 rounds⁶⁰. Their latest funding was raised in February 2020 from a Series G round. Tencent Holdings from China is one of the most recent investors of Roblox.

The US gaming ecosystem boasts also more new networks and communities where gamers can interact. For instance Phovi is a Mobile Gaming Social Network set up in New York in 2019. The company connects users through texting, video calls during live game matches, communities of various subjects and a competitive global ranking⁶¹.

In the area of music tech, the US-based Mediachain connects media to its creator and is a protocol for registering, identifying, and tracking creative works online. It automatically resolves

⁶⁰ https://www.crunchbase.com/organization/roblox

⁶¹ https://www.crunchbase.com/organization/phovi

media to who made it, what its about, and where it originated using content indentification technology. Mediachain also lets creators, organisations, and developers collaborate on metadata in an open, universal media library and allows participants to retain control over their data while broadening their reach using a decentralised architecture.

Chinese gaming startups focus on mobile games and immersive gaming experiences. China's game industry is the largest in the world but it is structured very differently with a focus on mobile. China is also the largest international investor in AR/VR with the government heavily investing alongside the private sector. China's gaming industry is also subject to strict regulations. Chinese policymakers introduced a number of reforms and regulators must approve the game's content and issue it a license⁶².

⁶² https://www.china-briefing.com/

4. Skills supply and demand

Key messages

Within the registered professionals on LinkedIn and employed in the creative industries, **Augmented** and Virtual Reality related competences are the most relevant in terms of the number of professionals with these skills. AR/VR is followed up by **Cloud technologies** since moving content to the cloud offers more flexibility and new ways of collaboration, creation and distribution. **Artificial Intelligence** represents the third most popular advanced technology skillset.

When looking at the patterns of AI professionals employed in each creative industry segments, we find that it is the **video games industry that has by far the largest share of AI professionals** (2.79% of professionals employed in video games and with a LinkedIn profile have AI skills). It is followed up by design, newspapers, publishing, music and museums.

Based on the skills requirements listed in the jobs posted on LinkedIn by the European creative industries, the most demanded advanced technology related skills include AI, AR/VR and Blockchain.

4.1 Advanced technology skilled professionals employed in the creative industries

The nature of creative industries is characterised by rapid technological changes that requires an increasingly complex knowledge. Artists, designers, screenwriters, publishers need to acquire new competences and skills in order to be able to keep up with the pace of this change⁶³. Creative industries are at the forefront of applying new technologies and there is a high demand for professionals with advanced technological and digital skills.

As a result of digital transformation, users are overflooded with disposable content. In this world, the creative industry needs to be prepared for more problem solving and more originality and the ability to create and share in a sense `what's never been done before'⁶⁴.

The availability of professionals with advanced technological skills and employed in the creative industries has been analysed with the help of LinkedIn data⁶⁵. Figure 6 illustrates the general distribution of technological skills in the creative industries across all EU27 countries. Based on the analysis of LinkedIn ⁶⁶, the figure provides a picture of the supply of professionals with advanced technological skills relevant to the creative industry in 2020.

The following categories defined by LinkedIn have been taken into account in this analysis:

Architecture and planning

- Computer games
- Design
- Music
- Motion pictures and film
- News media (online media, broadcast media, media production, newspapers)
- Museums and institutions
- Visual art and Photography
- Performing arts
- Publishing, Writing and Editing

Figure 6: Share of skilled professionals employed in the creative industries as percentage of all advanced technology skilled in the industry, EU27, 2020



Source: Technopolis Group based on LinkedIn analysis

reports/advanced-technologies-industry-methodologicalreport ⁶⁶ To harvest the data from LinkedIn, keywords capturing

⁶³ Kamprath and Mietzner, 2015

⁶⁴ Brandon Philbrick, Creative Director at Leighton Interactive

⁶⁵ The full methodology of the LinkedIn analysis is available here:<u>https://ati.ec.europa.eu/reports/eu-</u>

⁵⁰ To harvest the data from LinkedIn, keywords capturing skills by advanced technology have been defined and reviewed by technology experts. Queries have subsequently been constructed to filter the database by location and industry.

Within the registered professionals on LinkedIn and employed in the creative industries, **Augmented and Virtual Reality** related competences are the most relevant in terms of the number of professionals employed in the creative industries. As discussed in the previous sections, AR/VR paved the way for several new immersive experiences especially in the gaming, film and design creative segments. One of the examples for the use of this technology has been the Pokémon Go⁶⁷.

The biggest employers of AR/VR skilled in the EU27 are mostly firms active in the video games creative segment such as Crytek in Germany, elite3d in Spain, Vertigo Games in the Netherlands, Bohemia Interactive in the Czech Republic and XReal Games in Hungary. Other type of creative industry firms with the highest number of AR/VR professionals include Platige Image in Poland and Green Pixel Production in Greece (see Figure below).

Figure 7: Top employers of AR/VR skilled professionals in creative industries in the EU27, 2020



Source: Technopolis Group based on LinkedIn data

AR/VR skilled professionals are employed in the highest number in the video games industry. 11.9% of professionals in this industry possess augmented and virtual reality competences. The film industry also boasts a relatively higher share of AR/VR skilled professionals. This also confirms the connection of AR/VR to visual content on the first place. Other creative industries employ far way less AR/VR skilled professionals (see Figure 8).





Share of AR/VR professionals in total industry professionals

Source: Technopolis Group based on LinkedIn data

AR/VR is followed up by Cloud technologies. Moving content to the cloud offers more flexibility and new ways of collaboration and creation. Cloud solutions are gaining importance in particular in the media industries as they enable creative companies to work more efficiently at distance. In the cloud, virtualised applications and servers allow to pool resources when needed and work in distributed teams. Among the creative subindustries it is video games, news media and publishing which employ the highest share of these professionals compared to their total number of employees. Cloud technologies are particularily important for the 'screen' industries (such as films and broadcast media) enabling the remote production and distribution of video content (included also under the category called 'News media').





Share of Cloud technology professionals in total industry professionals

Source: Technopolis Group based on LinkedIn data

Artificial Intelligence represents the third most popular advanced technology skillset. Creative professionals are using AI with the objective to revolutionise art, fashion, journalism, music and

⁶⁷ https://pokemongolive.com/en/



Figure 10: Artificial Intelligence skilled professionals employed in specific creative industries in the EU27, 2020

Source: Technopolis Group based on LinkedIn data

film. AI brings lot of challenges as it needs to be integrated into the creative workflow and applied in a way that it can enhance creative content. As it was found by a recent study⁶⁸, AI challenges the creative value chain in two ways: shifting services performed by humans to algorithms and empowering and enhancing the creative process.

When looking at the AI professionals employed in each creative industry segment, we find that it is the **video games industry that has by far the largest share of AI professionals** (2.79% of professionals employed in video games and with a LinkedIn profile have AI skills). It is followed up by newspapers, publishing, music and museums (see Figure 10). Among the EU27 countries Finland, Sweden and Ireland have the highest share of professionals employed in the video games and newspaper industries with skills in AI. Music is led by Sweden (also due to the importance of Spotify as a main employer), the film industry by Germany, architecture by Denmark and arts by the Netherlands.

Other advanced technological skills that are relevant for creative industries include **3D**

technologies as part of Advanced Manufacturing in particular in the case of video games.

The number of professionals with the Internet of Things (IoT) skills is highest in the design subindustry, as technology becomes embedded into new products.

Figure 11 displays the biggest employers of this talent across EU countries. Some of these companies are active in video games such as Ubisoft in France and Bulgaria, and Havok in Ireland. Others are related to television broadcasting such as RTV in Slovenia or Sky Italia and multi-media platforms such as Red Bull Media House in Austria. Spotify in Sweden is the largest employer in AI related to music. Postimees in Estonia is the largest media group.

⁶⁸ European Parliament, 2020

Figure 11: Top employers of AI skilled professionals in creative industries in the EU27, 2020



Source: Technopolis Group based on the analysis of LinkedIn data

LinkedIn data also allow the comparison of the creative industry professionals located in the EU27 and the US in terms of their skills profile. This is particularly interesting to compare, seeing the important role of the US in various creative segments. After taking the share of professionals with advanced technology skills employed in the creative industries (all segments together) within the total number of professionals in the industry, it can be observed that the **EU27 has a lower share of professionals in Cloud and AR/VR than the US** as depicted in Figure 12. The EU27 is, however, on a par with the US in the fields of Artificial Intelligence and Blockchain.





0,20% 0,40% 0,60% 0,80% 1,00% 1,20%

Share of AT professionals in total creative industry

Source: Technopolis Group based on the analysis of LinkedIn data

4.2 Demand for new skills - AI and Blockchain

After analysing the availability of technological skills in the creative industries, it is also important to look which skills have been the most common in recent hires. In order to measure this demand, the one-year growth rate of technological skills can be analysed by comparing the skills indicated in the status of December 2019 and December 2020.

Figure 13 visualises the advanced technological skills that showed growth within the last year in the EU27. Skills related to AI and Blockchain are on the top followed up by Big Data and Cloud technologies.

Figure 13: One-year growth of professionals with advanced technology skills hired in the creative and cultural industries (over the period of 2019-2020)



Source: Technopolis Group based on LinkedIn analysis

Figure 14 illustrates the general distribution of the one-year growth rate in technological skills as observed in the creative industries across all EU27 countries. Poland (+23%), Germany (+22%), Romania (+22%) and Italy (+21%) experienced the highest rise in the number of professionals in advanced technologies and employed in the creative industries. These trends have to interpreted with caution, since some countries such as Romania have a much lower number of creative industry professionals represented on LinkedIn and it is easier to observe higher growth rates.



Figure 14: EU countries ranked according to highest oneyear growth of AT professionals in the creative industries

Source: Technopolis Group based on LinkedIn analysis

Based on the skills requirements listed in the jobs posted on LinkedIn by European creative

industries, the most demanded skills include AI AR/VR and Blockchain skills (see Figure 15). Hiring demand is defined as the share of job ads published on LinkedIn and requiring the specific skill.

Figure 15: Hiring demand in creative industries, 2020



Source: Technopolis Group based on LinkedIn analysis

5. Future outlook: challenges and opportunities

5.1 Kick-start the recovery process

Although creative industries play a highly important role in the economy as providers of local, high growth services and quality employment⁶⁹, they have been highly impacted by the current Covid-19 pandemic. Given the fact that at the time of writing this report, most European countries are again in a lockdown (museums are closed, live events, concerts are not happening), it will be critical to explore how to adequetly digitise previously location-based experiences and the impact to creators and audiences.

A key challenge for policy will be to facilitate the emergence of innovative infrastructure and distributed knowledge for the creative industries. These must offer new opportunities to be enriched at regional and local level. Innovative business models such as micropayments, crowdfunding, streaming, Pay-Per-View, self-publishing, gamification will become even more relevant to offset the negative consequences of lockdowns.

With the aim to save cultural and creative industries, the European Investment Fund and the European Commission have launched new Covid-19 support measures under the Cultural and Creative Sectors Guarantee Facility to enhance access to finance for small and medium sized enterprises and small public enterprises in the cultural and creative sectors⁷⁰.

These new measures will incentivise financial intermediaries to provide more flexible terms and conditions in order to alleviate the resulting working capital and liquidity constraints caused by the Covid-19 crisis. EIF will provide guarantees and counter-guarantees to financial intermediaries to continue providing financing to the industry hit by the economic consequences of the coronavirus pandemic.

5.2 Reaching out to a digital audience

Another important challenge of creative industries is how to reach out to the new digital audience (as a trend reinforced by Covid) and to capture young

⁶⁹ https://www.creativityworks.eu/

people's interest in a positive and ethical way. Engaging new users requires not only the development of novel creative content but new ways to make this content accessible.

In this context, it is expected that cultural content will increasingly be marketed by relying on users data, retail and digital distribution in well managed release patterns.

5.3 Winner-takes-all and monopolisation

Digital technologies have not only benefits but several risks that should be tackled and mitigated. AI has the potential to exacerbate the 'winnertakes-all'⁷¹ phenomena and problems for artists looking to earn from their work. The automated production process will deflate the cost of producing creative work, which is in line with the deflationary effects of technology. Lowering the cost of the production of creative works in turn lowers the cost to consumers.

By introducing AI in the creative industries, a smaller number of AI producers and products are expected to become the winners and this will potentially reduce competition amongst AI producers and create a monopolised market for AI within the creative industries. The virtuous cycle of AI is a theory proposed by Professor Andrew Yan-Tak Ng whereby "the best products have the most users, and the most users usually means getting the most data, and with modern machine learning, the product becomes better."⁷² This is clearly beneficial to some companies who will in turn have less competition from other products, but what is the impact on creators?

A study in 2015 which looked at music sector in North America and 15 European countries found that while the number of new releases rose significantly since 2000 (due to lowering of production costs), and that cultural and creative content accessed and shared at unprecedented level (due to platforms and content aggregation services), revenues have not witnessed a similar peak and often have decreased⁷³. Reasons for retail revenue losses are connected to (digital) piracy⁷⁴, fragmentation of revenue sources and

https://www.eif.org/what_we_do/guarantees/news/2020/e uropean-commission-eif-announce-new-Covid19measures-under-cultural-creative-sector-guaranteefacility.htm ⁷¹ OECD, 2015

⁷² Andrew Ng, 2017

⁷³ JRC, 2015

⁷⁴ Film, TV series, recorded music and software are the European creative industries most impacted by piracy. They experiences retail revenue losses of €10 billion and losses of more than 185 000 jobs. See Building a Digital Economy: the Importance of Saving Jobs in the EU's Creative Industries (2010) Tera Consultants.

need for a fairer remuneration in the platform economy 75 .

Monopolies restrict the supply of goods and services to consumers and increase the barrier to entry for competing services and products. Consequently, in the absence of ethical business models or ethical economic policies, the benefit of AI could be limited to a small number of businesses with minimal benefit to consumers and other competing businesses. A further potential effect of "AI monopolies" is creative monocultures, where artistic expression is limited by the products monopolising the market.

5.4 Copyright

Copyright will be a further key challenge to be tackled in the case of creative industries. The issues with copyright and the attribution of ownership to art works generated by an algorithm raises many difficult legal and ethical questions⁷⁶:

- If the art produced by AI is in some way derived from hundreds, thousands or millions of existing art works, does the original creator of one of those works have any moral or economic rights to be attributed to the new work⁷⁷?
- If the work produced by AI is derived from a training set of existing art works, does the existing law prohibit the use of that training set in the absence of attribution or appropriate licencing mechanisms?
- How can artists legally deny and protect access to their work from AI art applications? How can businesses legally use and reuse existing art as training data?
- If an AI art produced work resembles an existing work of art, does it contravene the copyright of the original work of art? How can an algorithm be accused of copyright infringement?
- Who owns the copyright for an AI art produced work of art?

From a legal perspective, the last three years have witnessed an increasing ferment in the European copyright landscape, with the EU setting ambitious goals under the objective of the 'Modernisation of EU copyright rules'. As the European Commission identified, the EU "needs modern copyright rules fit for the digital age"⁷⁸.

Regulation is focused on the cross-border portability of online content services in the internal market in order to increase cross-border access to TV and radio programmes by simplifying copyright clearance and setting the important principle of 'country of origin' in the clearance or rights.

Another Directive on 'Copyright in the Digital Single Market'⁷⁹ proposes a wide array of crucial changes in areas such as copyright, access to content, fair and transparent remuneration.

These regulatory measures will have an important impact on the creative industries, in particular in the areas of improving the knowledge and dissemination of culture, the conservation and safeguarding of artistic creation, and in the promotion of innovation.

⁷⁵ Harvard University Press, 2020

⁷⁶ https://www.wipo.int/export/sites/www/aboutip/en/artificial_intelligence/call_for_comments/pdf/ind_cedi llo.pdf

⁷⁷ BOP, 2020

⁷⁸ https://ec.europa.eu/digital-singlemarket/en/modernisation-eu-copyright-rules
⁷⁹ https://eur-lex.europa.eu/eli/dir/2019/790/oj

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About the 'Advanced Technologies for Industry' project

The EU's industrial policy strategy promotes the creation of a competitive European industry. In order to properly support the implementation of policies and initiatives, a systematic monitoring of technological trends and reliable, up-to-date data on advanced technologies is needed. To this end, the *Advanced Technologies for Industry* (ATI) project has been set up. It provides policymakers, industry representatives and academia with:

- Statistical data on the production and use of advanced technologies including enabling conditions such as skills, investment or entrepreneurship;
- Analytical reports such as on technological trends, sectoral insights and products;
- Analyses of policy measures and policy tools related to the uptake of advanced technologies;
- Analysis of technological trends in competing economies such as in the US, China or Japan;
- Access to technology centres and innovation hubs across EU countries.

You may find more information about the 16 technologies here: <u>https://ati.ec.europa.eu</u>.

The project is undertaken on behalf of the European Commission, Directorate General for Internal Market, Industry, Entrepreneurship and SMEs and the European Innovation Council and Small and Medium-sized Enterprises Executive Agency (EISMEA) by IDC, Technopolis Group, Capgemini, Fraunhofer, IDEA Consult and NESTA.

