SHIFT

MetamorphoSis of cultural Heritage
Into augmented hypermedia assets
For enhanced accessibiliTy
and inclusion

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EXECUTIVE SUMMARY

This is the first iteration of SHIFT D6.2 Market analysis, business models, commercial sustainability and knowledge transfer, due in M6. The second and third iterations are timed for delivery in M18 and M36 respectively. As such, this version represents a broad preliminary overview of relevant market conditions, developments and potential opportunities among the SHIFT stakeholders. It draws mainly upon published information, together with contributions based on the current knowledge of relevant partners. This general perspective will be deepened and refined in the subsequent iterations of the Deliverable through a programme of investigation among stakeholders.

Europe's cultural heritage is one of the richest in the world. Advanced digitisation of cultural heritage assets and the reuse of such content can generate new jobs not only in the cultural heritage sector but also in other cultural and creative sectors. The COVID-19 pandemic has highlighted the strengths and vulnerabilities of the cultural heritage sector and the need to accelerate its digital transformation to make the most of the opportunities provided.

The SHIFT project will address the challenge of enabling cultural heritage access for wide international audiences affected by sensory impairment. The project relies on using digital technologies with the latest innovations in AI and ML to promote content transformation across visual-auditory-haptics-based interactive enhancement.

SHIFT aims to:

- Strengthen the use of digital technologies among cultural.
- Deploy Artificial Intelligence (AI) algorithms to enable contemporary interpretation and description of content and tools that allow easy access of cultural heritage assets to citizens experiencing sensory impairment.
- Increase the competitiveness of cultural and creative industries (CCI) in the internal market and internationally and provide opportunities for jobs creation.
- Explore the role of digital tools, such as 3D/4D simulations, virtual and augmented reality technologies in engaging with cultural heritage, and exploiting recent developments in the field of haptics.

The main toolkits produced will be: Visual; Auditory toolkit; Haptics; and IPR.

Initial markets for SHIFT have been identified as including solutions for CCI, cultural institutions, performing arts sector, professional content providers, the content consumer industries, gamification, and the public sector. Application areas concerned with online media access and distribution are also intended to be addressed. Potential opportunities identified for commercialising the project

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outcomes include (i) Cloud based software as a service (SaaS); (ii) Commercial software licensing; (iii) Royalties; (iv) Patents; (v) Freemium support; (vi) Internal exploitation

It is initially foreseen to make use of two contemporary business model approaches for SHIFT and its components: (1) As an integrated SaaS solution based on a freemium business model and (2) Following a component-based business model based on license fees through the partners' individual exploitation of results.

Among important initiatives with a clustering effect which SHIFT can advantageously engage with are:

- the Europeana Initiative (which is now the core operator of the Data Space for Cultural Heritage) incorporates a Network Association with 4000 members and represents a key cluster and potential avenue for SHIFT exploitation.
- The European Collaborative Cloud for Cultural Heritage (ECCCH) which appears likely to provide an infrastructural environment amenable to exploitation of the results of SHIFT.
- The recently founded Knowledge and Information Community on Culture and Creativity, funded under the European Institute of Innovation and Technology (EIT).
- Network of European Museum Organisations (NEMO) an independent network of national museum organisations which represents140-plus members speaking for over 30,000 museums across Europe and is potentially a further cluster which could assist SHIFT exploitation to cultural institutions and their users.
- The Horizon-CL2-2021-HERITAGE-01-04 project cluster of six projects, of which SHIFT is one, provides potential for identifying synergistic and complementary development of tools.
- The Recovery and Resilience Facility (RRF) through the National Recovery and Resilience Plans (NRRP) Member States.

The Creative Europe programme may provide a further channel for exploitation of individual results of SHIFT in the digital content and entertainment sectors.

The aim is that Haptics Industry providers will consider SHIFT tools for vulnerable groups and will generate business growth in their field through more demand for sensing devices and through using revitalized content for interactive CH environments. SHIFT will interact with EHS and other industry associations/stakeholders to communicate and enhance the exploitation of its results.

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The changing market demographics for assistive technology, including the aging population, present opportunities to inventors and a potential change of paradigm in the market share, with an increased number of end-users and more varied needs for assistive technology. As a result there are parallel product markets serving different user needs, preferences and settings which SHIFT can address in its own context.

Members of the Balkan Museum Network (BMN) – a partner in SHIFT - have been working on developing different haptic solutions for blind, visually impaired and disabled persons with other impairments (as well as children and all audience members interested in this way of interaction).

In conclusion, the findings of this deliverable summarise generally promising market conditions for exploiting the results of SHIFT with each of its four main target audiences. Between now and the second iteration of this Deliverable in Month 18, further investigation of the precise nature and extent of demand will be planned and carried out, enabling the future versions of D6.2 to provide clearer insight into the potential deployment of the tools and knowledge emerging from SHIFT and a roadmap for exploitation actions.

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Abbreviations and Acronyms

Abbreviation / Acronym	Description
AI	Artificial Intelligence
CCI	Cultural and Creative Industries
CH	Cultural Heritage

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CHI	Cultural Heritage Institutions
CRPD	Convention on Rights for People with Disabilities
DEP	Digital Europe Programme
EAF	Europeana Aggregators Forum
EC	European Commission
ECCCH	The European Collaborative Cloud for Cultural Heritage
EF	Europeana Foundation
ENA	Europeana Network Association
EU	European Union
GATE	Global Cooperation on Assistive Technology
GDPR	General Data Protection Regulation
IPR	Intellectual Property Rights
ML	Machine Learning
NGEU	Next Generation EU,
NRRP	National Recovery and resilience Programme
PWD	People With Disabilities
REA	European Research Executive Agency
RRF	Recovery and Resilience Facility
SaaS	Software as a Service
TRL	Technology Readiness Level
WHO	World Health Organisation
WIPO	World Intellectual Property Organisation

1. INTRODUCTION

1.1. SCOPE AND OBJECTIVES

This is the first iteration of SHIFT D6.2 Market analysis, business models, commercial sustainability and knowledge transfer, due in M6. The second and third iterations are timed for delivery in M18 and M36 respectively. As such, this version represents a broad preliminary overview of relevant market conditions,

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developments and potential opportunities among the SHIFT stakeholder groups in line with Task 6.4 Market overview on CH accessibility and tools for inclusion for wider community, new business models for CH content economy and growth. It is draws mainly upon published information, together with contributions based on the current knowledge of individual partners.

This general perspective will be deepened in the subsequent iterations of the Deliverable through a programme of investigation among stakeholders, beginning with the results of the survey being carried out in connection with Task 1.1 Stakeholder Requirements Study on Cultural Curation, Accessibility, Inclusion and Storytelling and refined as the characteristics and functionalities of the tools and solutions developed through the envisaged SHIFT process emerge more clearly alongside market needs

1.2. STRUCTURE OF THE REPORT

The report begins in Section 2 by providing overall contextual information about the cultural heritage sector in Europe, then by recounting the main objectives of SHIFT and their broad market orientation.

Following this, Section 3 gives an overview of characteristics of major initiatives affecting each target market segment defined by SHIFT, principally: cultural heritage institutions (CHI); digital content creators and entertainment; the haptics industry; and citizens and vulnerable groups.

Section 4 provides a case study description from SHIFT partner BMN (Balkans Museums Network) illustrating the findings from work done to date in using digital technologies for the benefit of people with disabilities.

Finally, Section 5 draws some overall conclusions from the findings in this document and outlines the further steps to be taken in developing it iteratively over the remaining versions due in Months 18 and 36 in order to realise fully its objectives as a Deliverable.

2. BACKGROUND

2.1. THE CONTEXT OF CULTURAL HERITAGE

Europe's cultural heritage is one of the richest in the world. Cultural heritage (CH) was recognised by the Council of European Union and the European Commission in 2014 as a strategic resource that not only should be preserved, but also leveraged as a driver of economic and social development. In this context, CH content contributes to the Digital Single Market, by providing copyright content protection, expertise and can connect businesses to communities of end-users.

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Cultural heritage is not only a key element in building a European identity that relies on common values but also an important contributor to the European economy, fostering innovation, creativity and economic growth. For example, cultural tourism represents up to 40 % of all tourism in Europe, and cultural heritage is an essential part of cultural tourism. Advanced digitisation of cultural heritage assets and the reuse of such content can generate new jobs not only in the cultural heritage sector but also in other cultural and creative sectors, including for instance the gamification and film industries. Cultural and creative industries contribute to 3.95 % of EU value added (EUR 477 billion), employ 8.02 million people and involve 1.2 million firms of which 99.9 % are SMEs

The COVID-19 pandemic has highlighted the strengths and vulnerabilities of the cultural heritage sector and the need to accelerate its digital transformation to make the most of the opportunities provided. Many cultural institutions incurred a major financial loss or had to close. Nonetheless, despite the financial challenges created by the pandemic, many also managed to retain or even expand their audiences by increasing their digital services (e.g. engaging with audiences, sharing collections, offering digital tools), demonstrating once more their high value to society and to the European economy.

Due to the Covid-19 crisis, the total number of people employed in cultural professions in the EU fell significantly from 2019 to 2020, by about 222,000 people, equivalent to 3.0 %. In 2021, the overall number rose back to the 2019 value. At the EU aggregated level, this recovery is registered both in absolute numbers (the total number of people employed in the field) and in relative terms (cultural employment as a share of total employment). However, at country level the picture varies.

In 2021, the socio-demographic profile of cultural employment in the EU did not differ much from that of total employment when broken down by sex and age of employees. Since 2011, the share of women in cultural employment has increased. In 2011, 3.63 million men and three million women were involved in culture related professional activities, with a gap of 0.63 million units. Ten years later the gender gap narrowed to 0.16 million, with 3.76 million men and 3.60 million women.

Among the people employed in cultural professions, 7.2 % had the lowest levels of educational attainment (ISCED 0-2), 32.2 % had upper secondary education (ISCED 3-4), and 60.4 % had tertiary education (ISCED 5-8). In total employment, these classes accounted, respectively, for 16.1 % , 47.1 % and 36.6 %, indicating a general higher level of educational attainment for the cultural field.

Besides the high share of tertiary educated workers, cultural employment is also characterised by a relatively high proportion of self-employment. This reflects the independent and specialised nature of many occupations in the cultural sector —

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for example, authors, performing artists, musicians, painters and sculptors, or craftspeople. In 2021, across the EU one-third (32 %) of the cultural workers were self-employed (compared with an average of 14 % in the whole economy).

In 2021, more than three quarters (77 %) of the cultural workers in the EU were employed on a full-time basis, four percentage points fewer than in the whole economy. This pattern can be seen in almost all EU countries, with the exception of Belgium, the Netherlands and Romania and could be explained, at least partly, by a number of cultural jobs being characterised by self-employment/freelancing and job flexibility. The share of full-time employment in the cultural field varied considerably between countries reflecting more general differences between national labour markets (e.g. the importance of part-time work), rather than specific characteristics of cultural employment.

2.2. SHIFT OBJECTIVES

The SHIFT project will address the challenge of enabling cultural heritage access to European citizens affected by sensory impairment. The project relies on using digital technologies with the latest innovations in AI and ML to promote content transformation across visual-auditory-haptics-based interactive enhancement.

SHIFT aims to:

- Strengthen the use of digital technologies among cultural institutions by offering scientific innovations that promote improved accessibility and inclusion for citizens experiencing sensory impairment.

- Deploy Artificial Intelligence (AI) algorithms to enable contemporary interpretation and description of historical records of cultural content and tools that enable easy access of cultural heritage assets to citizens experiencing sensory impairment.

- Increase the competitiveness of cultural and creative industries (CCI) in the internal market and internationally and provide opportunities for new and sustainable jobs creation.

- Explore the role of digital tools, such as 3D/4D simulations, virtual and augmented reality technologies in engaging with cultural heritage, by offering digital interactions for all citizens and exploiting recent developments in the field of haptics.

SHIFT will generate results across three technical workpackages which are thematically clustered into visual-auditory-haptics components for enabling efficient and effective interaction of cultural heritage assets.

The main toolkits produced will be:

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- **Visual toolkit**: the use of AI and ML algorithms will enable **automatic transcription** of the cultural heritage content. The toolkit will identify objects and actions, which will assist in transcribing the historical depictions at economies of scale.
- **Auditory toolkit**: the toolkit will deliver an **emotional response** to the audience by using advances in auditory synthesizers. Human-like correspondence will minimise the barrier for effective interaction of citizens affected by sensory impairment.
- **Haptics toolkit**: SHIFT will enable a haptics toolkit to experience **multi-sensory interaction** with digital objects. The novelty of the approach will depend on delivering haptic feedback to users, to emulate the feeling of touching a digital object.
- **IPR toolkit**: to bridge the gap between Open Access to cultural heritage content and the justified protection of digital native content, the SHIFT project will adopt international standards on copyrights and digital protection of derivative copyrights.

Initial markets for SHIFT have been identified as including solutions for CCI, cultural institutions, cultural clusters, performing arts sector, professional content providers, the content consumer industry, gamification and the public sector. Application areas concerned with online media access and distribution are also intended to be addressed.

Targeted messaging and communication/engagement are envisaged using appropriate channels in order to share innovations and outcomes promptly, while managing IP actively. Exploitation roadmap analysis will ensure the transition from technologies demonstrated in the relevant industrial environment (TRL 5-TRL 6) towards further investment required to become commercial solutions ready for market (TRL 9).

Potential opportunities identified for commercialising the project outcomes include (i) Cloud based software as a service (SaaS); (ii) Commercial software licensing; (iii) Royalties; (iv) Patents; (v) Freemium support; (vi) Internal exploitation.

It is initially foreseen to make use of two contemporary business model approaches for SHIFT and its components:

(1) As an integrated SaaS solution based on a freemium business model and.

(2) Following a component-based business model based on license fees through the partners' individual exploitation of results.

3. CHARACTERISTICS OF TARGET MARKETS

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The key target groups identified by SHIFT are:

- Cultural heritage institutions (CHI)
- Digital content creators, video and gamification industries
- Edutainment and educational sectors
- Haptics industry
- Citizens and vulnerable groups

3.1 CULTURAL HERITAGE INSTITUTIONS (CHI)

Europe's cultural heritage (CH) is one of the richest in the world. Cultural Heritage was recognised by the Council of European Union and the European Commission in 2014 as a strategic resource that not only should be preserved, but also leveraged as a driver of economic and social development. In this context, Cultural Heritage content contributes to the Digital Single Market, by providing copyright content protection, expertise and can connect businesses to communities of end-users. SHIFT will support wider adoption of its results across EU CH institutions. Community engagement will be advanced by enriching CH experiences by local museums, libraries and galleries.

Among important initiatives with a clustering effect which SHIFT can advantageously engage with are:

THE EUROPEANA INITIATIVE

Financed by the European Commission with the support of EU Member States Europeana has aggregated 52 million digital items of cultural heritage content since 2008, open to public access through the Europeana portal . The Initiative is run by the Europeana Foundation, as the operator of the core service, with a consortium of partners and in close collaboration with the Europeana Aggregators' Forum (EAF) and the Europeana Network Association (ENA). This collaboration creates a multiplier effect for the Initiative's many activities at European level. Together with work undertaken at Member State level, an ecosystem is created to support Member States' drive for digital transformation across the sector and across Europe, including 40+ aggregators (national and domain/thematic) which ingest metadata linked to content from over 4,000 Cultural Heritage Institutions (museums, libraries and archives). Alongside this ENA has around 4000 individual members from CHI, education, research, the creative industries and elsewhere, from every EU member state.

Under its most recent procurement contract within the Digital Europe Programme (DEP),Europeana is the core operator of the Data Space for Cultural Heritage. Within this, there is a special focus on Europe's digital transition. Europeana is contributing through:

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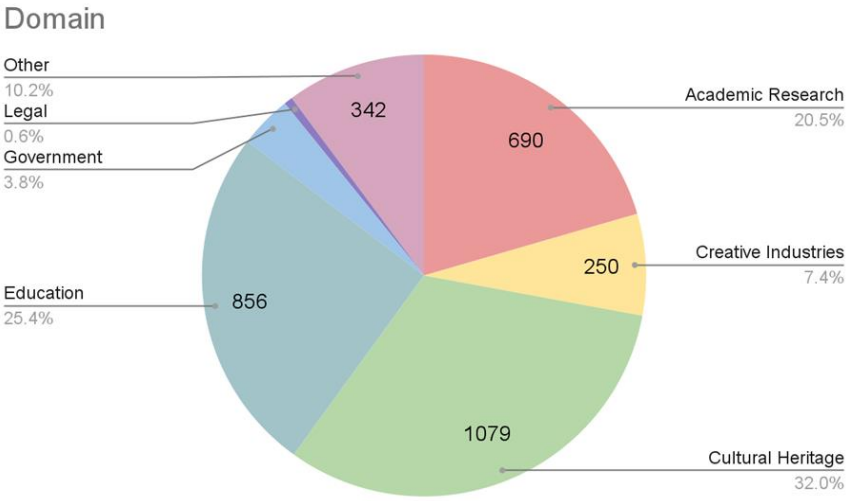
- empowering heritage institutions to develop leadership and capacity for digital transformation;
- offering tools, a network and events for heritage professionals to learn new skills, develop expertise and gain specialist knowledge;
- developing a training programme and resources which support participation in the common European data space for cultural heritage;
- and a strategy that guides the development of capacity building through the data space.

Europeana's priorities for action within the data space include exploiting 3D content and Artificial Intelligence.

As such Europeana represents a key cluster and potential avenue for SHIFT exploitation.

Fig 1. Europeana Network Association: members by domain



THE EUROPEAN COLLABORATIVE CLOUD FOR CULTURAL HERITAGE (ECCCH)

The ECCCH is a more recent initiative, launched in 2022 with a reputed 100 million Euros of funding, which is intended to join and mutually reinforce other past and future European initiatives such as Europeana/Data Space for Cultural Heritage.

This Cloud has the purposes to:

- help cultural heritage institutions to work with their digital objects more visibly and in a more interconnected way;

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- unlock the untapped potential of the sector by organising joint exhibitions, digitising artefacts, researching artworks, and documenting data;
- enable transdisciplinary and large-scale collaboration between specialists, who will be able to work in a highly professional digital working space using state of the art tools;
- generate new income for CHI by opening new opportunities for marketing and commercialisation, in particular of the digital dimension of the cultural heritage sector.

ECCCH appears likely to provide an infrastructural environment amenable to exploitation of the results of SHIFT, although its practical specification is still at a formative stage and services are not expected to be available until 2025. Nevertheless, SHIFT and the Horizon project cluster of which it is a member should maintain active contact with the initiative as it develops both through the Research Executive Agency (REA) and independently.

In December 2022, the European Commission published the results of a 'Stakeholders' survey; conducted between September and November, aiming to gather the views of cultural heritage stakeholders on the Commission's ECCCH initiative. A thousand detailed responses revealed high interest within the sector in a digital collaboration platform for cultural heritage. This provides a basis upon which the Commission will target support for the cultural heritage sector and prioritise the most useful types of tools.

Movable tangible heritage (books, documents, movable artworks, machines, clothing, etc.) is the type of cultural heritage that the most respondents (72.8%) worked with, along with 46.7% who work with immovable tangible heritage (buildings, monuments, etc.) and 42% with intangible culture (folklore, traditions, language, knowledge, etc. 15.3% worked with natural heritage and 7% with underwater heritage.

A need was felt among respondents for a clear strategy and plan on how the ECCCH will relate to existing infrastructures as well as to other existing initiatives at the local, regional, national, and international level.

For some respondents, it was important that any technology is always human-centred and that it augments but does not replace the work of a person. The importance of personalising tools and of accessibility and ease of use were manifest in the responses. Tools must be perceived as a service, developed together with together with the target users and tested at a large scale.

The ECCCH survey responses regarding types of tools needed ranked digital interaction highest, including those for:

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- creating, sharing and re-using interactive content on the Cloud (43.3%);
- AI-assisted metadata enrichment i.e. to make CH content interoperable (37%)
- advanced interaction with the digital content of the Cloud (36.4%);
- analysing, designing and testing interactions with visitors (33.6%).

A need for training on how to use the Cloud and in digital skills, alongside an active user community, appropriate IT equipment and support was also evident. Respondents pointed out several challenges and difficulties, for example, the lack of knowledge, information or understanding of the ECCCH initiative. The lack of a digital strategy among management is also a frequent concern both for those working either in a cultural heritage institution or in a private company along with the lack of available time, personnel and funds, especially among volunteer-led organisations. Respondents were also concerned about the potential obsolescence of current virtual reality/augmented reality experiences or services and the long-term sustainability of the projects after the end of funding.

The ECCCH activities will need to be complemented by other activities funded through EU programmes like Digital Europe, Creative Europe, the European Institute of Innovation and Technology (EIT)[1] and its recently founded **Knowledge and Information Community on Culture and Creativity**[2], together with the structural funds, in order to mobilise researchers and cultural heritage professionals at a European scale. Making available up-to-date IT equipment and broadband internet access to Cultural Heritage professionals at a broad scale throughout the European Research Area will be a prerequisite for the wide use of the Cloud by the sector, requiring mobilisation of all the available funds.

Among the ECCCH survey respondents (14.1%), who had participated in other European initiatives or research infrastructures, projects specified included those funded by the EU on digital cultural heritage, under Erasmus+ or under Horizon 2020,including such as: IMPACT Centre of Competence, Open Preservation Foundation, DataCite, Europa Nostra, MuSA Museum Sector Alliance, European School Education Platform, inDICEs, 4CH, PREFORMA, MIMO Musical Instrument Museum Online, IMI system, SKS Scientific Knowledge Services, LIBER, Baltic Sea History Project, JPI Cultural Heritage and various other European digital film restoration projects. These initiatives and projects may, to varying degrees, be seen as potential channels for SHIFT exploitation planning.

[1] https://eit.europa.eu/who-we-are/eit-glance
[2] https://projects2014-2020.interregeurope.eu/regionarts/news/news-article/14832/new-kic-on-culture-and-creativity/

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The NETWORK OF EUROPEAN MUSEUM ORGANISATIONS (NEMO)

NEMO was founded in 1992 as an independent network of national museum organisations representing the museum community of the member states of the Council of Europe. Together, NEMO's 140-plus members speak for over 30,000 museums across Europe. The network also includes museum networks as well as individual museums. NEMO ensures museums are an integral part of European life by promoting their work and value to policy makers and by providing museums with information, networking and opportunities for co-operation.

NEMO supports European museums in their aim to learn from each other by networking and co-operation and shows them ways to participate in the existing European cultural policies in its function as an information channel between European institutions and museums. Believing that museums are key players in safeguarding cultural heritage and central figures on the way for a better understanding within Europe, the network fosters European policies that help museums in fulfilling their role as keepers of cultural heritage by promoting their importance to European policy makers. **It is potentially a further cluster which could assist SHIFT exploitation to cultural institutions and their users**.

HORIZON-CL2-2021-HERITAGE-01-04[3] CLUSTER

This cluster of six projects, of which SHIFT is one, provides potential for identifying synergistic and complementary development of tools. A fuller table, provided by the Commission, contains further information on objectives, outcomes, validation/demonstration. TRL, technological areas, standards, events, publications and policies etc.

Table 1. Summary of projects cluster objectives

Area	MEMENTOES	PERCEIVE	PREMIERE	MuseIT	SHIFT	MEMORISE
Focus	Computer games and museums	Colours in CH	New ways of presentation for dance & theatre	CH accessibility for people w/sensory impairment haptics	CH accessibility for people w/sensory impairment visual-auditory-haptics UX	Digital memories Nazi persecution

[3] Horizon-CL2-2021-HERITAGE-01-04

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RECOVERY AND RESILIENCE FACILITY (RRF)

In 2020, as an immediate response to the pandemic crisis the EU institutions adopted a one-of-a-kind stimulus package, called Next Generation EU, (NGEU), to boost the recovery of the continent. The core component of this envelope, called Recovery and Resilience Facility (RRF) is channelled to EU Member States between 2021 and 2026 to better cope with the pandemic fallout and make European economies and societies more sustainable, resilient and better equipped for the green and digital transitions.

In the framework of the European Union's rescue plan Next Generation EU, which accounts for 806.7 billion Euro, 723.8 billion Euros have been designated to the Recovery and Resiliency Facility (RRF) for a five-year period, as a mixture of non-repayable grants and repayable loans. As a result of this choice and the actual requests coming from the Member States, however, the EU is mobilising a spending firepower which is of around 500 billion euros. However, many countries could still ask for more funds.

Following the call by the European cultural and creative sectors, and backed by the European Parliament, to specifically earmark at the very least 2% of each National Recovery and Resilience Programme (NRRP) for culture, at the time of preparation of the various national strategies between October 2020 and March 2021, coordinated joint actions and two open letters asked the EU Member States to ensure an explicit inclusion of culture in their NRRPs. 14 countries out of 261 - 53% of the total - have included culture in their NRRPs.

Analysis stemming from this indicates that at least 2% in the EU26 - i.e., around 12 billion euros - has been mobilised for culture. As a result of the mapping exercise performed, it is thought that, while the 2% figure has been met at an aggregated EU level, the majority of Member States either do not foresee any specific line for culture or lag behind this figure, standing at around 1% The 2% figure at the EU level has been boosted by the performance of a limited number of countries, such as Italy and France, with notable good practices represented, inter alia, by Czech Republic and Austria.

Despite some interesting exceptions, including by those countries which are supporting contemporary creation (France) and regeneration through culture (Italy) with EU investments, as well as the adoption of a Status of the Artists (Spain, the Czech Republic) as part of the reforms featured in their NRRPs, culture and cultural agents are still very much instrumentally perceived for their contribution to the economy rather than as values in themselves.

There are however clear indications that in some countries, investments from their NRRP have had a strong focus on innovations which may bear further investigation in the context of SHIFT exploitation.

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3.2 DIGITAL CONTENT CREATORS, VIDEO AND GAMIFICATION INDUSTRIES

Revenue in Europe's Digital Media market is projected to reach about €75bn in 2023. The market's largest segment is Video Games with a projected market volume representing more than half of this. In global comparison, most revenue will be generated in the United States (about €140bn in 2023)[4]. Rapid growth in the cloud-based video streaming market is driving the market growth.

The creative sector needs "fresh" and new content. The aim is that content creators will subscribe and adopt the SHIFT tools to create valuable CH content, creating new moving image content from existing stills with reliable long-term preservation. Cultural content will become more attractive to younger audiences, combatting its decline due to the digital era and invasive social media content. Augmented hypermedia assets will promote niche or "long tail" content which is produced by smaller content creators, and which would generally be overlooked in "mass consumption" content scenarios

(e.g., viral video on social networks), yet which needs this greater reach to achieve ROI.

The Culture strand of the Creative Europe programme supports a wide range of cultural and creative sectors including among others: architecture, cultural heritage, design, literature and publishing, music and performing arts. **Creative Europe aims to foster artistic creation and innovation support the promotion and the distribution of European content across Europe and beyond help artists find creation and performance opportunities across borders and stimulate the digital and environmental transition of the European Culture and Creative Sectors and may provide a further channel for exploitation of individual results of SHIFT.**

3.3 EDUTAINMENT AND EDUCATIONAL SECTORS

Video games are one of the most popular forms of culture in the twenty-first century, particularly among young generations (80% of Europeans aged 11-24 are video game players)5. Video games deliver experiences that enrich the everyday cultural lives of more than half of all Europeans aged 6-64, equating to approximately 250 million EU players . European cultural heritage is represented in an increasing number of games inspiring novel ways of understanding and interacting with digitised European cultural heritage, and enabling players to contribute to its enrichment. Video games

[4] https://www.statista.com/outlook/dmo/digital-media/europe

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therefore play therefore a relevant role in solving the EU's social challenges. Furthermore, European video games that include representations of European cultural heritage gain worldwide attention. Games are a powerful way to motivate and facilitate learning and a powerful way to make it more engaging. **There is a strong tendency in academic but also school teaching to convey cultural content via playful and immersive (XR) applications. This is potentially one of the most interesting markets for SHIFT tools,** supporting the project's objectives towards digital cultural content and Immersion (e.g., roleplaying).

3.4 HAPTICS INDUSTRY

Haptics are key technologies found throughout many different types of electronic devices today. They involve the use of actuators to stimulate the sense of touch and are used as part of the user interface in many diverse types of products (over a billion items per year). The technologies that first sparked interest in haptics are those related to remote handling, often in the context of hazardous environments or products. A variety of different markets now requires different types of haptic technologies which can potentially benefit people whose exploration is impaired due to a visual disability.

The aim is that Haptics Industry providers will consider SHIFT tools for vulnerable groups and will generate business growth in their field through more demand for sensing devices, due to existing innovative solutions. Revitalized content could be used for interactive CH environments, Virtual Reality (VR), Augmented Reality (AR) experiences, billboard advertising, brokers, etc.

Haptic technology, or haptics, is a feedback technology which takes advantage of the sense of touch by applying forces, vibrations, or motions to the user. Considered by type of feedback, the haptic technology market comprises of tactile and force feedback.

- Tactile feedback is essentially a physical response on a device from user input. It responds by creating a slight vibration, indicating that it properly registered the command. It is primarily used in smartphones, tablets, major appliances, or car navigation systems.
- Force feedback affects the ligaments and muscles through skin into the musculoskeletal system, whereas all other types of haptic feedback affect only our skin receptors. Force devices move together with a human and have an impact on large areas of the body such as an arm or a leg.

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By component, the haptic technology market comprises actuators, drivers & controllers, and software.

- Haptic actuators are used to implement the haptic vibration through magnetic field
- Haptic driver chips are used to control the haptic actuators
- Haptic software are integrated to generate the haptic feedback with the help of hardware components

By application, the haptic technology market is currently seen as mainly comprising consumer electronics, gaming, automotive, healthcare, and robotics

The global market size for haptic technology in 2019 was estimated at €6.67 billion in revenue. The haptic technology market size in Europe (including Western Europe, CIS and Central & Eastern Europe) in 2017 was estimated at €1.175 billion and is predicted to witness a high growth by 2026 due to rising consumer spending on technologically advanced consumer electronics devices [5].

Increasing utilisation of haptic in cars, mobiles, and IoT appliances are expected to achieve improved product design and operating accuracy which will boost the market growth. Consumers are increasingly spending on modern infotainment systems with simulated touchscreen displays for enhanced safety and driving experience in passenger cars and commercial vehicles. Several benefits provided by haptic, such as enhanced sound, touch, and visual effects in touchscreen devices are contributing to its wide adoption in the electronics sector. The vibration feedback provided by haptic technology aids users to improve touchscreen accuracy

The amplifying trend of incorporating haptic technology in gaming applications and augmented reality enabled devices is providing a positive outlook for the market. Gaming input devices, such as joysticks and operating consoles, incorporate haptic technology to create different levels of vibrations, enhancing the user experience.

The gaming sector is anticipated to witness significant growth through 2026 led by increasing adoption of mobile-based video games. Haptic technology integrated with gaming consoles and mobile gaming interfaces provides players with an enhanced real- life experience. Haptic enabled gaming controllers provide a sense of tangibility to several events in a video game,

[5] Global Market Insights. Haptic Technology Market (pre-publication draft), 2023

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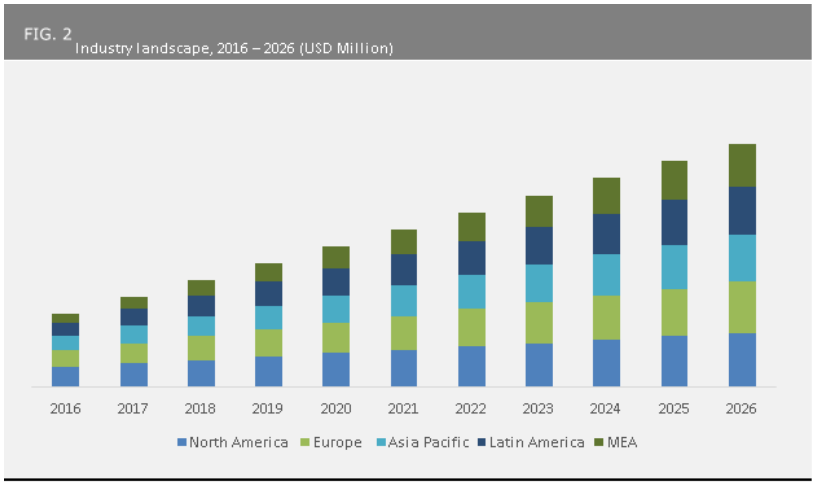
such as a crash or an explosion, providing robust growth opportunities for the market.

Fig 2. Global Market Insights. Haptic Technology Market Report, 2020



The EuroHaptics Society (EHS) was officially founded on July 2nd, 2006, in Paris, France. The purpose of EHS is to contribute to and promote the advancement of Haptics, all over the world, but with a focus on Europe, by suitable means. In particular by forming the official body organizing the EuroHaptics conference, by organizing other workshops and events on Haptics, by disseminating information about Haptics, and by establishing relations with other similar associations, national or international. **SHIFT will interact with EHS and other industry associations to communicate and enhance the exploitation of its results.**

3.5 CITIZENS AND VULNERABLE GROUPS

People living with impairments have long relied on new technologies for increased independence and fuller interaction with their world. From the invention of the crutch in ancient Egypt through the simple prosthetics of the Middle Ages to our latter-day Braille tablets, we are now on the cusp of a future where autonomous wheelchairs, mind-controlled hearing aids and wearables monitoring health and emotion alleviate the impact of human limitations. Innovators the world over have designed assistive technologies for people with specific needs. Many of these innovations will be adapted for use in a wider array of consumer products in the coming years. This means increased commercialisation of assistive technology applications for a wider consumer base .

This evolution toward mass use of assistive technology is set to expand this market. Currently, more than 1 billion people globally need at least one

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assistive product, a figure that is expected to double in the next 10 years as populations age and consumer electronics and assistive products converge. Even more people will benefit from assistive technology – such as wearables, customized solutions and connected and smart devices – as these technologies spread to the wider population through new consumer goods.

As with all innovations, access to assistive technology needs to become widespread and ensure no one is left behind. Globally, only 1 in 10 people currently have access to the assistive products they need. Global discussions and efforts towards increased access to assistive technology include implementation of the UN Convention on Rights for People with Disabilities (CRPD) and the work of the World Health Organization (WHO) to promote greater access to assistive technology through its Global Cooperation on Assistive Technology (GATE).

European citizens spend on average 1/3 of their waking time-consuming media in one form or another and European creative industries are dominated by small enterprises (micro-companies and freelancers represent 85% of companies in creative industries). SHIFT can have a significant societal and economic impact in this area.

Museums have taken measures to be more accessible and considerate of the needs of people with disabilities, for example by providing audio descriptions to accommodate people with visual impairments or by offering virtual tours benefiting people who are unable to travel. But much remains to be done to enable disabled people to enjoy their fundamental right to access cultural content in cultural institutions like museums on an equal basis with others. Creation of new automated content using technologies like 'Text to Speech", "Video to Text" and haptics sensing encourages vulnerable groups to engage in an innovative manner with CH content and promotes wider inclusion.

There is still a lack of data about the inclusion of people with disabilities, particularly on access to culture. According to the EC, 80 million people in the EU are affected by a disability ('long-term physical, mental, intellectual or sensory impairment') to some degree. As the population is ageing, the figure is expected to grow: by 2020, one-fifth of the EU population is expected to have some form of disability.

One in seven people between the ages of 15 and 64 has difficulties with basic activities, such as walking (4.2 % of women, 3.4 % of men), seeing (2.1 % of women, 1.8 % of men) or hearing (1 % of women, 1.3 % of men). Only 1 % - 5 % of literature is accessible to blind and visually impaired

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people. Three categories (blind and partially sighted people (estimated at 30 million by the European Blind Union); wheelchair users (estimated at 5 million) and deaf people (750,000 sign-language users according to the European Union of the Deaf) constitute almost half the whole population of people with disabilities. Despite the additional barriers they face, artists with disabilities make a creative contribution to cultural life.

The United Nations (UN) Convention on the Rights of People with Disabilities entered into force in 2011. It enshrined, among other rights, those of people with disabilities to access cultural venues such as theatres, cinemas and museums, and to enjoy cultural materials, books, films and music in an accessible format. It also highlighted the right of people with disabilities to participate in cultural life as both amateur and professional artists. The European Union, as party to the Convention, is committed to working on legislation, and implementing and promoting programmes and actions in favour of these rights.

The EU disability strategy is a step in this direction, also covering the cultural rights of

80 million people with disabilities in the EU. Various EU funds contribute financially to research and innovation, cultural and infrastructure projects, and programmes promoting the right to cultural life of people with disabilities within this framework.

In October 2018, the EU also ratified the Marrakesh Treaty, administered by the World Intellectual Property Organization (WIPO), to facilitate access to published works for people who are blind, visually impaired, or otherwise print disabled. The EU effectively became a party to the treaty as of 1 January 2019, committing to set mandatory limitations and exceptions for the benefit of the blind, visually impaired, and otherwise print disabled.

The European Parliament and its Disability Intergroup, established in 1980, promote the rights, including the cultural rights, of people with disabilities. The Intergroup has contributed to Parliament's legislative work and resolutions on relevant issues, such as the September 2015 resolution on an integrated approach to cultural heritage.

In its 2016 resolution on the implementation of the UN Convention on the Rights of Persons with Disabilities (CRPD), the European Parliament recognised that a disproportionate number of people with disabilities were left out of digital developments, missed information and could not access important services. It also stressed the right to full access to cultural performances and to audiovisual and other works with suitable subtitles or audio descriptions for people with disabilities.

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The European Accessibility Act, an EU directive adopted in March 2019, sets out rules on products and services accessible to people with disabilities and functional limitations, including electronic devices, websites and audiovisual media services. It addresses access to audiovisual media services such as broadcast television and related consumer equipment, TV equipment related to digital television services, e-books, and e-commerce.

EU funding programmes co-finance and promote projects centered on access to cultural life for people with disabilities. In 2016, the EU disability card was piloted in eight Member States: the card offers people with disabilities equal access and mainly free admission to cultural venues, a visual and audio guide, sign language tours and information geared towards the visually impaired, thus helping to overcome financial and physical barriers. The European structural and investment funds help to improve physical access to cultural sites and buildings. This is particularly important for old theatres or museums that need to adapt to the needs of wheelchair users.

The Horizon 2020 programme co-funded the successful Arches project on translation software and sign language avatars[6]. This allows deaf people to access information on works of art exhibited in museums using a computer database and animated sign language avatars. The Creative Europe programme has co-funded projects which enable audiences and artists with or without disabilities to enjoy the same cultural experience, together with those which support disabled artists who face additional barriers on their professional journey.

There is a large, unmet need for assistive technology worldwide. The Global report on assistive technology[7]€€ presents a comprehensive dataset and analysis of current assistive technology access, drawing the attention of governments and civil society to the need for, and benefit of, assistive technology, including its return on investment. Everyone is likely to need assistive technology during their lifetime, especially as they age. For some people there will be only short episodes of functional difficulties, for example after an accident or serious illness. People born with an impairment or functional difficulty may need longer periods using assistive technology, or even life-long use. There is evidence that the number of people needing assistive technology is growing worldwide with an increased need for interventions that support self-management, healthy lifestyles and rehabilitation, as well as to cope with the functional difficulties resulting

[6] https://commission.europa.eu/news/reas-arches-project-short-listed-horizon-impact-award-2020-09-18_en
[7] https://www.who.int/publications/i/item/9789240049451

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from these conditions. Circumstances change over time as technologies advance and needs, preferences and priorities evolve. Consequently, there is a continual need to update and replace assistive technologies. The report sets out ten recommendations for improving access to assistive technology, which in turn support the achievement of the Sustainable Development Goals, inclusive Universal Health Coverage, and alignment with the CRPD.

The market is shaped not only by demographics and the demand for consumer electronics, and the investment this attracts, but by legislation and policies. CRPD recognizes access to assistive technology as a human right, bringing with it state obligations and expected market influence. A new taxonomy identified in a recent study separates conventional assistive technology from emerging assistive technology and identifies nine "enabling" technologies which allow for the development of emerging assistive products, also exploring the technology readiness level (TRL) of the identified emerging assistive products filed for patent protection, to see how close they are to commercialisation, alongside overall trends. Its findings show that patenting activity in the area of conventional technology is nearly eight times bigger than that of emerging assistive technology, with 117,209 patent filings compared to 15,592. However, filings in emerging technology are growing three times faster than conventional. Most patent filings in conventional assistive technology relate to mobility, followed by the built environment, hearing and vision.

Assistive technology has traditionally been considered external to the human body and non-invasive. The field is now converging with medical technologies. Several emerging assistive products include implants and other products that would qualify as medical devices, with many of those moving beyond assistance towards augmentation or recovery of missing human functions. Data shows that emerging products are usually not replacing conventional assistive products but complementing them.

Analysis reveals that all identified emerging assistive products use one or a combination of several enabling technologies, such as artificial intelligence (AI), the Internet of Things, brain– computer/machine interface (BCI/BMI) and advanced sensors. These allow for smarter and connected assistive products which learn from the user's behaviour and environment, optimize and customize their functions and support independent living and navigation, telemedicine and smart nursing. The primary crossover disciplines in emerging assistive technologies are information technology, data science, materials science and neuroscience, while the overlaps with the consumer electronic goods market are mainly in the areas of communication, navigation and gaming. The convergence between

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disciplines, domains and markets increases the breadth of functionality of products for different user profiles and boosts the pace of innovation in emerging assistive technology.

The changing market demographics for assistive technology, including the aging population, present opportunities to inventors and a potential change of paradigm in the market share, with an increased number of end-users and more varied needs for assistive technology. Two-thirds of emerging communication filings relate to smart assistants. Areas of recent development with great potential are brain–computer interface-based control of devices and sensory substitution technology, As a result there are parallel product markets serving different user needs, preferences and settings which SHIFT can address in its own context.

However, these potential developments need to be discussed alongside ethical considerations around social exclusion, collection of and access to data and privacy, as well as issues related to intellectual property, particularly in relation to fast-paced developments such as artificial intelligence- or brain–computer interface-based products. New technologies bring with them new challenges in terms of data, privacy and intellectual property. Understanding these developments will help support continued investment in and use of assistive technology by identifying new opportunities for industry, providing guidance for developers and stakeholders and giving end-users the confidence to take up new assistive technologies.

New technologies bring with them new challenges in terms of data, privacy and intellectual property (IP). This is the case with assistive technology, as the development of emerging assistive products relies heavily on the use of enabling technologies. AI in particular solicits debate over patentability requirements and inventorship; as other enabling technology, such as brain–computer interface, develops further, similar or new IP-related questions may emerge. The unprecedented collection and use of data and the related insights it provides are essential to enabling technology but are not without challenges: data and privacy issues are more accentuated in the area of assistive technology, given the more vulnerable groups involved. The responsiveness of the IP system to these debates could in turn influence the speed of development of assistive technology and its commercialisation.

4. SHIFT CASE STUDIES

4.1 BALKAN MUSEUM NETWORK

Members of the Balkan Museum Network (BMN) have been working on developing different haptic solutions for blind, visually impaired and

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disabled persons with other impairments (as well as children and all audience members interested in this way of interaction). Its approach is based on the social model of disability that improves various aspects of the environment.

BMN has been investing effort in increasing access and inclusion in member museums for persons with disabilities (PWD). In order to determine how many members of the BMN use digital technologies to increase accessibility for this group, and the ways in which technologies have been developed and implemented, BMN conducted a survey in March 2023.

Ten museums stated that for their general audience, they offer some form of digital technology, whose users are also groups of PWDs Three museums (National Gallery of Bosnia and Herzegovina, Homeland Museum in Knjaževac and the Pavle Beljanski Memorial Collection) developed digital technologies specifically for these groups. Museums that participated in the research offer audio guides, forms of assistive technologies and accessible websites to the public. Most of the developed digital technologies in Balkan museums are intended for use in the museum space and outside with a free download of different applications. The devices on which these technologies are used include smartphones/tablets, PCs, and touch screen devices such as interactive panels.

For developing digital technologies and creating digital content based on collections, all the museums have achieved interdisciplinary forms of cooperation with the IT sector, rehabilitation and education sector and creative industries. Museums have achieved most collaborations with freelance IT experts, educators from associations dealing with the protection of PWD rights, defectologists, graphic designers and experts in 3D modeling. Expert teams are mostly small consisting of five external experts or less.

Most of the museums stated that the development of digital technologies and content was financed from international and national grants, while three museums partly co-financed the proceeds from the sale of tickets, souvenirs and museum publications. Most of the museums have invested over €10,000 in the development of digital technologies and required infrastructure.

Target groups of digital technology users in the involved museums include vulnerable groups of society, among which the largest are people with hearing impairments, visually impaired and blind people, elderly people, groups of migrants with diverse cultural and linguistic needs, and more rarely, people with developmental disabilities.

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Following the social model of disability promoted by BMN, most museums assess the needs of PWD and in various ways have involved them in the process of development, content creation and technology testing. The largest number of museums identified the needs of the target group by disseminating questionnaires to individuals with disabilities about sensory needs and preferred learning methods. Several museums disseminated questionnaires about the needs of PWD to educators, managers of associations, and parents/ guardians, while the remaining needs of individuals were determined through direct conversation.

The ways in which PWD were involved in the process of developing digital technology and content included verification of the ease of understanding of the language of textual interpretations of exhibits, selection of exhibits, and participation in technology tests. Only rarely are the representatives of the target groups authors of interpretations of content based on the museum's collection. It is very important that museums test digital technologies and their contents with target audiences of users when releasing the technology to the public. In this way, museums will be able to correct all possible technical shortcomings and see how users react to the content and how they connect with them.

The segment tested in the museum space is especially important for digital technologies which are exclusively intended for use outside the museum, because museum experts are given the opportunity to see how users connect with real exhibits presented in this form. In the context of testing technologies with groups of end users, the museums involved organised most activities in the museum's exhibition space. During these activities, some museums conducted observations through which they sought to determine the functionality of the technology, user reaction to content and social interaction among participants. Only one museum informed that it collected feedback online on the experience of using digital technologies outside the museum.

Museums with digital technologies offer a multimedia way of presenting a collection that is particularly suitable for different groups of PWD, since they provide opportunities to get the same content in different ways. This is one of the principles of universal design (for learning) that all the museums involved have adhered to.

For the presentation of content based on the collection, museums mostly chose the media of sound, animation, video, text written in easy-to-understand language, 3D visualization, with a smaller number choosing systems based on artificial intelligence with elements of augmented and

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virtual reality. Museums rarely incorporate gamification elements into their digital technologies.

Given the majority representation of museums with an encyclopedic type of collection in this research, the museums based the contents of digital technologies on a variety of exhibits: art, archaeological, historical objects and specimens of flora and fauna. The presentation of museum exhibits in a particular medium at all museums was accompanied by written information about the exhibit. Museums have also offered this information to end users through easy-to-understand language with the use of the appropriate font, font size and appropriate contrast. For this purpose, some museums have implemented software for converting text into sound and other interactive digital tools.

All the museums involved in the research claimed to have promoted digital technologies to associations dealing with the protection of the rights of PWD in their communities. Also, many have confirmed that they are continuously carrying out additional activities for target groups of digital technology users in a museum's exhibition space. In this way, museums will provide vulnerable groups of society such as PWD with additional opportunities for social inclusion. The museum' efforts to include minority groups in its work through additional activities with the help of digital technologies that reduce barriers in the collection will initiate democratisation processes that will increase their role in society.

The research also sought to determine whether museum experts disseminate their experience in the process of development and use of technologies with target groups through scientific research work, participation in regional and international conferences, etc. Given that the main goal of the BMN is to connect museum experts, it believe it is important that positive museum practices in digital accessibility of the PWD collection are shared among museum experts.

Respondents listed the following conferences and platforms where they shared their experiences:

- International Conference "Culture of Diversity: Underrepresented and Vulnerable Groups in Culturally Diverse Space" organized by the Typological Museum in Zagreb.
- Publications of national committees of the International Council of Museums (ICOM).
- Online articles of the ICOM platform for sharing experiences among museum experts in the magazine "ICOM Voices".

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- "Balkan Museums Without Barriers" regional seminars organized by BMN.

Examples of good practice of members of the Balkan Network of Museums include the following case descriptions.

Digital Android and iOS app "Takeaway Museum: A Museum for All"
Homeland Museum in Knjaževac
Release date of the app to the public via Google Play Store: November 10, 2020.
Number of users who have installed the app via GPS: 10+

The application is intended for use outside the museum for the purpose of presenting the collections that the museum keeps. The app was developed for the general audience with taking into account the needs of people with different forms of disabilities. Its purpose is to introduce users to the museum institution and its contents, especially vulnerable groups of society, such as children in hospitals and other social institutions, users of centers for the elderly and students in rural areas of Serbia. The app is designed according to the principles of universal design and easy to understand language. As interpretive digital tools, the application offers 3D visualization, sound description, video content, text use and interpretation of content in sign language.
The application was created in cooperation with the Homeland Museum in Knjaževac and the ArchiMedia Group of the Mathematical Institute of the Serbian Academy of Sciences and Arts.

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Digital form of assistive technology **"ARTsee"**
National Gallery of Bosnia and Herzegovina
Release date of the app via Google Play Store: February 05, 2021.
Number of users who have installed the app through the Google Play Store: 100+
The application was created with the intention of offering the target group of people with developmental disabilities (autism spectrum, Down syndrome and intellectual impairments) alternative ways of interpreting the exhibits of the art museum. "ARTsee" can be used outside the museum, but also in the museum space where the user is offered interpretations of a certain work of art in three different media: animation, sound and easy-to-understand text through a QR code scanning. Textual content is available in three different levels of intelligibility and in three languages (Bosnian, English and Greek). The textual contents were verified by representatives of the target group from the association "Oasis". In the context of using the app outside the museum, digital technology offers the user a selection of museums, exhibitions and individual works/exhibits that can be accessed through the 3 specified media.

What makes this application special is the existence of a user interface intended for museum experts who can modify and add museum content as needed. This feature makes "ARTsee" an online platform that can be joined by museums that want to make their exhibits more accessible to people with developmental disabilities. So far, parts of the collections from three museums have been adapted for this group: The National Gallery of Bosnia and Herzegovina, City Gallery Korinthos (Greece) and Museum of Sarajevo (annex Brusa bezistan). The application was tested with control groups of respondents in the museum space, where observations were made of manipulation of tablets by users, understanding of the developed technology, and user reaction to digital content and original works in the space on which the contents are based. During this process, observations of social interaction among the participants of the activity were also carried out. During the COVID-19 pandemic, the application offered children with disabilities accessible digital content of non-formal-educational character based on the museum collection. Parents/guardians of the target group were provided with instructions for using the application: connecting visual and sound content and reading text content with the child or for the child. The digital contents and the technology itself proved to be very interesting for typical children of younger age. In 2020, ARTsee was nominated for the annual international SALTO Award in the digital transformation category.

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4.2 HAPTICS IN ROMANIA:MAKING MUSEUMS ACCESSIBLE

In recent years, haptic technologies and innovative solutions for the visually impaired have been in full development. One such example is the **Tactile Images project,** which focuses on making the heritage of museums and other cultural institutions accessible to the visually impaired.

Another important operator in the field of cultural accessibility for people with visually impairments, is The Urban Development Association (known in the market as the Tactile Images brand). This organization has initiated and implemented numerous projects to facilitate the access of visually impaired or blind people to the museum heritage.

An example of impact in the Romanian cultural environment was the collaboration with the Museum of Old Maps and Books, which consisted in making maps accessible for the blind, these being translated into Braille language. This project allowed visually impaired people to explore maps and understand the geographic and historical context.

"**Feel the Art**" " and "**Feel the Art on the Road**" are two innovative projects that have changed the lives of visually impaired or blind people, bringing art and culture closer to these people. Through these projects, Tactile Images has developed materials and technologies that allow visually impaired people to experience and understand different works of art and museum exhibits.

The virtual assistant Tactile Images Reader[8] facilitates access to works of art and museum exhibits for the visually impaired. Through a smartphone camera, it detects the position of the finger on the touch image and provides contextualized audio information, replicating the experience of a human curator. This system of artificial intelligence and multimodal data processing enables a better understanding and accessibility of museum heritage.

Tactile Images collaborates with developers and software integrators to implement accessibility solutions. Technologies used include artificial intelligence, machine learning, multimodal data processing, digital content transformation, semantic representation, linguistic analysis, and haptic interfaces.

Using AI and linguistic analysis, Tactile Images has developed systems that allow curators to create detailed descriptions and explanations of museum exhibits tailored to the needs of the visually impaired. These descriptions can then be integrated into the Tactile Images Reader app to provide a personalized and accessible museum visit experience.

[8] www.tactileimages.org

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Tactile Images focuses on creating materials and tools to facilitate access to museum heritage and other cultural resources for the visually impaired. This includes developing tactile images, audio guides, and other resources to enable these individuals to experience and understand artworks and museum exhibits in a way that is tailored to their specific needs.

By promoting equal access to cultural resources and by encouraging the participation of visually impaired people in cultural activities, Tactile Images contributes to the creation of a more inclusive society. The "Feel the Art" and "Feel the Art on the Road" projects represent good organizational practices that contribute to the elimination of barriers faced by people with disabilities in accessing cultural heritage elements.

Tactile Images uses technology and innovation to develop creative **storytelling** methods that enable visually impaired people to explore and understand the context and meaning of artworks and museum exhibits. By combining tactile and audio information, Tactile Images Reader provides an immersive and accessible experience for all visitors to museums and cultural institutions.

Accessibility and inclusion in the cultural field are imperative to ensure the equal participation of all people, regardless of their abilities. Through the use of haptic technologies and innovative solutions, Imagini Tactile aims to change the way visually impaired people interact with cultural heritage and create a more inclusive and accessible world for all.

The Tactile Images Reader project started in 2013 with the aim of facilitating the access of visually impaired people to cultural heritage. Over the years, the team has developed an MVP product that has reached 150 countries and collaborated with partners such as Microsoft Romania to integrate advanced technologies such as ChatGPT, DALL-E and NLP processes. These integrations will improve communication between the user and the virtual assistant, providing more relevant and contextual responses and information, and facilitate the creation of accessible tactile materials for the visually impaired.

Tactile Images Reader is based on a number of advanced technologies and concepts, including AI, machine learning, multimodal data processing, digital content transformation, semantic representation, linguistic analysis and haptic interfaces. These technologies allow the virtual assistant to provide an adapted and personalized experience for the visually impaired, facilitating access to works of art and museum exhibits in a completely new and inclusive way.

The scalability of the Tactile Images Reader solution offers great potential for the future transformation of how visually impaired people interact with cultural heritage. By adopting and integrating advanced technologies, Tactile Images

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Reader demonstrates a strong commitment to innovate and improve accessibility and inclusion in the cultural field.

The Urban Development Association team and the Access2Accessibility Movement have developed other projects aimed at improving access and inclusion in the cultural field for visually impaired people. Among them are the projects Simte Arta and Simte Arta la Drum, which have had a positive impact on the lives of these people, giving them the opportunity to experience and enjoy cultural heritage in a way adapted to their needs.

The educational platform is another important effort towards improving access and inclusion in the cultural field. The platform provides educational resources and tactile materials for people with visual impairments, as well as information and support for professionals and institutions working in this field. This project contributes to raising awareness and promoting accessibility solutions in the educational and cultural community.

Tactile Images Reader and the associated projects represent a powerful combination of innovation and social impact in the cultural field. By improving accessibility and promoting inclusion for people with visual impairments, these projects contribute to creating a more equitable and diverse society.

5. CONCLUSIONS AND NEXT STEPS

The findings of this deliverable summarise a generally promising market and relevant potential for exploiting the results of SHIFT for each of its main target audiences: cultural heritage institutions; digital content creators and entertainment, the haptics industry; and citizens and vulnerable groups. A large majority of the respondents to the initial version of the SHIFT user requirements questionnaire survey (D1.1) find their experiences with digital technologies across CH institutions good ones (77%) and CH content engaging (78.4%).A wide range of technology applications (of the kind envisaged by SHIFT) are seen as being capable of improving the interaction of citizens with European culture, together with increased accessibility and inclusion.

Between now and the second iteration of this Deliverable in Month 18, further investigation of the precise nature and extent of demand will be planned and carried out, enabling that version of D6.2 to provide clearer insight into the potential deployment of the tools and knowledge emerging from SHIFT within the target user sectors and a roadmap for exploitation actions.

Along with that, in terms of scientific research communities, 56.6% of the respondents to the ECCCH consultation survey, had never participated before in any related European initiatives or research infrastructures (almost one third of the respondents have participated in Europeana, while some had participated in

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the pan-European digital research infrastructure for arts and humanities scholars (DARIAH) (11.4%), TimeMachine (5.1%), CLARIN (4.3%), EOSC (3.8%), E-RIHS (3.3%) and GAIA-X (0.7%), indicating that there remains a lot to be done to raise awareness and transfer knowledge of research needs in SHIFT's fields of activity, not least the role of inclusion by design methodologies in this area. Similar is likely to be true about many public policy organisations and those organisations who set out to promote inclusion.

By the time of the final version of D6.2 in Month 36, a better data- and empirically-based understanding of the market, feasible business models, value chains and their commercial sustainability, drawing on the use-case demonstrations in WP5, will become available. All of this is likely to require further segmentation of users and their needs, including the adoption of digital transformation strategies in practice and the extent of the power of SHIFT tools and algorithms to revitalise historical and cultural high value content and to enriching user experiences for interaction with cultural assets. Finally, we expect that the progressive iteration of work underlying the iterative versioning of this Deliverable (of which this version is the inception stage) will lead to allow the further identification of investors and strategic partners and to a model for baseline measurement of economic impacts.

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