i-Game

Building a community for the co-creation of games with high impact on innovation, sustainability, social cohesion, and growth

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D2.1
Research Report v.1

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Abstract

This deliverable reports on the methodology and outcomes of the desk and field research implemented in *T2.1 Design of the research framework* and *T2.2 Context and needs analysis.* The established research framework defines the relevant target group, identifies the relevant research areas, and establishes the main methodology and implementation timeline for the research. The analysis establishes the context of use and needs of each main target group, employing both top-down (desk research) and bottom-up (e.g. field research - interviews, focus groups, surveys). The desk research focused on 9 research areas which comprehensively cover the gaming landscape. In the field research activities, a total of 158 stakeholders were engaged in order to collect firsthand insights and contextualize the analysis. The main findings focus on: why each TG in interested in videogames and gamification, how to they feel about such technologies and their sector readiness to adopt them (including facilitators and obstacles), which are their requirements from the games, for which target groups they want to build them, which groups/communities should be considered more when creating

new digital products, and which are the best practices in their domain. Further research results from the T2.2 activities will be reported in the updated version of this report planned at month M26 of the project.

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Executive Summary

This deliverable reports on the methodology and outcomes of the desk and field research implemented in *T2.1 Design of the research framework* and *T2.2 Context and needs analysis.*

Chapter 2 is dedicated to the presentation of the research framework established in *T2.1 Design of the research framework*, including details on the objectives of the research activities, the definition of the relevant stakeholders and target groups, the identification of the main research areas relevant for the targeted comprehensive analysis of the gaming landscape, the preliminary establishment of the research methodology and data collection tools, the timeline and data analysis plan, and the relevant legal and ethical consideration for the implementation of the planned research activities.

Chapter 3 is dedicated to the presentation of the desk research outcomes for the identified relevant research areas, including: (i) innovative technologies, games and good practices for culture and museums, and similar CCI stakeholders; (ii) innovative technologies, games and good practices for the textile and fashion industry, and similar sectors; (iii) innovative methodologies, approaches and practices around games for creativity, lifelong learning and inclusion; (iv) game co-creation, design and management - frameworks, platforms and tools; (v) gamer experience; (vi) game accessibility; (vii) policy, legal and ethical frameworks for game co-design; (viii) impact assessment methods and metrics in Serious Games (SGs) projects; and (ix) financial support for serious games projects and game co-creation initiatives. The outcomes of the desk research are analysed in order to establish the context and needs of the various stakeholder groups, with direct interest in using the iGame platform or demonstrators. The analysis showed that video games are positioned as transformative tools for enhancing visitor engagement in museums and cultural institutions. Challenges include funding constraints, digitization complexities, and the need for collaboration between museums and game developers. Successful integration relies on creating cost-effective, educational, and historically accurate games. The textile and fashion sectors can leverage gamification and digital tools to promote sustainability, creativity, and efficiency. Games and virtual experiences are being used to enhance consumer awareness of ethical practices, while technology integration drives innovation in design and production.

Chapter 4 is dedicated to the presentation of the field research methodology and outcomes for the 4 stakeholders groups considered for the Phase I of the field research activities, namely Museums and similar CCIs institutions and professionals (TG1), Textile and fashion industry professionals (TG3), Game co-creators (TG6) and Game industry (TG7). Similar to the desk research outcomes, collaboration across domains emerges as a critical factor for success, as interdisciplinary partnerships can address resources and skill gaps while fostering innovation. Also, the main challenges in adoption of games and advanced technologies are related to the financial constraints, resistance to change and lack of technical expertise. This creates an opportunity for the i-Game platform and ecosystem to support partnerships between museums, fashion professionals and the gaming industry to foster mutual growth and social inclusion.

Chapter 5 presents the results of the synthesis of the desk and field research outcomes for TG1 and TG3, the main stakeholder groups with direct interest in the iGame project in adopting games and gamification to build new products/services in order to promote culture and inclusive participation. The analysis provides insights in regard to their needs from games, and the context of use (e.g. why and for whom they need games, which are the main barriers/facilitators for adoption and use of such technologies, etc.). The research highlights the transformative potential of the i-Game platform in promoting co-creation and inclusivity of videogames in the cultural context, and sustainability and circular economy for the fashion industry. Stakeholders value games for their ability to engage, educate, and innovate. However, accessibility and ethical considerations are critical for broad adoption, and collaboration between sectors is essential for addressing challenges and maximizing impact.

The finding presented in this report provide ground knowledge and information to guide the future design and implementation activities, both for the co-creation platform (WP3 and WP4) and for the demonstrators that will be piloted in WP5.

Abbreviations and Acronyms

AI	Artificial Intelligence
APXs	Accessible Player Experiences
AR	Augmented Reality
APX	Accessible Player Experience
CCIs	Cultural and Creative Industries
CCS	Creative Sectors and Industries
CBA	Cost-Benefit Analysis
DMA	Digital Markets Act
DSA	Digital Services Act
ESRB	Entertainment Software Rating Board
F2P	Free-to-Play
GDPR	General Data Protection Regulation
Gen AI	Generative Artificial Intelligence
GGJ	Global Game Jam
GLAMs	Galleries, Libraries, Archives and Museums
HCI	Human-Computer Interaction
HEFA	European Fashion Heritage Association
ICT	Information and Communication Technologies
IP	Intellectual Property
IT	Information Technology
KPIs	Key Performance Indicators
LCA	Life Cycle Assessment
LIME	Local Interpretable Model-Agnostic Explanations
LLM	Large Language Model
LBG	Location Based Game
MCA	Multi-Criteria Analysis
mLBG	mobile Location-Based Game
MR	Mixed Reality
MuQAR	Multimodal Quasi-AutoRegression
NPC	Non-Player Character
NVGP	Non-Video Game Players
PAM	Precaution adoption model
PEGI	Pan European Game Information
RA	Research Area
RGB	Red Green Blue
SDT	Self-determination theory
SG	Serious Game
SHAP	SHapley Additive exPlanations
SIA	Social Impact Assessment
SROI	Social Return on Investment
STT	Speech-to-Text

T&C	Terms and Conditions
TG	Target Group
TG1/ MCCIs	Museums/CCIs institutions and professionals
TG2/ MCCIs Users	Museums/CCIs visitors/customers
TG3/ T&F	Textile and Fashion industry and professionals
TG4/ T&F Users	Textile and Fashion customers
TG5	Game Players
TG6	Game co-creators
TG7	Game Industry
TG8	Citizens
TG9/PMs	Policy Makers
TG10/ SMEs	Small and Medium-sized Enterprises
TG11/ HEIs	Higher Education and Research Institutions
TG12/ SEOs	Social Economy Organizations
TTS	Text-to-Speech
UI	User Interface
UNCRC	United Nations Convention on the Rights of the Child
UX	User Experience
VR	Virtual Reality
VGP	Video Game Players
VICTOR	Visual InCompatibility TransfORmer
VR	Virtual Reality
WCAG	Web Content Accessibility Guidelines
WIPO	World Intellectual Property Organization
WP	Work Package
W3C	World Wide Web Consortium
XAI	Explained AI

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1 INTRODUCTION

The **i-Game** project represents a ground-breaking initiative within the European cultural and creative sectors and industries (CCSI), focusing on the innovative intersection of gaming and societal impact. At its core, i-Game aims to establish an open-source platform to facilitate the co-creation of video games by diverse stakeholders, spanning cultural organisations and museums, fashion and textile industry professionals, game creators, and the gaming community. This endeavour not only addresses the pressing need for innovative approaches in game development but also seeks to harness the transformative power of games to foster social cohesion, sustainability, and economic growth within the European Union. Unlike traditional game development initiatives that primarily focus on entertainment or profitability, i-Game emphasizes the co-creation of games to drive societal change, addressing a notable gap in the European gaming industry's contribution to cultural and social innovation.

The importance of the i-Game project lies in its potential to revolutionise the way video games are conceived, developed, and used, pushing beyond entertainment to effect meaningful societal change. This builds on the high relevance that video games currently have in society, since as an interactive art form they redefine entertainment and are a significant cultural force, shaping art, storytelling, and interactions. On one side, they serve as a medium for creative expression, reflecting societal values and technological advancement, and on the other side they foster community creation and have the power to influence society development (e.g. impact on education and mental health, influence fashion, bridge cultures and generations, etc.). As the gaming industry increasingly explores themes of social responsibility and inclusivity, the i-Game project builds on this momentum by democratizing game development through open-source tools, setting itself apart from commercial counterparts. For example, museums that currently lack the technical expertise to integrate interactive digital content can leverage i-Game's platform to co-create engaging, culturally rich gaming experiences, distinguishing it from platforms designed for mainstream developers.

By enabling collaboration among various actors within the CCSI, i-Game aspires to democratise game development, making it accessible to a broader spectrum of individuals and entities. This inclusivity is pivotal, as it brings together unique perspectives and expertise, fostering a rich environment for innovation and creativity. The project's objectives are strategically aligned with the broader goals of enhancing innovation, encouraging social inclusiveness, and promoting sustainable growth within the EU's digital and cultural landscapes. While global initiatives like UNESCO's Games for Change focus on advocacy and awareness, i-Game takes a step further by providing tangible tools and frameworks to enable grassroots co-creation, particularly within the diverse cultural landscape of the EU.

The desk and field research underpinning i-Game activities is critical for laying the groundwork for subsequent experimentation and implementation across the three pilot countries. Through the context and needs analysis foreseen in T2.2 of WP2 the consortium aims to assess the current state of game development and utilisation within these diverse cultural contexts, identifying specific needs, opportunities, and challenges, and addressing the several stakeholders involved in the project. Early findings indicate that cultural organizations in the pilot countries face significant barriers in accessing cost-effective game development tools, a challenge that i-Game directly addresses. Thus, this foundational research is essential for establishing the context of use and user needs to guide the development of a platform that is robust, versatile, and capable of meeting the varied demands of its users. The main research questions are:

(1) Why do stakeholders from cultural and fashion domains need games, gamification?
(2) What requirements they have from such technologies in order to integrate them in their business?
(3) Which are the main facilitators and obstacles for adoption of such technologies?
(4) Which are the main challenges to co-design games and whom they would like to involve?
(5) Which technologies and tools have proved to work for culture, museums, and fashion industry?
(6) What tools and functionality are needed to facilitate the co-creation process?
(7) How do end-users (e.g. museum visitors, fashion customers, game players) perceive

videogames and what is needed to make the video games inclusive and accessible?
(8) Which are the policy, legal and ethical aspects that should be considered during the video game co-design and when exploiting artificial intelligence in game co-creation?
(9) How do we assess the impact of such technologies?
(10) How could non-profit game co-creation initiatives be funded and sustained?

These questions guided the definition of the Research Framework, including the selection of the relevant Research Areas for the desk research and the definition of the questions that were used in the Interviews and Focus Group discussions with the potential users of the co-creation platform.

1.1 Purpose, Scope, and Structure of the Document

This deliverable, *D2.1 Research Report v.1*, reports on the methodology and outcomes of the activities implemented in *T2.1 Design of the research framework* during the project months M1-M6, and *T2.2 Context and needs analysis* during the project months M5-M12.

T2.1 Design of the research framework was dedicated to the definition of the framework for the research activities for the entire duration of *T2.2 Context and needs analysis.* This included definition of the guidelines, preparation of templates for information collection, and schedule of the activities in alignment with the needs of other project tasks.

T2.2 Context and needs analysis is dedicated to the implementation of the desk and field research activities which support the project to analyse the context of use and stakeholders' needs scientifically and comprehensively in relation to the targeted platform and demonstrators. The consortium used a mix of top-down (desk research) and bottom-up approaches (field research, i.e., interviews and focus groups) to comprehensively investigate the field. Desk research synthesizes broader scientific knowledge and insights from international, European, and national case studies, providing a foundational context. Complementarily, field research focused on capturing localized and stakeholder-specific knowledge, experiences, and specific circumstances particularly in the piloting countries, to ensure the research reflects both overarching trends and specific, on-the-ground realities. The interdisciplinary nature of the project imposes the need to consider a wide variety of topics, in particular in regard to the desk research, including game technologies and experience, game accessibility guidelines and tools, stakeholders, impact, policy & legal framework, etc. The research will also identify innovative methodologies, approaches, and practices around games for creativity, lifelong learning, and inclusion. A strong focus will be made on the areas related to culture and museum sectors, and especially within textile and fashion sectors.

The structure of *D2.1 Research Report v.1* follows the time-line of activities implementation in the above-mentioned tasks:

- Chapter 2 is dedicated to the presentation of the research framework established in *T2.1 Design of the research framework*, including details on the objectives of the research activities, the definition of the relevant stakeholders and target groups, the identification of the main research areas relevant for the project, the preliminary establishment of the research methodology and data collection tools, the timeline and data analysis plan, and the relevant legal and ethical consideration for the implementation of the planned research activities.
- Chapter 3 is dedicated to the presentation of the desk research outcomes for the identified relevant research areas, including: (i) innovative technologies, games and good practices for culture and museums, and similar CCI stakeholders; (ii) innovative technologies, games and good practices for the textile and fashion industry, and similar sectors; (iii) innovative methodologies, approaches and practices around games for creativity, lifelong learning and inclusion; (iv) game co-creation, design and management - frameworks, platforms and tools; (v) gamer experience; (vi) game accessibility; (vii) policy, legal and ethical frameworks for game co-design; (viii) impact assessment methods and metrics in Serious Games (SGs) projects; and (ix) financial support for serious games projects and game co-creation initiatives. The outcomes of the desk research are analysed in order to establish the context and needs of the various stakeholder groups, with direct interest in using the iGame platform or demonstrators.
- Chapter 4 is dedicated to the presentation of the field research methodology and outcomes for the 4 stakeholders groups considered for the Phase I of the field research activities, namely

Museums and similar CCIs institutions and professionals (TG1), Textile and fashion industry professionals (TG3), Game co-creators (TG6) and Game industry (TG7).

- Chapter 5 presents the results of the synthesis of the desk and field research outcomes for TG1 and TG3, the main stakeholder groups with direct interest in the iGame project in adopting games and gamification to build new products/services in order to promote culture and inclusive participation. The analysis provides insights in regard to their needs from games, and the context of use (e.g. why and for whom they need games, which are the main barriers/facilitators for adoption and use of such technologies, etc.).

1.2 Intended Audience

The main target audience for this deliverable are the i-Game consortium partners, as this document identifies the context of use and user needs of the main stakeholders interested in using the game co-creation platform and demonstrators. In particular, for the consortium stakeholders from the cultural and fashion domains, or with direct link to such stakeholders, which will lead the implementation of the i-Game pilots, it is important to understand why, how, with whom and why to build video games. On the other side, for the technical partners, it is important to understand what tools and functionality the users need for co-creation, how to make games entertaining and accessible, and how to make the process and the games ethical.

1.3 Relation to other Work Packages and Tasks

The definition of the i-Game stakeholders' groups was defined in *T2.1 Design of the research framework* in close collaboration with *T2.3 Impact framework co-development*, given the close relationship between the various dimensions in regard to context of use, needs, and impact of the developed technologies.

On the other side, the outcomes of tasks *T2.1 Design of the research framework* and *T2.2 Context and needs analysis* provide ground knowledge and information for the implementation of other tasks of *WP2 - Exploring the ecosystemic impact of i-Game* (e.g. *T2.6: Ethical and legal analysis*) and for other work packages. In particular:

- The outcomes of the research activities conducted in *T2.2 Context and needs analysis* are further analysed in *WP3 - Co-creating games by engaging people from different backgrounds*, namely in *T3.2 User Personas and co-creation definition*, in order to develop user personas, scenarios and use cases for the co-creation and co-design processes.
- *WP4 - Co-creation platform and integration with existing solutions*, is further analysing the outcomes of *T2.2 Context and needs analysis* in order to establish the functional and non-functional requirements of the platform.
- *WP5 - Pilot cases*, is further analysing the outcomes *of T2.2 Context and needs analysis* in order to contextually ground the demonstrating pilots in relation to the needs of the involved stakeholders.

2 RESEARCH FRAMEWORK

The **Research Framework** for i-Game, defined in task *T2.1 Research Framework*, is designed as a clear and brief guide for the use of the consortium partners, which will be responsible to conduct the subsequent context and user needs analysis in task *T2.2 Context and needs analysis*. All in all, the i-Game research phase represents our blueprint for creating a game co-creation platform that truly resonates with users, ensuring we are not just building with technology in mind but with a real understanding of what gamers and creators are looking for.

At its core, the research framework aims to integrate insights from various stakeholders within the gaming and CCSI ecosystem, including the cultural and fashion sectors, industry professionals, game creators, and players. This is achieved through a combination of **desk research**, which includes a thorough review of existing literature to establish a solid theoretical foundation, and **field research**, which involves direct engagement with the target groups to gather real-world insights. The methodology outlined in the framework is comprehensive, employing both qualitative and quantitative research tools to capture a broad spectrum of data. This data will then be collected and analysed systematically in the context of the research phase (*T2.2 Context and needs analysis*) to inform the development and refinement of the i-Game platform, ensuring it meets the identified needs and preferences of its users. **Ethical considerations** are paramount throughout this process, with strict protocols in place to protect the privacy and rights of all participants involved in the field research.

A detailed **timeline** guides the partners in the project's research progression, ensuring each phase of the research is completed efficiently and effectively, leading to the successful implementation of the i-Game experimentation in the pilot countries. The framework's flexible yet rigorous structure is crucial for adapting to findings and stakeholder feedback, highlighting its role as the backbone of the i-Game project's mission to transform the gaming industry through co-creation and innovation.

The i-Game research framework is designed as a dynamic document, embodying the project's adaptive and evolutionary nature. Acknowledging that the landscape of gaming and technology is continually shifting, this framework is positioned as an open, work-in-progress blueprint. It serves not only as the current guide for our methodologies and objectives but also as a foundation that anticipates future updates and versions. This approach ensures that the framework can incorporate new insights, respond to emerging challenges, and adapt to feedback from stakeholders, maintaining its relevance and effectiveness throughout the lifecycle of the i-Game project and beyond. The first version of the research framework has been delivered at M3, to provide the necessary guidance for the desk research in task *T2.2 Context and needs analysis*, while the current version included in this deliverable, has been revised, and finalized during the implementation of task *T2.1 Research Framework*. If the case, further updates, and revisions will be reported in *D2.2 Research Report v.2*, that will be delivered at M26.

2.1 Objectives of the research

Considering the details provided about T2.2 (Context and needs analysis), as outlined in the technical proposal, the objectives and research questions are refined to align with this specific task. T2.2 focuses on a thorough analysis conducted by RtF in collaboration with OI, supported by all partners, employing both top-down (desk research) and bottom-up (field research) approaches. This dual approach provides a comprehensive analysis by integrating broad, evidence-based insights with detailed, stakeholder-driven perspectives to address specific needs and contexts effectively.

The **objectives of the research** can be summarised as follows:

- **Conduct a comprehensive context analysis**: the consortium partners will perform desk research to gain an in-depth understanding of the gaming landscape within the pilot countries, the EU, and globally. This includes exploring game experiences and technologies; policy and legal frameworks; impact assessment metrics for the gaming and CCS industries; accessibility policies and solutions; training and thematic capacity building and mentoring programmes; good practices; events.
- **Identify innovative practices**: the consortium will seek out innovative methodologies, approaches, and practices used in games for inclusion, creativity, and lifelong learning, with

special attention to the culture and museum sectors, particularly textile and fashion.

- **Engage directly with stakeholders**: Through interviews and focus groups, the consortium will collect first-hand insights from stakeholders to ensure the research is attuned to actual needs and perspectives.
- **Impact assessment in game and CCS industries**: The consortium will determine the most employed and effective metrics, indicators, and impact reports for assessing the impact of projects and organisations involved in gaming that contribute to inclusion, sustainability, and the enhancement of the cultural and art sector.
- **Inform future Work Packages:** The consortium will generate a detailed research report in two phases, crucial for the strategic planning of work packages: *WP3 - Co-creating games by engaging people from different backgrounds*, *WP4 - Co-creation platform and integration with existing solutions*, and *WP5 - Pilot cases*.
- The main **research questions** relevant for the definition of the users' needs and requirements, that the consortium has pre-identified, are summarised in Table 1. These are overarching research questions, which are to be answered by the research conducted in various tasks and phases of WP2 implementation, but also in other work packages (e.g. in WP3, WP4 and WP5).

Table 1. Main research questions relevant for the definition of the users' needs and requirements in i-Game

Objective	Research question
Comprehensive context analysis	What are the current dynamics of game experiences, technologies, and accessibility at the local, EU, and global levels? How are these influenced by stakeholders, events, impacts, good practices, and policy/legal frameworks?
Innovative practices	Which innovative methods, approaches, and practices are currently advancing games for inclusion, creativity, and lifelong learning, especially within the cultural, museum, and specifically textile and fashion sectors? Which purposes do education pathways, exhibitions, gamified experiences, collections, stories, have within museums? What are the purposes of setting up online vs onsite experiences? What are museums' experiences with digital tools and technology, and what lessons have they learned?
Stakeholder engagement	What specific needs, expectations, and experiences do stakeholders have regarding the development and societal impact of games? What are stakeholders' motivations to use games, in particular serious games? Are these motivations related to generational gaps?
Impact assessment in game and CCSI	What metrics and indicators are most effective for assessing the impact of gaming projects and organisations focused on inclusion, sustainability, and cultural and art sector enhancement? What are the identified good practices in impact-driven gaming projects?
Informing future WPs	How can the insights from this research guide the design and development strategies and initiatives of WP3, WP4, and WP5 to ensure the project's success?

2.2 Relevant Stakeholders and Target Groups

The i-Game project engages a wide array of **stakeholders** across multiple sectors, each playing a vital role in shaping the research and the eventual success of the platform. These stakeholders will only provide valuable insights and feedback within the project's research and impact assessment phases but also represent the direct and indirect beneficiaries of the project's outcomes. The i-Game

stakeholder map is presented in Figure 1.

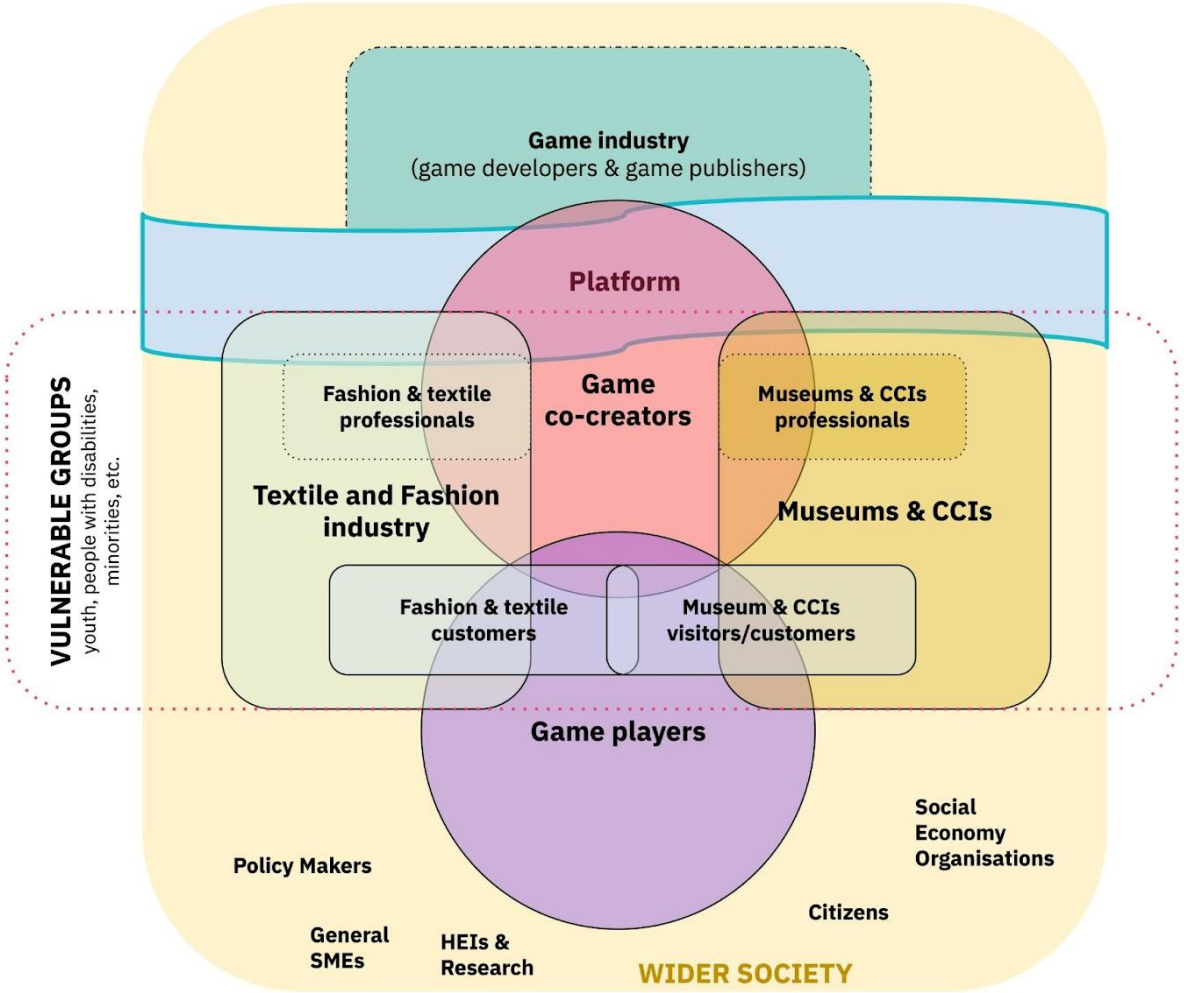

Figure 1. i-Game Stakeholders' Map

Starting from this conceptual image, the consortium has identified **stakeholder clusters** and **stakeholders types**, as presented in Table 2, and highlighted their relevance for either the research or the impact assessment phases, or both.

Table 2. i-Game stakeholder clusters and types

Cluster	Type and Name	Short name	TG#
Museums & CCIs	Museums/CCIs institutions/professionals	MCCIs	TG1
	Museums/CCIs visitors/customers	MCCIs Users	TG2
Textile & Fashion	Textile and Fashion industry/professionals	T&F	TG3
	Textile and Fashion customers	T&F Users	TG4
End-users	Game players	Game Players	TG5
	Game co-creators	Game Co-Creators	TG6
Game industry	Game industry	Game Ind	TG7
Wider society	Citizens	Citizens	TG8

Cluster	Type and Name	Short name	TG#
	Policy Makers	EU PMs	TG9
	SMEs	SMEs	TG10
	Higher Education and Research Institutions	HEIs	TG11
	Social Economy Organisations	SEOs	TG12

Once the project's stakeholders were identified, the following step was to establish their relevance for the research as well as for the impact assessment phases of the project (see Table 3)– which also implies the employment of research tools, data collection instruments and a calendarisation that should accord to research, in order to avoid over-engagement with stakeholders and/or redundancies in inquiries, for both tasks (research + impact analysis).

Table 3. Stakeholders' relevance in relation to the research and impact assessment phases

TG#	Short name	Relevance for research	Relevance for impact	Relevance
TG1	MCCIs	yes	yes	Research + Impact
TG2	MCCIs Users	yes	yes	Research + Impact
TG3	T&F	yes	yes	Research + Impact
TG4	T&F Users	yes	yes	Research + Impact
TG5	Game Players	yes	yes	Research + Impact
TG6	Game Co-Creators	yes	yes	Research + Impact
TG7	Game Ind.	yes	no	Research
TG8	Citizens	yes	yes	Research + Impact
TG9	EU PMs	yes	yes	Research + Impact
TG10	SMEs	yes	no	Research
TG11	HEIs	yes	no	Research
TG12	SEOs	no	no	No direct relevance

For every research-relevant project's stakeholder, the consortium has further defined who they are and why they are important for the i-Game ecosystem, and the relevant inclusion criteria, to be considered when engaging them in the field research activities, are also indicated (see Table 4).

Table 4. Stakeholders' description and selection criteria

TG#	Short name	Description	Who they are	Selection criteria
TG1	**MCCIs**	Museums and relevant CCIs organizations and experts, contributing insights into cultural trends, audience engagement, and content creation. Their expertise ensures the gaming platform respects cultural heritage while being innovative.	Curators, Archivists, Education coordinators, Outreach coordinators, Managers, Tour guides, Directors	Age, Gender, Education level, Expertise area, Experience level
TG2	**MCCIs Users**	As potential future game players, they offer perspectives on engaging with cultural content through gaming, influencing the development of informative and enjoyable games.	Citizens	Age, Gender, Education level, Other vulnerability factors
TG3	**T&F**	Individuals with knowledge of trends, sustainability, and the integration of technology in design. They guide the development of games that feature fashion and textiles, promoting creativity and industry innovation.	Textile designers, Graphics designers, Colour technologists, Industrial engineers, Sales managers, Quality managers, Fashion designers, Brand managers, Garment technologists, Marketers, Illustrators, Production managers	Age, Gender, Education level, Expertise area, Experience level
TG4	**T&F Users**	Potential future game players providing viewpoints on integrating fashion and textile themes into gaming, driving interest in sustainable and culturally relevant designs.	Citizens	Age, Gender, Education level, Other vulnerability factors
TG5	**Game Players**	Essential for testing and refining game concepts, ensuring games are engaging, accessible, and enjoyable for a broad audience.	Citizens	Age, Gender, Education level, Other vulnerability factors
TG6	**Game Co-Creators**	Game Co-creators participate actively in the development of gaming content, providing creative inputs and feedback to ensure the game is engaging and meets the expectations of its target audience. They bridge the gap between developers and players.	TG1, TG3, TG7, Play testers, Content creators, Gamers actively involved in community forums, Accessibility experts, Representatives of vulnerable groups	Age, Gender, Education level, Expertise area, Experience level (experience in game development or testing), Active participation in gaming communities, Ability to provide constructive feedback
TG7	**Game Ind.**	Professionals within the game industry encompass a range of roles focused on the production, marketing, and distribution of games.	Game/Level Designers, Graphical/tech artists, Audio artists/musicians, Writers Creative practitioners, Researchers (within serious gaming mostly), Students (covering various disciplines), Game publishers	Age, Gender, Education level, Expertise area, Experience level

TG8	**Citizens**	Citizens represent the general public and potential consumers of gaming products as well as museum visitors, F&T consumers, etc. This TG partly overlaps with TG2, TG4, TG5, but is not necessarily related to / interested in CCIs and F&T.	Casual gamers, Parents of gamers, Educators interested in gamification, Non-gamers with an interest in technology, museums or F&T, Community leaders, Advocates for digital inclusion	Age, Gender, Education level, Other vulnerability factors
TG9	**EU PMs**	Essential for navigating regulatory frameworks and leveraging funding opportunities, ensuring the platform's development aligns with current regulations and policies.	Local/regional-level policy makers, National-level policy makers, European-level policy makers, Government regulators, Members of legislative bodies Consumer rights advocates, Economic development officers, Public health officials, Education policy experts	Positions held in governmental or regulatory bodies, Influence on technology and entertainment legislation, Commitment to consumer protection and ethical standards, Interest in economic, social, and health aspects of gaming, Capability to enact or influence policy changes
TG10	**SMEs**	SMEs encompass a diverse range of small and medium enterprises across various sectors beyond specific industries like museums or fashion. These businesses are dynamic and agile, often driving innovation and responding swiftly to market demands and technological changes. They contribute significantly to economic growth and employment	Entrepreneurs, Start-up founders, Business owners, Product managers, Innovation leads, Marketing directors	Business size and scale, Business location (geographical), Sector of operation (excluding museums, CCIs, and F&T), Engagement with digital transformation and sustainability practices
TG11	**HEIs**	Higher Education Institutions encompass universities, colleges, and other tertiary education organisations. They are centres for advanced learning and research, contributing to the development of knowledge and technology through scholarly activities. HEIs are also crucial in preparing a skilled workforce and fostering innovation across various sectors.	University professors, College lecturers, Research fellows, Academic advisors, University administrators, Students engaged in research	Age, Gender, Education level, Academic disciplines and specialties, Contributions to research and development, Partnerships with industry and government
TG12	**SEOs**	Social Economy Organizations (SEOs) focus on addressing societal needs such as employment, social inclusion, and community development through sustainable business practices. They offer valuable insights into making the platform accessible and relevant to underrepresented groups, ensuring it promotes equity and inclusivity.	Social entrepreneurs, Non-profit directors, Cooperative members, Social enterprise managers, Community development officers, Impact investors	Not relevant for research

2.3 Research Areas

The following tables provide an overview of the identified relevant Research Areas (RAs) in relation to the definition of the i-Game users' needs and requirements, along with details on the project partner who is leading the research activities in this particular field and the main contributing partners.

Table 5. Overview of RA1: Innovative technologies, games and good practices for culture and museums

Research Area #1 (RA1): **Innovative technologies, games and good practices for culture and museums and similar CCI stakeholders**	
Lead partner	MSS
Contributing partners	TMP, ENM
Brief description	This research area focuses on the integration of innovative technologies and games in museums, and cultural and creative industries (CCI). It emphasizes the role of digital tools from the perspective of museum visitors, exploring how these technologies enhance or impact the museum experience. The study also examines the challenges and collaborative dynamics between the social environment of museums and the tech-driven design world. Additionally, it seeks to look into digital practices which contribute to achieving social and economic sustainability, by helping museums address the societal, digital, and green transitions essential for maintaining relevance and public value in contemporary society.
Methodology	Desk research, Field Research
Data collection tools	Literature review, Interview, Focus groups, Surveys
Stakeholders involved	TG1, TG2, TG6, TG7
Level	National (NL, EST, IT), European and International
Structure of section	Museums' needs and challenges Expertise and capacity-building needs and challenges in museums Games for social and economic sustainability in museums Motivators for the development of a game co-creation space (needs and challenges) Museum visitor experience Best practices in the museum field

Table 6. Overview of RA2: Innovative technologies, games and good practices for the textile and fashion industry

Research Area #2 (RA2): **Innovative technologies, games and good practices for the textile and fashion industry**	
Lead partner	KEPA
Contributing partners	CERTH, TMP
Brief description	This research area focuses on the application of innovative technologies, games, and best practices within the textile and fashion industry, as well as related sectors. It aims to explore how cutting-edge digital tools and gamification can enhance design, production,

	and retail processes. The study will assess the impact of these technologies on enhancing creativity, sustainability, and efficiency across the industry. Additionally, it seeks to uncover good practices that can be adopted by other sectors, fostering cross-industry learning and innovation. The research will also consider the challenges of integrating new technologies into traditional workflows and the potential solutions to facilitate this transition, ensuring that industries can adapt and thrive in a rapidly evolving digital landscape.
Methodology	Desk research, Field Research
Data collection tools	Literature review, Interview, Focus groups, Surveys
Stakeholders involved (TG#)	TG3, TG4, TG6, TG11, TG12
Level (EU, country)	National (GR, IT) and European
Structure of section	Technology integration in fashion Sustainable fashion practices in games Fashion games Web platforms and mobile applications for promotion of ethical and sustainable practices in fashion Gamification in fashion

Table 7. Overview of RA3: Innovative methodologies, approaches, and practices around games for creativity, lifelong learning, and inclusion

Research Area #3 (RA3): **Innovative methodologies, approaches, and practices around games for creativity, lifelong learning, and inclusion**	
Lead partner	CERTH
Contributing partners	KEPA, RTF, UNIS
Brief description	This research area investigates innovative methodologies, approaches, and practices that utilise games to promote creativity, lifelong learning, and inclusion. It focuses on how games can be designed and implemented to serve educational purposes, enhance creative thinking, and foster inclusive environments that welcome diverse populations. The study will explore the integration of capacity-building, training, and mentoring programs into the game co-creation, design, and management processes. The research also examines how educational strategies can be scaled and adapted to various contexts to support continuous learning and engagement across different stages of life and cultural backgrounds. The goal is to provide actionable insights that can lead to more effective, engaging, and inclusive educational games.
Methodology	Desk research, Field Research
Data collection tools	Literature review, Interview, Focus groups, Surveys
Stakeholders involved (TG#)	TG5, TG6, TG7, TG8, TG11, TG12
Level (EU, country)	European and International
Structure of section	Innovative methodologies, approaches, and practices in the realm of video games AI in gaming Value co-creation in games Gamification as a driver for learning and innovation

	Raising awareness through serious games Inclusive game co-creation Inclusive capacity building

Table 8. Overview of RA4: Game (co)-creation, design, and management: frameworks, platforms, and tools

Research area #4 (RA4): **Game (co)-creation, design, and management: frameworks, platforms, and tools**	
Lead partner	CB
Contributing partners	CERTH, NURO, KUL, UNIS
Brief description	This research area examines existing frameworks, platforms, and tools used in game co-creation, design, and management, including AI-generated content tools. It explores how these technologies aid collaborative development and assesses their impact on team efficiency and creativity. The study aims to identify the best practices and pinpoint gaps in current technology that could enhance the creative process and support the complex dynamics of game development teams.
Methodology	Desk research, Field Research
Data collection tools	Literature review, Literature review, Interview, Focus Groups
Stakeholders involved	TG6, TG7, TG11
Level (EU, country)	EU
Structure of section	Collaborative development principles Communication and team collaboration tools Productivity and document collaboration suites Project and task management tools Documentation and knowledge-management tools Online collaborative whiteboards Interface and prototype design tools Visual interactive canvases Storytelling and interactive narratives Feedback surveys and online forms

Table 9. Overview of RA5: Gamer experience

Research area #5 (RA5): **Gamer Experience**	
Lead partner	CB
Contributing partners	NURO, RTF
Brief description	This research area investigates the gamer experience, focusing on how players interact with and respond to video games. It examines the factors that contribute to engagement, satisfaction, and immersion in gaming environments. The study explores various aspects such as game design, user interface, storytelling, and interaction mechanisms, and how these elements influence the overall enjoyment and re-playability of games. Additionally, this research looks at the psychological impacts of gaming, including effects on motivation, emotion, and social behaviour. The aim is to identify best practices and innovative approaches to enhance the gaming experience, making games more accessible, inclusive, enjoyable, and rewarding for a diverse audience.

Methodology	Desk research, Field Research
Data collection tools	Literature review, Survey
Stakeholders involved (TG#)	TG2, TG4, TG5, TG6, TG7, TG8
Level (EU, country)	European and International
Structure of section	Game genres, skills training, and positive effects of gaming Positive psychology theories and game design Motivators contributing to the engagement Best practices in real gaming experiences Analysis of involved player types, game elements and mechanics in real games and experiences

Table 10. Overview of RA6: Game accessibility

Research area #6 (RA6): **Game accessibility**	
Lead partner	RTF
Contributing partners	CB
Brief description	This research area focuses on game accessibility, particularly in relation to vulnerable groups which have diverse abilities, digital or language accessibility needs (e.g. minorities, people with disabilities, people with low digital skills, etc). It aims to explore the barriers these groups face when accessing digital games, and the design strategies that can mitigate these challenges. The study will evaluate existing standards, recommendations and frameworks for game accessibility that must be considered in the game design process. Furthermore, existing tools for game creators and relevant digital accessibility features and technologies, such as customizable user interfaces (audio descriptions, captioning, colour contrast), are analysed, to determine their effectiveness in making games more inclusive. The main scope is to provide the ground for designing games with accessibility in mind, to accommodate a broader range of abilities (e.g. physical, cognitive). This will be achieved by establishing the guidelines and best practices that ensure gaming is a universally enjoyable experience, promoting inclusivity and equality within the i-Game gaming community.
Methodology	Desk research, Field Research
Data collection tools	Literature review, Interview, Focus Group, Surveys
Stakeholders involved (TG#)	TG2, TG4, TG5, TG6, TG8
Level (EU, country)	EU, International
Structure of section (summary)	Definition, context, and relevance Standards, recommendations, and frameworks for game accessibility Accessibility tools for game creators Accessible games best practices

Table 11. Overview of RA7: Policy, legal and ethical frameworks for game co-design

Research Area #7 (RA7): ***Policy, legal and ethical frameworks for game co-design***	
Lead partner	KUL
Contributing partners	CB
Brief description	This research area delves into the policy, legal, and ethical frameworks that govern the co-design of games. It seeks to identify the regulatory challenges and ethical considerations involved in collaborative game development, particularly to embed legal and ethical requirements at early stages of game design. The study aims to examine how intellectual property rights are managed in co-design scenarios, issues related to data privacy and dark patterns, the implications of user-generated content and the considerations associated with AI & Gen AI technology from an IT/IP perspective. Furthermore, the research will explore policy recommendations to support a fair and sustainable collaboration while ensuring that all participants' rights are protected, including minors.
Methodology	Desk research (Descriptive, evaluative, recommendatory)
Data collection tools	Literature review, Survey
Stakeholders involved (TG#)	TG5, TG6, TG7, TG8, TG9, TG11
Level (EU, country)	Primary focus on EU and International level, but with room for additional insights from national law in the sphere of copyright law in particular (as copyright ownership has not been harmonised at the EU level)
Structure of section (summary)	Legal and ethical considerations associated with i-Game Context: Gaming & the Law IT considerations: ethical and legal game creation IP considerations: games co-creation and copyright AI & Gen AI considerations: IT & IP perspective on Games creation.

Table 12. Overview of RA8: Impact assessment methods and metrics in serious games projects

Research area #8 (RA8): ***Impact assessment methods and metrics in serious games projects***	
Lead partner	OI
Contributing partners	MSS, ENM
Brief description	This research area investigates the methods and metrics utilised to assess the impact of serious games projects. It aims to provide an overview of existing assessment approaches across various domains. Through this investigation, the research seeks to enhance our understanding of how serious games contribute to wider impact and inform future development efforts.
Methodology	Desk research
Data collection tools	Literature review
Stakeholders involved (TG#)	All
Level (EU, country)	EU
Structure of section	Introduction Impact assessment methodologies, tools, metrics, and indicators

(summary)	Emerging trends and considerations in impact assessment Challenges and opportunities

Table 13. Overview of RA9: Financial support for serious game projects and game co-creation initiatives

Research area #9 (RA9): ***Financial support for serious game projects and game co-creation initiatives***	
Lead partner	CB
Contributing partners	RTF, OI
Brief description	This research area investigates the potential financial support available for serious game projects and game co-creation initiatives, both at the EU and national levels, with a particular focus on the culture and museums' domain. It aims to analyse the funding mechanisms, grants, and incentives offered by governmental bodies, research organisations, and private institutions to support the development and implementation of serious games which have a social inclusion dimension. By examining funding opportunities at different scales, the study seeks to identify trends, gaps, and challenges in accessing financial support for serious game initiatives. Additionally, it will explore the impact of funding policies on the growth and sustainability of the serious games industry, as well as their effectiveness in promoting innovation and collaboration in game co-creation efforts in a cross-domain context. Through this investigation, we aim to provide a preliminary analysis to contextualize potential exploitation and sustainability pathways for the iGame co-creation platform and games.
Methodology	Desk Research, Field Research
Data collection tools	Literature review, Survey
Stakeholders involved (TG#)	TG1, TG3, TG6, TG7, TG10
Level (EU, country)	EU
Structure of section (summary)	Research on existing EU funding schemes for both co-creation and game creation Analysis of studies, benchmarking white papers and literature related to sources and volume for the startup and videogame ecosystems Study of new and alternate funding opportunities Identification of the opportunities

Table 14. Overview of RA10: i-Game stakeholders' context and needs

Research area #10 (RA10): ***i-Game stakeholders' context and needs***	
i-Game stakeholders' context and needs	
Lead partner	RTF
Contributing partners	KEPA, CB, MSS, TMP, ENM
Brief description	This research area explores the context of use, along with the needs and requirements of

	the diverse stakeholders with a direct interest in game co-creation and development, from museums and cultural institutions to the textile and fashion industry, and beyond to gamers and citizens that could potentially be interested in diverse access to culture and museums. It aims to analyse the results of the desk research performed for various topics, to understand how games can enhance visitor experiences in museums, support educational goals in fashion, and meet the entertainment and engagement expectations of players and visitors/customers, taking into consideration also individuals from vulnerable groups. The study will also consider the needs of game co-creators and the broader game industry for tools and frameworks that support effective and inclusive design and management. By examining these varied requirements, the research seeks to identify cross-sectoral opportunities for innovation in game co-creation and development that also consider societal and economic impacts. This approach aims to align the interests of cultural, educational, and commercial stakeholders with the capabilities of gaming technologies towards fostering broader societal benefits.
Methodology	Desk Research, Content Analysis
Stakeholders involved (TG#)	TG1, TG2, TG3, TG4, TG5, TG6, TG7
Level (EU, country)	EU, International
Structure of section (summary)	Review of vulnerability criteria Analysis of context of use, facilitators and barriers, and needs and requirements per stakeholder group.

2.4 Overview of the Research Methodology and Data Collection tools

In developing the research methodology for the i-Game project, we have designed a dual-approach strategy that intertwines extensive desk research with immersive field research. This methodology is crafted to encapsulate the full spectrum of the gaming, CCIS and Fashion & Textile ecosystems, ensuring our research is comprehensive. By integrating these approaches with a suite of diverse data collection tools, we aim to implement a research that is effective and inclusive, particularly emphasizing the inclusion of vulnerable groups such as women, the elderly, migrants, minorities, and people with disabilities.

2.4.1 Desk research

Desk research is a key component of user research, which helps gaining better understanding of the application domain and framing the scope of the project, providing the ground for informed-decision making for the future design and implementation work.

The desk research performed in T2.2 serves as the foundation of our study, offering a broad overview of the existing landscape in gaming, cultural and creative industries, fashion and textile and accessibility standards. This top-down approach involves a systematic review of academic literature, industry reports, policy documents, and case studies that provide insights into game design and development, user engagement strategies, and best practices for inclusivity. Through this lens, we aim to identify gaps in the public services, current market, and opportunities for innovation, ensuring our platform addresses real needs and sets new standards for digital inclusivity and sustainability.

2.4.2 Field research

Field research allows for the direct exploration of the problem within its real-world context, capturing firsthand impressions, experiences, and attitudes from stakeholders. This approach ensures the data collected is rich, grounded, and reflective of the specific realities and perspectives of those involved. By engaging with participants directly through the interviews, field research provides an opportunity to validate

or enrich findings from desk research, offering more detailed insights that might otherwise be overlooked in theoretical analysis.
Complementing our desk research, the planned i-Game field research allows us to engage directly with our diverse stakeholders, capturing the nuanced perspectives and lived experiences of end-users, game creators, developers, and representatives from vulnerable communities, amongst others. This approach encompasses interviews, focus groups, and surveys, offering a granular understanding of the expectations, challenges, and desires of those interacting with, or affected by gaming platforms. This hands-on engagement is crucial for grounding our project in reality and ensuring also that the voices of often underrepresented groups are considered and shape our development process.

2.4.3 Data collection tools

The main tools employed for the implementation of the research are presented in Table 15.

Table 15. Data collection tools

Data collection tool	Type	Description
Literature review	N/A	A systematic and critical analysis of academic publications and relevant sources of information on specific topics (see the identified RAs in section 2.3), aimed at synthesizing and evaluating existing knowledge in the relevant research areas.
Survey	N/A	A data collection method that involves gathering information from a sample of individuals or entities through standardised questionnaires, typically used to gather quantitative data on opinions, behaviours, or characteristics.
Interview	Structured interview	An interview method where the interviewer asks predetermined questions in a fixed order to all participants, ensuring consistency and comparability of responses, often used to gather specific information on a topic.
	Semi-structured interview	An interview method that combines predetermined questions with opportunities for open-ended discussion, allowing flexibility for follow-up questions and exploration of participant responses, commonly used to gather in-depth qualitative data on experiences, opinions, or perceptions.
Focus group	N/A	A qualitative research method where a small group of participants is brought together to discuss a specific topic or issue in a guided discussion facilitated by a moderator, often used to explore diverse perspectives, attitudes, and experiences within a group setting.

2.5 Timeline and Data Analysis Plan

The research in T2.2 will be implemented in two phases, as presented in Table 16 and Table 17.

Table 16. Planning of Phase I of research implementation

Phase I	
Duration	**M4-M12** (May 2024 – Jan 2025)

Objective(s)	**Implementation of the desk research** for the established main research areas. **Implementation of the field research** with the following groups of stakeholders: TG1, TG3, TG6 and TG7.	
Output	**D2.1** (Research report I) due M12	
Draft plan	**M4-M5** (May-Jun2024)	**Conducting desk research** and drafting the report per research area. This activity is performed under the guidance of the research area leader by all involved partners.
	M4-M5 (May-Jun2024)	Preparation of the English version of all necessary **materials for the field research data collection involving TG1, TG3, TG6 and TG7**. This activity is led by RtF and is supported by all partners involved in T2.2 and T3.2.
	M6 (Jul 2024)	Translation of materials to local languages by relevant partners and implementation of online surveys by RtF
	M7-M9 (Aug-Oct 2024)	**Implementation of the field research with TG1, TG3, TG6 and TG7** at national, EU and international level. When necessary to work in a local language, the respective project partner implements the field research under the guidance of RtF. For EU and international level, if the activity is performed in English, RtF and/or CB contribute to the implementation of the field research (e.g. performing some of the interviews, collaborating with the partners during the focus group activities).
	M10 (Nov 2024)	**Process and analyse field research data** and prepare the first version of the draft report. RtF leads this activity.
	M11-M12 (Dec 2024 - Jan 2025)	Revision, finalisation, and submission of deliverable D2.1.

Table 17. Planning of Phase II of research implementation

Phase II		
Duration	**M22-M26** (Nov 2025 – Mar 2026)	
Objective(s)	**Implementation of the field research** with the remaining main groups of stakeholders: TG2, TG4, TG5, TG8. A smaller effort will be allocated to field research involving: TG9, TG10, TG11.	
Output	**D2.2** (Research report II) due M26	
Draft plan	**M22-M23** (Nov-Dec 2025)	Preparation of the English version of all necessary **materials for the field research data collection involving the main targeted groups TG2, TG4, TG5, TG8**. This activity will be led by RtF and will be supported by all partners. Translation of materials to local languages where needed. Preparation of a short survey in English for the other TGs.
	M24-M25 (Jan-Feb 2026)	**Implementation of the field research with TG2, TG4, TG5, TG8, TG9, TG10, TG11** at national, EU and international level. When necessary to work in a local language, the respective project partner will implement the field research under the guidance of RtF. For EU and international level, if the activity is performed

		in English, RtF and/or CB can contribute to the implementation of the field research (e.g. performing some of the interviews, collaborating with you during the focus group activities).
	M25-M26 (Feb-Mar 2026)	**Process and analyse field research data**. Preparation and submission of deliverable D2.2.

The data analysis plan will be designed and applied within M10, prior to the process of analysis and interpretation of the insights coming from the field research, Phase I.

2.6 Legal and ethical considerations

The research performed in the context of WP2, which involves participation of individuals in the field research activities, follows all relevant legal and ethical considerations. To achieve a high level of protection, i-Game partners received a background note on personal data processing from KULeuven CiTiP. The note provided some theoretical knowledge on data protection regulation to raise awareness and clarify concepts. Moreover, as ethical considerations have a central place in i-Game, partners brainstormed on how to achieve a high standard of protection for the data processed during the field research. It was decided that to maximise protection, data processing operations would be limited, strict security measures will be ensured, and data will be anonymized to the extent possible by the relevant partners. In particular, the following aspects are considered:

Informed Consent: each participant will read and sign the Informed Consent Form for participation in the research activities of the project. Further details on this aspect are provided in section 4.2. The template used by the project partners for the preparation of the Informed Consent Form is included in Annex 8.2.

Data Management: all data sets to be collected during the field research are described in detail in deliverable D1.1 *Project and data management, quality assurance plan and self-assessment plan*, in section 6.1.1 [1].

Data Anonymization: data collected during the field research activities will be anonymized to the possible extent, with particular focus on breaking the links between individual identification information (e.g. name, contact information) and potentially sensitive socio-demographic information.

Secure data processing and storage: all consortium partners handling personal information or sensitive data respect the General Data Protection Regulation (GDPR). More information is provided in deliverable D1.1

3 DESK RESEARCH

The main scope of the desk research presented in this chapter is to provide a solid foundation and in-depth understanding of the gaming landscape with application to the cultural context. While some of the outcomes of this research are highly relevant for the forthcoming development work in the technical work packages of the project (e.g. best practices in game development and co-creation, including serious games and games for inclusion), it was equally important to conduct a comprehensive context analysis (why and when are games used in the cultural field and non-institutional cultural practices), to identify innovative technologies (e.g. video games) and approaches that have proved to be successful and to understand how to assess their impact. The latter plays a key role in establishing the ground for the successful development of the i-Game pilot demonstrators in WP5.

Video games are interactive digital experiences designed primarily for entertainment but often extending beyond play to encompass educational, cultural, and artistic dimensions. While early definitions described them as 'games played through an audiovisual apparatus' [2], the evolution of technology, including augmented reality (AR) and virtual reality (VR), has expanded their scope and possibilities. Despite these advancements, at their core, videogames remain games - dynamic systems designed to engage players - despite their other characteristics (a form of art, a cultural form, a narrative form, etc.), or potential to achieve any other goals (e.g. educational, informational, cultural, etc.).

The use of video games or gamification elements in learning contexts had as a result the huge movement and research in the last decade around the so called “serious games” [3]: “Serious games differentiate themselves from traditional video games by infusing instruction with the gameplay as part of their inherent design. Thus, the objective is not winning but learning from the experience. Commonly likened to simulation games, which mimic real-life situation that might not otherwise be feasible due to several considerations, such as cost and safety, serious games are said to stimulate experimental learning or learning-by-doing.”

The development of such games benefits greatly from the collaboration of professionals and individuals with diverse knowledge, skills, perspectives and abilities, which is usually achieved through the co-creation practices, which has the potential to unlock the creative potential of the participants and facilitate the development of game-based innovative solutions which extend beyond mere entertainment (e.g. include educational, awareness-raising and exploratory goals) [4]. In particular, in order for the serious games to keep their basic game characteristics (e.g. captivating and engaging) it is important to involve the end-users (game players) in the co-creation process [5], [6], and to have a very good understanding of the main factors (positive and negative) that should be considered when creating the motivational profiles of the game players (e.g. what will attract and keep them interested in a video game).

Last, but not least, in this highly dynamic landscape of video games development and integration in various life domains, it is important to identify the regulatory challenges and ethical considerations both for the co-creation process (e.g. intellectual property rights), but also for the end-products (e.g. safe and ethical video games).

3.1 Innovative technologies, games and good practices for culture and museums, and similar CCI stakeholders

This section investigates the integration of innovative technologies and games in museums and the wider cultural and creative industries (CCI). It emphasizes the crucial role of digital tools from the perspective of museum visitors, exploring how these technologies enhance or impact the museum experience, and the relationship between museum and visitors. The study also examines the challenges and collaborative dynamics between the social environment of museums and the tech-driven design world. Additionally, it seeks to identify digital and gamified practices that support museums in achieving social and economic sustainability, helping them address the societal, digital, and green transitions essential for maintaining relevance and public value in contemporary society.

In terms of exploring the ecosystemic impact of the project, which is in line with this specific task T2.2, this analysis builds on the impact framework developed as part of the project (see *D2.3 Impact Monitoring Dashboard* [7]), whose key components include outcome areas and specific project outcomes (see Table 19). Linking to the main research area (see Table 18) will encourage the involvement and participation of different

groups of stakeholders in the co-creation space and ensure that the research findings are directly relevant to the project. This data was systematically collected and analysed during the desk research phase, and due to the large number of articles considered, these are presented in more detail in appendix 8.1.
The articles selected in the research provide significant insights into the synergies between co-creation and gamification, especially in cultural heritage contexts. They underscore the significance of collaborative and interdisciplinary approaches in the co-creation of educational games. The research highlight the need for balancing historical accuracy and educational context with engaging gameplay, leveraging on cost-effective technologies, and involving a wide range of stakeholders to create culturally enriching and pedagogically effective game experiences. These insights can be crucial for advancing the field of game-based learning in cultural heritage and other educational contexts. Also, the fact that not so many papers are available in the literature on this specific research area, means that it can be an interesting field to be explored and advanced by the i-Game project.
The contributions emphasize the importance of collaborative design processes involving diverse stakeholders, including users, designers, and museum guides. This approach not only enhances the game's relevance and engagement but also ensures the crucial and educational content is accurately represented. The hands-on, iterative nature of co-creation, where participants actively contribute to the design and development phases, ensures that the game meets educational and cultural objectives while staying engaging for users. Moreover, a focus on the technological and practical considerations is essential for game co-creation processes. Cost-effective core technologies, such as reusable game engines and assets that can significantly reduce development time and costs, represent one important need. This is particularly crucial in the context of Serious Games (SGs) and mobile Location-Based Games (mLBGs). The research stresses the importance of accurate historical modelling and the integration of the real-world cultural and historical elements to create an authentic and immersive learning experience.
The articles identify the collaboration with experts as a critical factor in the co-creation of games (educational in particular). The engagement of historians, cultural experts, and educators ensure the result, and the process are both pedagogically sound and historically accurate, which is an essential need for museums and users to create a meaningful experience. This multidisciplinary approach helps avoid educational games being either too focused on learning at the expense of fun or too entertaining without sufficient educational value.
The articles can connect especially to areas 1, 5, and 7 of the Impact Framework since their focus on an interdisciplinary approach and technologies for gamified cultural experience aligns with the possibility of knowledge exchange among experts from different fields and a debate on new technological tools.

3.1.1 **i-Game Relevance**

The analysis presented in this section mainly relates to the Museums & CCIs stakeholder as defined in Table 2, namely: TG1 Museum institutions and professionals (MCCIs), and TG2 Museum visitors and customers (MCCIs Users).

Table 18. Main research fields relevant for RA1.

A	Research on museums needs and challenges (game development, cross-sectoral collaboration, innovation, engagement, business)
B	Expertise and capacity-building needs and challenges (on personnel and organizational levels)
C	Research on games for social and economic sustainability in museums
D	Research on motivators for the development of game co-creation space (needs and challenges)
E	Research on visitor experience (needs)
F	Research on best practices in the museum field

Table 19. Project impact and outcome areas relevant for RA1.

1	Knowledge Exchange	Expanded knowledge on arts and culture Expanded knowledge on technology development
2	Network Development	Enhanced network development
3	Community and Social Relationships	Strengthened sense of belonging to a broader community Increased participation in cultural activities
4	Economic development	Increased job opportunities Boosted organizations sustainability Innovation in cultural services and products
5	Learning & Capacity building	Development of soft and life skills Improved educational performance/experience Enhancement of hard skills
6	Social inclusiveness	Elevated awareness on sustainability and inclusion Increased accessibility to cultural initiatives
7	Technological development	Human-centred technology development Fostered ethical-design culture in video game industry

3.1.2 **Museums' needs and challenges**

Museums can leverage the interactive nature of video games to complement material exhibitions, thereby offering a richer, more engaging visitor experience, educating people about art, expanding the museum's audiences, supporting monetization, and boosting teamwork. Nevertheless, video games in museums often are still perceived as mostly educational tools. Serious games, specifically designed for educational purposes, can effectively convey cultural content and several games embody a deep understanding of cultural heritage. The integration of pedagogical models into game design ensures that educational objectives are met, supporting both formal and informal learning contexts within museums.

The implementation of video games in museum settings involves several practical and technological considerations:

- Museums must navigate the complexities of digitizing their collections and ensuring these digital representations are compelling within game environments.
- Designing location-based games requires careful attention to the interplay between genre, context of use, technological solutions, and learning effectiveness.
- From the museum perspective, games are often assumed to be too expensive to produce and production faces funding challenges (incl. updating costs). It has been indicated that given the associated costs, the production of computer games for exhibitions is usually only employed in support of child-oriented learning outcomes. While this strategy is effective in attracting the attention of children who, given their youth, are not as competent at reading or interpreting as adults, it does not account for the statistic that the average computer game player is in their early 30s. It appears that, if nothing else, the assumption that games should be for children represents a missed opportunity for museums to engage an important segment of their audience.
- Also, the rate of redundancy of an exhibit and the associated cost of refreshing an out-of-date exhibit is perceived to be a consideration. At the same time, it has been shown that successful games in exhibitions need not be digitally based, nor expensive to produce and maintain.
- The question regarding the perceived cost of incorporating games into exhibits is the issue of how quickly they lose their relevance for visitors. Games can have quite a long-life span because the objectives of a museum game are different from a commercial computer game the need for them to 'wow' a user with high technology is not so great.
- Handling the technical aspects of the games both in the development and further maintenance phase can be challenging, as museums lack a skilled workforce for that.

- The relationship between museums and video game studios is still evolving, with both sectors needing to pay more attention to each other's expertise and context. Museums often struggle to pass on a sense of ownership and leadership to their audiences, while game developers may overlook the historical accuracy and educational value required by museums. Addressing these challenges requires ongoing research, dialogue, and iterative design processes.
- Successful integration of video games into museums requires robust collaboration between cultural institutions and game developers. Each stakeholder brings unique perspectives and priorities.

These considerations and selected texts, derived from the analysis of scientific research articles ([8], [9], [10], [3], [11], [12], [13], [14], [15], [16], [17], [18], [19], [20], [21], [22]) and online reviews or collections e.g. (e.g. institutional web pages, blogs, magazines, news articles, etc.)[1,2,3], connect to all impact areas mentioned in Table 19. Applying digital technologies, particularly games, into museum offers helps to expand knowledge of arts and culture. On the other hand, it enhances museums' knowledge of advanced technologies and how these can be applied to increase the engagement of visitors.

3.1.3 Digital resources for Cultural Heritage

Cultural heritage is evolving rapidly thanks to digital technologies, providing digital cultural assets that can be used also as resources for the game co-development. Platforms like ***Europeana***[4] and European national cultural heritage databases serve as resources that empower cultural heritage through digitization, making it more visible and allowing the public to appreciate heritage objects. Similar international resources are ***The Australasian Underwater Cultural Heritage Database*** *(AUCHD)*[5] and the ***Hong Kong Intangible Cultural Heritage***[6]. They hold metadata relating to digital objects on Archaeology, Art, Fashion, Industrial Heritage, Manuscripts, Music, Natural History, Newspapers, Rhopography, etc., and contain historical and environmental information about shipwrecks, sunken aircraft and other types of underwater heritage sites located in the Oceania and Southeast Asian regions. These are just a few examples of such resources, as a high number of databases from different European Galleries, Libraries, Archives and Museums (GLAMs) exist at European level. In this context, Europeana initiative is trying towards standardization of the data formats and presentation. When it comes to video games, on one side the platform plays a role in preserving them, as it hosts collections related to classic and historical video games, and on the other side it hosts a vast collection of historical documents, maps and artwork that can serve as reference material for game world-building, character design and storytelling.

3.1.4 Expertise and capacity building needs and challenges in museums

The identified research articles ([23], [18], [24]) and online reviews and collections[7,8], indicate that museums face significant challenges in digital transformation and capacity-building. Museums lack dedicated digital staff and cohesive digital strategies. Leadership support for digital initiatives is variable.
Introducing video games into museum services is promising, yet current implementation is often hindered by a lack of theoretical integration and practical challenges. Enhancing digital maturity, fostering digitally literate leadership, and bridging the digital divide are crucial for successful digital transformation in museums. The knowledge about introducing video games into museums is not influenced by the available literature and guidelines. The sector needs support and new ways of working with the game industry. Representatives of the museums featured in one of the studies thought that games in exhibitions have not been particularly successful in achieving either the goals of exhibitions or the potential that games offer. Increasing knowledge and the introduction of theories on play and on games into museum theory and practice have the potential for significant advances in order to enhance exhibition development. In order to

[1] **https://www.ne-mo.org/news-events/article/nemo-report-on-digital-learning-and-education-in-museums**
[2] https://journals.scholarsportal.info/browse/00113069/v56i0003
[3] https://www.museumnext.com/events/museum-games-play-summit/
[4] https://www.europeana.eu/en/about-us
[5] https://www.dcceew.gov.au/parks-heritage/heritage/underwater-heritage/auchd
[6] https://www.hkichdb.gov.hk/en/index.html
[7] https://knightfoundation.org/reports/digital-readiness-and-innovation-in-museums/
[8] https://www.museumnext.com/events/museum-games-play-summit/

facilitate collaboration between the game and museum sector and understanding the trends, needs, and potential of video games, museum personnel should be encouraged to play games, so as to understand what works and communicate their findings to the developers.
Additionally, the articles highlight sometimes conflicting roles and needs of different stakeholders in the creation of games. For example, the role of curators or educators is to help users engage with heritage, strengthen connections, and open contexts. Research experts might focus on expertise and materiality, viewing objects as storytellers. Meanwhile, game developers prioritize the entertainment and technical aspects of the game.
The selected texts address obstacles in digital transformation and enhancing museums knowledge on advanced technologies, museum employers digital literacy, understanding the potential of video games from the perspective of the museum sector as well as the resources needed for the uptake.

3.1.5 **Games for social and economic sustainability in museums**

Academic research has not sufficiently covered the sustainability issues around introducing the video games to the museums: ecology, social issues, and economy. The latter links with the trends around increasing sustainability of museums which carry out their services with increasingly limited resources [21]. A NEMO report[9] (Barekyan, Peter 2023) suggests that a lot of museums have similar use cases and therefore good digital education and mediation tools in different museums should be reused. Also, short-term digital applications should not be developed for long-term museum applications, such as collections, rather the discussion needs to centre around sustainable codes for sustainable projects [25]. Museum tech development has to focus on the life cycle management of applications, as these cannot be rebuilt all the time.

3.1.6 **Motivators for the development of a game co-creation space (needs and challenges)**

Gaming in museums should be used for providing visitors with a sense of agency to avoid the feeling of passivity that comes from merely being presented with an exhibit. The research ([26], [16], [27], [28], [3]) and the online reviews[10] on motivators for developing game co-creation spaces in museums and the heritage sector offers several insights, suggesting that engaging diverse audiences and stakeholders can be achieved through participatory and co-design activities. A central theme across the selected studies is the necessity of involving various groups (local communities, heritage professionals, various visitor demographics, the educational sector) in the design process to ensure contextual relevance, engagement, or educational value. For example, participatory design and co-design activities are vital for creating Location-Based Games (LBGs) that promote cultural heritage. By involving local communities and heritage professionals, museums can ensure that the games are contextually accurate and culturally significant. In the selected study, the iterative co-design approach, which includes field visits, play testing and field studies allowed for continuous refinement of game prototypes, ensuring they are engaging and educational for visitors. This method highlights the importance of selecting representative participants with diverse backgrounds and expertise to contribute meaningfully to the design process.
Game design as a participatory activity in museums enhances audience engagement and community building. Technology plays a crucial role in this process, providing scaffolds that help visitors create games as "public artifacts" that can be integrated into museum collections. This approach fosters a deeper connection between visitors and museums, enriching the cultural experience and encouraging repeat visits. The creation of user-generated content, supported by mobile technologies and social media, allows visitors to contribute to the museum's narrative, bridging the communication gap between the institution and its audience. Examples from institutions like the British Museum and Tate Gallery demonstrate how involving visitors in game design workshops can successfully engage different age groups and create meaningful, educational experiences.
As one of the case studies shows, involving teenagers in the co-design process is particularly significant. Teenagers, an often-overlooked demographic in museum engagement strategies, can offer fresh

[9] https://www.ne-mo.org/news-events/article/nemo-report-on-digital-learning-and-education-in-museums
[10] https://futures.clir.org/game-based-design/

perspectives and creative ideas. The study on co-designing gaming experiences with teenagers illustrates the potential of this age group to contribute to the development of engaging museum technologies. The selected study highlighted how teenagers can actively participate in the design process. This involvement not only empowered them but also ensured that the resulting games are appealing and relevant to their peers. Video games workshops at the museums could potentially be added to the study curriculum by the teachers, facilitating the sustaining of museums and educational department's partnerships.

Co-designing with diverse participant groups presents several challenges, including managing varying schedules, ensuring meaningful contributions, and achieving tangible outputs. Effective strategies involve a well-coordinated design process that focuses on results and iterative feedback. Techniques such as field playtesting and incorporating expert reviews help identify and address errors, inconsistencies, and areas for improvement, ensuring the historical accuracy and appropriateness of the cultural content.

Selected co-design efforts support the argument that these activities not only enhance visitor engagement but foster a stronger connection between museums and their audiences at large, ultimately supporting the digital transformation of cultural institutions.

Other forms of collaboration between museums and stakeholders in the area of video games, can be

- hosting conferences about games
- providing a place for video game experimentation
- merging games and museums by gamifying the museum experience through augmented reality.

Research in the field of technology enhanced learning has already highlighted the learning potential not only of game play but also of game design and development, whereas memory institutions have not applied it into their practices related to visitor engagement.

Museum audiences can construct games which can function as "public artifacts" and can be added to the museum's assets, enhancing audience engagement and community building[11]. Game creation in cultural institutions as participatory learning activity should be integrated in activities that will give the chance to visitors to interact with museum staff and discuss, negotiate, and integrate in their games different aspects of cultural content.

A study suggests that if museums want to employ game design in the cultural experience, we need to create a platform that engages users with what is considered crucial for the cultural experience. The game design platforms could focus on the connections the visitor can make between the different cultural artifacts and with overarching concepts, beliefs, and narratives.

The idea of involving visitors in creating computer-based public artifacts that make use of cultural content is new. It builds on a theoretical background that acknowledges the gap in the communication between the museum and the visitor and calls for active participation of visitors in the dialogue with the museums, approaching cultural experience through engaging visitors in the creations of "meta-artifacts" – i.e. games or stories based on compositions of elements of cultural content - which are supposed to have a public status.

Three examples of this kind are: (a) The British museum organized a 2- hour family workshop on game design. Participants were invited to build their own games that can be uploaded on the web, inspired by the collections and stories of the British museum (after visiting experience). (b) In Tate Gallery young visitors (6-12 years) create games for Galleries and films for pieces of art. (c) An activity involving remixing museum content for the creation of a visitor generated narrative.

The selected texts connect to almost all impact areas from Table 2 showing how technologically mediated participatory activities, such as co-creating games, increase the visitor engagement, address disadvantaged and minority groups and support the relevance of museums as institutions, offering cultural experiences.

However, it should be noted that the biggest obstacle is not the engagement - but the technical complications, resources that go to the game development versus benefits that would come from the game (and not any other medium that can be used). In particular, game industry is seen as a domain very commercially oriented and not really engaging or agile when it comes to collaboration with traditionally non-technical domains (e.g. museums).

[11] https://www.bozar.be/en/calendar/bozar-arcade-love-and-emotions-video-games#event-page__description

3.1.7 **Museum visitor experience**

The digital transformation of museums is closely tied to understanding visitor needs and how emerging technologies including video games, can enhance visitor experiences and engagement. The studies ([9], [29], [30], [31], [14], [32], [27], [33], [34]) and the collections[12] in this sample highlight the potential of integrating digital and game-based elements into museum services to create more inclusive, engaging, and educational environments. Some trends in studies, reflecting on the emergence of understanding the potential of visitor-technology relationships can be identified. A study proposes that the evolution of technology in museum visitor experiences can be segmented into four stages: ICT Incubation, Smart Technology Adoption, ICT Transformation, and Futuristic Innovation. Focus has evolved from interest towards basic interactions with technology and learning to adopt more diverse technologies, including multimedia applications and smart technologies, leading to a deeper conceptual engagement with visitor behaviour, satisfaction, and virtual presence. Recent trends emphasize future innovations like mixed reality (MR), eye tracking, 3D printing, and the Metaverse, which further promise to enhance visitor experiences.
However, there remains a need to ensure these technologies make museums accessible and inclusive for diverse visitors, as the evolution of the video game sector is known for enforcing the existing divides. Game-based design offers a promising approach to create inclusive and accessible digital exhibits in the exhibitions. By leveraging video games, museums can reach wider audiences who potentially do not have access to exhibits, such as people with disabilities, various minority groups, people living in rural areas, older adults, and youth with underprivileged backgrounds. Video games can become an entry point for underrepresented and inaccessible audiences, including making them producers of video games.
Serious games are increasingly used to enhance museum visits. These games motivate participation, spark curiosity about artifacts, and improve overall museum experiences. Museums are also exploring the use of online games to create narrative worlds that foster empathy and deeper emotional connections with cultural content. SGs with strong virtual navigation features can foster a sense of ownership over museum artifacts. These games aim to construct experiences that resonate with visitors, enhancing their engagement and understanding of museum narratives.
Successful game-based exhibits require collaboration with the intended audience and the creation of networks for game creation, education, and community outreach. This approach not only enhances engagement but also fosters community building and increases the usage of museum resources and services.
A separate strand of studies study visitor needs from the cognitive aspects, pointing out that game designers must consider individual differences in how people process visual information when creating cultural heritage games. These differences impact users' performance, experience, effectiveness, and efficiency in gaming environments. Current design practices often overlook these cognitive differences, which can affect the educational value and user experience of cultural heritage games. Addressing these variations can lead to more effective and personalized learning experiences.
The selected texts address user/visitor needs and the emergence from understanding museum technologies as primarily educational to facilitating visitor wellness, satisfaction, and behaviour, as well as applying a wider range of smart technologies and formats.

3.1.8 **Best practices in the museum field**

The research on best practices was mainly based on case studies ([10], [35]) and reviews[13,14,15,16,17] that show how effectively museums can integrate game technology into their exhibitions and how visitors benefit from gaming, as part of their museum experience was mainly explored at the MuseumNext Game&Play Summit[18] (see details on relevant best practices in annex 8.1.3).
Museums use video games to enhance engagement and challenge opinions on gaming focusing especially on

[12] https://journals.scholarsportal.info/browse/00113069/v56i0003
[13] https://www.ne-mo.org/news-events/article/nemo-report-on-digital-learning-and-education-in-museums
[14] https://journals.scholarsportal.info/browse/00113069/v56i0003
[15] https://icom.museum/en/news/museums-video-games-two-projects-developed-in-argentina/
[16] https://www.vam.ac.uk/young?srsltid=AfmBOorheM3CRCh7TROpw3kmp3KaIaDcQEpuLhR7SsSZTQrJgg4BN9EY
[17] https://www.nationalgallery.sg/programme/gallery-childrens-biennale-2023-lets-make-a-better-place
[18] https://www.museumnext.com/events/museum-games-play-summit/

kids and families. They advocate for play as a way of developing skills, being creative and having fun. Examples are: The National Gallery Singapore commissioned game development for their core value areas "Care, Respect, Imagine, Collaborate". Mi Rasna's case study (2018) consists of a strategic initiative to promote cultural heritage through a serious game (SG) focused on ancient Etruscan civilization. The experience was developed by EGA Entertainment in collaboration with several cultural institutions in central Italy. The Young V&A team worked closely with Microsoft to develop their own Minecraft. Challenges were anchored in the period of the project development during COVID-19 - like remote working and budget constraints. Their practical considerations to think about when bringing play to the museum are behaviour management, communication expectations as clearly as possible, providing clear guidance, supporting person-to-person communication, display maintenance, and ensuring resources are in place to provide the experience on an ongoing basis like material, repair, and cleaning. The Museo Histórico Sarmiento (Buenos Aires) and the Archivo-Museo Carmen Funes (Neuquén, Plaza Huincul) have both succeeded in producing two video games based on their assets, both aimed at children. Museum of Applied Arts and Science - Gaming Community Engagement in Museums - Australia was discovering the untapped potential of harnessing the gaming community's expertise in modern museums[19]. They shed light on the diverse ways consulting with the gaming community and how it can revolutionize curatorial, archival, and conservation practices. They highlight that from world-building to data management, gamers bring fresh perspectives and technical skills, which can be used in the creation of immersive exhibits and the preservation of digital games and accompanying virtual objects. With the consent of Alysha Connor (Audio Visual Preservation Specialist, PhD candidate at Deakin University), the project obtained access to the short version of her **video presentation**.

3.1.9 Conclusions

The integration of video games into museums is a highly promising avenue, currently being explored. Yet, the integration of the museum and gaming worlds is challenging, as games cannot be introduced to the museums as a new format, but must be compliant with the motivations, goals, activities, as well as digital readiness of the museum sector, as well as a wider discourse about critical new museology. This means the video game as a digital format has to adjust to the context of the museums to support achieving the goals of the museum sector.

The gamification approach is relevant in museums for a variety of purposes across all museum functions: democratization of the museum and audience engagement, including attracting underrepresented groups; improving learning skills and facilitating knowledge transfer about cultural heritage; opening up, discovering, and preserving collections; celebrating cultural diversity; enhancing sociability and museum experience; supporting museums as spaces for creativity. Across the selected articles, key themes highlight both the potential and the challenges of this integration. Yet, some areas call for further research and integration of knowledge from outside the museum and heritage fields and lack relevant studies to support innovation goals. Studies on integrating video games into the museum context include exploring how video games can enhance the visitor experience by improving communication and interpretation of museum narratives and utilizing gamified participatory design to involve visitors in exhibit design. They also analyse how games create a more engaging educational experience, developing educational games that mimic real-world museum experiences to facilitate learning and motivation and investigating how serious games can support experiential learning and engagement with museum exhibits among different age groups.

The wider trend in studying how technologies enhance visitor experience has evolved from studying interactive and educational technologies towards more complex research on emerging tech, such as mixed reality (MR) and Metaverse. Although digital tools and formats are acknowledged as crucially important for museum inclusion, there is no sufficient research on how museums can support diversity among visitor groups and enhance access for visitor groups who are more difficult to access by utilizing video games.

3.2 Innovative technologies, games and good practices for the textile and fashion industry, and similar sectors

This section explores the transformative potential of innovative technologies, gamification, and best

[19] https://drive.google.com/file/d/1b4GExzx-4M-zG1aAfNkPJo9IpzGLp_XE/view?usp=sharing

practices in reshaping the textile and fashion industry. By integrating cutting-edge digital tools into design, production, and retail processes, the study highlights how creativity, sustainability, and efficiency can be improved across the value chain. Additionally, it aims to identify successful strategies from other sectors that can be adapted to encourage cross-industry innovation and learning.
Desk research plays a crucial role in this process, offering a comprehensive understanding of the current technological landscape, market trends, and user needs. It supports the development of co-creation actions under WP3, by identifying key challenges, preferences, and behaviours of target groups, ensuring that the co-creation and co-design efforts are both relevant and impactful. The findings also uncover cross-sectoral practices and strategies, helping to adapt successful methods to the textile and fashion domains, while addressing common barriers to technology integration. This ensures that innovative solutions are grounded in practical insights and tailored to the specific needs of the industry.
Beyond informing pilot actions, desk research also contributes to WP5 by providing a framework for developing contextually relevant prototypes and evaluation metrics. It ensures that pilot outcomes are measurable and aligned with stakeholder expectations, while also offering strategies to engage diverse actors effectively. By bridging research with practical application, this approach ensures that the integration of gamification and digital tools not only meets immediate project goals but also establishes the foundation for sustained innovation and growth across industries.

3.2.1 Technology Integration in Fashion

The integration of technology in fashion is transforming the industry by enhancing various aspects of design, production, and consumer interaction. Blockchain technology ensures the traceability and authenticity of textile products, while virtual reality (VR) and augmented reality (AR) offer immersive experiences for consumers/users. Advanced techniques in garment classification and forecasting models optimize product categorization and design processes. Additionally, combining technology with textiles opens new avenues for collaboration across different sectors, promoting innovation and sustainable practices in fashion.

3.2.1.1 Key insights

The digitisation, access, and valorisation of fashion heritage resources at European level has been identified as a need of the fashion and textile industry, and an effort in this direction is made by the European Fashion Heritage Association (EFHA)[20], which provides an international hub to fashion GLAMs and brands to share their digital heritage assets and their experiences and best practices. Such resources provide the ground for further integration of advanced technologies in fashion for innovative services and customer experience.
Blockchain technology can trace and verify textile products, ensuring authenticity and combating counterfeit goods. This method uses decentralized records and smart contracts to enhance transparency and security throughout the supply chain, thereby increasing consumer trust and protecting brand reputation [36].
Virtual Reality (VR) focuses on realistic garment simulation, by addressing aspects like skinning and pose effects. This technology automates garment simulation properties, offering a comprehensive solution for testing garments virtually, which enhances consumer experience by enabling accurate virtual try-ons and better fitting predictions [37].
Augmented reality integrates technology and fashion to increase user engagement by allowing consumers to visualize how garments will look on them without physically trying them on. This provides valuable insights into how augmented reality can revolutionize clothing marketing and user experiences [38].
Advanced garment classification techniques use deep learning and hierarchical label sharing to efficiently extract detailed information from fashion imagery. This method achieves state-of-the-art results without requiring specialized annotations, thus improving the accuracy and efficiency of fashion product categorization [39].
When it comes to gaming and gamification, combining technology and textile can turn the artifact into a technological tool to enhance game activities. This mix opens interesting perspectives for collaboration between technological, fashion, textile companies, and game industries [40].
The "Fashion Island" VR application demonstrates how virtual reality can be effectively utilized in the fashion industry, offering an overview of VR technology's initial uses in fashion. The positive user acceptance of VR

[20] https://fashionheritage.eu/

systems highlights their potential to boost customer confidence and enhance the overall user experience in fashion gamification [41].
Innovative forecasting techniques utilizing novel neural network architecture predict garment popularity based on visual features. Integrated within a VR designer app, it provides real-time popularity estimates for design refinement. This approach offers accurate forecasting without additional inputs, surpassing state-of-the-art models [38].
The Visual InCompatibility TransfORmer (VICTOR) model addresses the need for nuanced outfit compatibility assessment by introducing innovative methods for detecting specific garment mismatches. It utilizes efficient computation techniques without compromising performance. Leveraging Transformer-based models and fashion-specific contrastive pre-training, VICTOR achieves state-of-the-art results in compatibility detection. This approach enhances the accuracy and efficiency of fashion recommendation systems, providing a more refined and personalized shopping experience [42].
The Multimodal Quasi-AutoRegression (MuQAR) model forecasts the visual popularity of new garment designs without historical data, integrating real-time feedback on garment designs without disrupting the creative process. It demonstrates the adaptability and generalization of the proposed architecture across various datasets and domains, making it a valuable addition to any virtual fashion toolkit [43].
Exploring advanced tools like virtual try-on and 3D avatars can significantly enhance user satisfaction through interactive features. These versatile applications are adaptable for both professional design and consumer-facing experiences, catering to diverse user needs and preferences. Leveraging VR, AR, and 3D simulations transforms fashion engagement by providing innovative solutions for garment design and consumer interaction [44].
The Virtual Loom tool allows detailed 3D modelling of historical fabrics, enhancing cultural heritage preservation and interactive exploration. Its intuitive Graphical User Interface (GUI) makes advanced technology accessible and engaging for users without technical backgrounds. Additionally, the flexibility to experiment with weaving techniques and materials supports creative and educational content [45].
Immersive storytelling through digital representation and preservation of traditional crafts enhances virtual experiences by offering engaging narratives. Using Augmented Reality (AR), Mixed Reality (MR), and web-based presentations provides captivating cultural experiences. Additionally, supporting craft education and attracting new apprentices helps preserve traditional crafts on the long-term [46].
Adopting a systematic method to comprehend, educate, train, and preserve crafts enriches virtual experiences through the preservation of traditional crafts and the promotion of cultural heritage. Utilizing computer-aided craft education, immersive interfaces, and simulation techniques expands access to craft learning, optimizes learning resources, and increases engagement. Emphasizing interdisciplinary collaboration and sustainability in craft preservation addresses challenges in documenting, revitalizing, and sustaining traditional crafts [47].
Interactive storytelling and digital technologies can significantly enhance user engagement and experience in the fashion sector, particularly in jewellery design. The integration of storytelling, digital technologies, and fashion can create a deeper meaning beyond the product itself, increasing customer engagement and adding value [48].

3.2.1.2 **Conclusion**

Incorporating advanced technologies into the i-Game platform provides substantial benefits and added value to the platform’s end-users. Blockchain technology ensures the authenticity of digital fashion items and combats counterfeiting, enhancing transparency and building trust among customers. VR and AR deliver immersive experiences, enabling users to try on garments virtually, thereby increasing engagement and satisfaction. Deep learning techniques for garment classification enhance the accuracy and efficiency of product categorization, while innovative forecasting models offer real-time design feedback, improving the creative process. The integration of technology with textiles fosters collaboration across the fashion, textile, and gaming industries, driving innovation, and expanding the platform's capabilities. Additionally, tools like the Virtual Loom and immersive storytelling through AR and MR have the potential to enhance user experience and support cultural heritage preservation, being well in line with the i-Game platform goals of fostering innovation, sustainability, and social cohesion through the co-creation of games.

3.2.2 **Sustainable Fashion Practices in Games**

Sustainable fashion practices in games focus on integrating ethical and eco-friendly principles into interactive and educational gaming experiences. These practices aim to promote mindful consumption, reduce waste, and encourage sustainable behaviour among players. By leveraging game design and technology, these initiatives raise awareness about the environmental and social impacts of fashion, helping consumers make informed decisions and support sustainable brands. This approach not only educates players but also fosters a more responsible and sustainable fashion culture through engaging and innovative gaming experiences.

3.2.2.1 **Key insights**

Ethical and sustainable practices are crucial for integrating ethical fashion knowledge into educational platforms, helping consumers make informed decisions and supporting brands that adhere to these standards[21]. Reducing waste and encouraging consumers to opt for repairs over discarding clothes can significantly extend the life of garments and reduce the environmental impact of fashion [49].

Game design and technological solutions can empower consumers and promote sustainable practices in fashion, demonstrating the potential of gamification in raising awareness and fostering sustainable behaviour through interactive and educational activities [50].

Fashion gaming incentivizes players to adopt mindful fashion consumption and sustainable behaviour. Recent surveys show that mobile gaming is more popular among women, who also spend more on these games. VR and AR can significantly reduce the carbon footprint of fashion items, as illustrated by The Fabricant's work. Additionally, while a majority of citizens express a desire to buy purpose-driven brands advocating sustainability, actual purchasing behaviour is lower. Careful consideration of gamification can reveal players' intrinsic motivations and encourage responsible behaviours like upcycling, wardrobe sharing, and sustainable laundry habits[22].

Threads[23] is an online game that explores the social and environmental impacts of our clothing. It creates a digital experience to bring positive change in how we make, consume, and care for clothes. Co-designed with young people, fashion campaigners, educators, and creative designers, it ensures maximum educational and engagement impacts. Players can follow the story of their clothes in a fun way to understand fast fashion and explore how clothing practices can be improved for the better.

GAME OF CLOTHES[24] is a set of educational and entertaining games designed to spotlight the excessive production and consumption of clothes. The games have clear pedagogical targets and address people of different ages, familiarizing players with the fashion value chain and encouraging critical thinking, debating, and understanding different lifestyles and opportunities. The game package includes a description, cards, rules, and tips available in multiple languages online.

PROJECT CECE [25] provides inspiration for sustainable fashion activities. "Style each other using your existing wardrobes" encourages new combinations and styles from existing wardrobe items, making fashion fun and sustainable. "Digitize your wardrobes" through digital wardrobe apps helps players keep track of what they own and try new combinations, promoting sustainable fashion practices and reducing clothing consumption.

The Interactive Futures Sustainable Fashion Challenge[26] is a competition that explores game design and technology solutions to empower fashion consumers and encourage the fashion and textile industries to develop more robust sustainability practices. The competition was well organized and promoted, offering significant rewards to participants, bridging the gap between game design, technology, and sustainable fashion.

"Recycle the Runway"[27] is a challenge where students design a game to help players make ecologically responsible fashion choices, from their shoes to their hats. The comprehensive framework provides an analytical description of the relevant Sustainable Development Goals (SDGs), key facts related to fashion and clothing, and theme resources and activities, enhancing both educational and engagement aspects.

[21] https://thesustainablemag.com/fashion/gamification-fashion-plays-the-game/
[22] https://www.fashionroundtable.co.uk/news/2021/3/16/fashion-gaming-the-quest-for-sustainability
[23] https://globalgoalscentre.org/project/threads/
[24] https://edugames.recycool.academy/
[25] https://www.projectcece.com/blog/599/fun-sustainable-fashion-activities
[26] https://ukft.org/interactive-futures-sustainable-fashion-challenge
[27] https://gamesforchange.org/studentchallenge/recycle-the-runway

3.2.2.2 **Conclusion**

Integrating sustainable fashion practices into the i-Game project aligns seamlessly with its goals of fostering innovation, sustainability, and social cohesion. By incorporating ethical fashion principles and eco-friendly habits into interactive gaming experiences, the platform can educate users about the environmental and social impacts of their fashion choices. This promotes mindful consumption and waste reduction, encouraging players to adopt sustainable behaviours. Utilizing gamification and digital tools, i-Game can engage a diverse audience, raise awareness about sustainability, and support brands that adhere to ethical standards. This approach not only enhances the educational value of the platform but also drives positive social and environmental impact. The value lies in its ability to transform consumer behaviour, create a more informed and responsible user base, and contribute to a more sustainable future for the fashion industry.

3.2.3 **Fashion Games**

Fashion games are revolutionizing the way consumers engage with fashion through immersive, interactive, and gamified experiences. By integrating VR and gamification elements, these games enhance consumer engagement, brand loyalty, and sales. Digital fashion games combine creativity, community, and fun, offering rewards and social interaction that foster a vibrant user community. High-fashion brands are increasingly collaborating with video game developers to create virtual fashion items, engaging younger, tech-savvy audiences, and providing a new platform for marketing. The growth of the gaming market, accelerated by the pandemic, highlights the potential of fashion games to merge the worlds of fashion and gaming, creating significant commercial opportunities and innovative marketing strategies.

3.2.3.1 **Key insights**

VR's potential to transform fashion e-commerce with immersive, gamified experiences enhances consumer engagement beyond traditional retail environments. Incorporating game elements into virtual reality applications can significantly increase user engagement and enjoyment, potentially boosting brand loyalty and sales [41]. Gamification as a marketing tool can enhance consumer awareness and engagement, demonstrating the significant impact of game elements on user enjoyment and interaction. Studies show that consumers find gamified applications fun, engaging, and beneficial, especially when they offer incentives like discounts or coupons [51].

Digital fashion games can combine creativity, community, and fun, offering rewards and social interaction. These games demonstrate the potential of gamification to foster a vibrant and engaged user community, where players can explore trends, earn rewards, and participate in creative activities [36].

High-fashion brands are increasingly collaborating with video game developers to create virtual fashion items, highlighting their collections within popular games. This trend allows brands to engage with younger, tech-savvy audiences and provides a new, interactive platform for fashion marketing and consumer engagement[28].

Branding fashion through gameplay integrates branded gaming and explores the dynamics in fashion markets using a game-theory approach, highlighting the strategic interactions between brands and consumers in a gamified environment [52].

The gaming market has seen significant growth due to the pandemic, while the fast fashion market has diminished. Real cases from luxury brands like Balenciaga on Fortnite, H&M and Moschino on Sims 4 EA, and Saint Laurent and Marc Jacobs on Animal Crossing highlight the power of gaming in daily life. Crossovers between fashion and games, such as customizable characters and user-created clothing, reflect the deepening integration of these industries[29].

The e-sports and gaming fashion brand "100 Thieves"[30] demonstrates the significant commercial potential of merging fashion with gaming. Starting as a passion project, it grew into a major brand with substantial investments and a diverse revenue stream centred on esports, branded apparel, and community events. The brand emphasizes community engagement, innovative collaborations, and mindful production practices to

[28] https://www.vogue.com/article/video-game-fashion-designer-collaborations
[29] https://contemporaryfashion.com/stories/is-gaming-fashion-the-next-step-for-the-sustainable-fashion-market-to-conquer/
[30] https://100thieves.com/pages/about-us

maintain and grow its market presence[31].
FashionVerse[32] offers possibilities for play, socializing, and creation. Players can earn in-game rewards, move up styling ranks, and create their own scenes. The game integrates the latest fashion trends, real-life brands, and backgrounds. Available on Google Play, App Store, or Netflix, it includes an Ambassadors Program that allows users to shape trends, create content, and enjoy in-game rewards.

3.2.3.2 Conclusion

Leveraging immersive VR and AR applications in the i-Game platform will provide the opportunity to create highly interactive and engaging fashion games, which could lead to increased user satisfaction and extensive game experience. Gamification elements such as rewards and incentives can build strong brand loyalty and encourage users to return frequently. Collaborating with high-fashion brands for unique virtual fashion items will attract younger, tech-savvy audiences and expand marketing opportunities. Emphasizing creativity and social interaction within the games will cultivate a vibrant user community. Additionally, the commercial potential of merging fashion and gaming can open new revenue streams, as seen with successful examples like "100 Thieves." Overall, the use of the above elements available in the i-Game platform, could enable the game creators (platform users) to enhance their end-user (game player) experience, build brand loyalty, create innovative marketing and revenue opportunities and foster community engagement.

3.2.4 Web Platforms & Mobile Applications for promotion of ethical and sustainable practices in fashion

Ethical and sustainable practices in fashion are being promoted through web platforms and mobile applications. These platforms provide brand ratings to educate consumers on ethical standards and offer services that extend garment life, encouraging repairs over replacements. Additionally, they foster collaboration between fashion, technology, and entrepreneurship, driving innovation and the development of sustainable solutions.

3.2.4.1 Key insights

Ethical and sustainable practices are highlighted through comprehensive brand ratings, educating users on the ethical aspects of fashion brands, and encouraging responsible consumer behaviour[33].
Promoting sustainability by offering convenient services that extend the life of garments helps reduce the environmental impact of fashion. Making these services accessible and convenient encourages repairs over replacements, supporting sustainable practices[34].
Bridging the fashion industry with technology, sustainability, and entrepreneurship fosters collaboration and innovation[35]. Promoting partnerships between fashion brands and technology companies encourages the development of cutting-edge solutions and sustainable practices.

3.2.4.2 Conclusion

By incorporating brand ratings that educate consumers on ethical standards, the games created with the use of i-Game platform can foster responsible fashion choices among their players. Offering services that extend the life of garments and encourage repairs over replacements aligns with the project's sustainability objectives, helping to reduce the environmental impact of fashion. Furthermore, promoting collaboration between fashion, technology, and entrepreneurship within the i-Game platform stimulates innovation and the creation of sustainable solutions. These integrations not only enhance user engagement and education but also support the i-Game's mission to advance sustainability and ethical practices in the fashion industry, ultimately creating a more informed and responsible user community.

3.2.5 Gamification in fashion

Gamification attracts Millennials (those born between 1981 and 1996) and Gen Z (also known as Zoomers,

[31] https://www.voguebusiness.com/story/technology/how-las-100-thieves-became-the-biggest-streetwear-brand-in-gaming
[32] https://www.playfashionverse.com/
[33] https://goodonyou.eco/
[34] https://www.sojo.uk/mission
[35] https://fashinnovation.nyc/fantasy-fashion-week/

born between 1997 and 2012) to luxury brands, enhancing engagement and loyalty. It promotes sustainable behaviours by educating consumers on eco-friendly practices. As a marketing tool, it boosts motivation and loyalty through enjoyable experiences. Additionally, it fosters innovation and sustainability by integrating digital design in fashion education and encouraging cross-sector collaboration.

3.2.5.1 **Key insights**

Gamification has emerged as a strategic tool within the fashion and textile industry, leveraging engaging and interactive experiences to drive consumer behaviour, enhance sustainability, and foster innovation. By integrating gamified elements, brands and educational institutions alike are transforming how they communicate, educate, and inspire their audiences [53]. This section explores the applications of gamification in luxury branding, sustainability initiatives, education, and cross-sectoral collaboration, along with its future implications.

Luxury brands such as Gucci, Kenzo, Burberry, and Fendi are utilizing gamification to attract Millennials and Gen Z by stimulating their hedonistic and social motivational drivers. Through gamified experiences, these brands create interactive content that enhances brand coolness and consumer loyalty, serving as a powerful communication tool. The aim is not to develop complex video games but to establish playful and visually engaging channels that resonate with younger audiences, fostering a deeper connection to the brand [54].

Gamification also plays a significant role in promoting sustainable consumption within the fashion industry. By incorporating eco-gamification techniques, such as reward systems that recognize environmentally friendly actions, brands can encourage responsible consumer behaviour. For instance, platforms that score actions like recycling or choosing sustainable materials can incentivize consumers through recognition medals, rewards, or social acknowledgment [55]. This approach connects multiple stakeholders—consumers, service providers, clothing brands, recycling companies, and local institutions—thereby promoting Circular Economy practices and reducing carbon footprints. Gamification not only drives user engagement but also educates consumers about sustainability, fostering a more environmentally conscious society [50].

The educational potential of gamification extends beyond consumer engagement, driving innovation within fashion education and practice. Cross-sectoral collaboration between artists, fashion designers, and game developers has introduced digital design practices into fashion education, fostering innovative virtual fashion experiences. Examples include the use of the Metaverse to create gamified learning environments such as survival games, escape rooms, and interactive mazes [56]. These immersive virtual experiences raise awareness about sustainability while enhancing creativity and multidisciplinary learning. This collaborative approach integrates gamification as a best practice, promoting interactive and dynamic educational environments that prepare future designers for a digital and sustainable future [57].

The adoption of gamification within the fashion and textile industry signals significant potential for continued innovation. Beyond its current applications in luxury branding, sustainability, and education, gamification is poised to reshape how industries interact with consumers and stakeholders. Platforms integrating gamified elements will likely drive greater user engagement, foster community-driven innovation, and address pressing challenges such as sustainability and inclusivity [50] [55]. By leveraging the motivational drivers of diverse audiences, gamification has the potential to inspire both behavioural change and systemic transformation across sectors.

3.2.5.2 **Conclusion**

Integrating these gamification strategies into the i-Game project offers significant value by enhancing user engagement, fostering social cohesion, and driving innovation. Attracting Millennials and Gen Z through interactive fashion games can boost user loyalty and time spent on the platform. Utilizing gamification as a marketing tool, such as offering rewards for completing challenges, increases user motivation and retention. Additionally, promoting cross-sector collaboration and digital design integration can create unique learning experiences and opportunities for creative expression. By leveraging these insights, i-Game can provide a dynamic and engaging platform that encourages diverse participation and innovative approaches to game development and fashion, aligning with its core objectives of community building and innovation.

3.3 Innovative methodologies, approaches, and practices around games for creativity, lifelong learning, and inclusion

This section investigates innovative methodologies, approaches, and practices that use games to support creativity, lifelong learning, and inclusion. It focuses on how games can be designed and implemented to serve educational purposes, enhance creative thinking, and foster inclusive environments that welcome diverse populations. Innovative methodologies, approaches, and practices in the realm of video games have been increasingly recognized for such potential. The section explores the integration of capacity-building, training, and mentoring programs into the game co-creation, design, and management processes. The research also examines how educational strategies can be scaled and adapted to various contexts to support continuous learning and engagement across different stages of life and cultural backgrounds. By examining key literature and case studies, this research highlights the diverse applications of video games, from enhancing cognitive and social skills to promoting gender equality and environmental awareness. The ultimate goal is to provide actionable insights that can lead to more effective, engaging, and inclusive educational games.

3.3.1.1 Transformative Potential of Video Games

Jane McGonigal's book "Reality Is Broken" argues that video games can be powerful tools to address real-world problems and improve lives [58]. She discusses the concept of gamification, where game elements are integrated into non-game contexts to motivate participation and achieve positive outcomes. In education, games inspire learning, boost problem-solving skills, and foster collaboration among students. In health, they promote physical activity, aid rehabilitation, and encourage behaviour change. In business, game mechanics can enhance productivity, motivation, and job satisfaction.

3.3.1.2 Creativity and Engagement in Gameplay

Inchamnan et al. (2014) present a framework to evaluate how game design influences players' creative activities, emphasising task motivation, exploration freedom, and problem-solving [59]. Games like "Minecraft" and "Portal" are highlighted for their potential to foster creativity. Rahimi and Shute (2021) further discuss the impact of game genres on creativity (see details on videogame genres in section 3.5.1), noting that sandbox, puzzle, and simulation games are particularly effective [60].

3.3.1.3 Educational Integration and Cognitive Benefits

Padaya & Chbaklo (2022) explore the integration of video games into education, showcasing their effectiveness in teaching subjects like history, environmental issues, and computer programming [61]. Games are recognized for their cognitive benefits, improving skills such as information processing, attention, and spatial visualisation. Gee (2003) identifies learning principles in video games that can be applied to education, such as active, critical learning, identity formation, and multimodal learning [62].

3.3.1.4 Addressing Gender and Diversity in Gaming

Woolbright (2018) and Hayes (2007) discuss the intersection of gender and gaming, highlighting the underrepresentation of women and minorities [63], [64]. Woolbright examines "Horizon Zero Dawn" for its representation of gender and environmental issues, while Hayes explores the gendered experiences of women playing "Morrowind." Richard (2017) emphasises the importance of culturally responsive computing and supportive communities in creating equitable learning environments [65].

3.3.1.5 Video Games and Scientific Literacy

Steinkuehler and Duncan (2008) argue that MMOs like "World of Warcraft" can foster scientific habits of mind, engaging players in activities parallel to scientific inquiry [66]. Squire (2003) highlights the potential of video games to enhance learning through play, creativity, and skill development [67].

3.3.1.6 Broader Impact on Society

The "Games in Society" section on the Video Games Europe platform[36] outlines the cultural, educational, health, environmental, and diversity impacts of video games. The platform also publishes key reports giving relevant insights into the impact, such as demographics or industry. Notable examples include the "Games

[36] https://www.videogameseurope.eu/games-in-society/

in Schools" project, therapeutic games like "I, Hope," and industry initiatives to reduce environmental impact and promote diversity.

3.3.1.7 Conclusion

The research underscores the multifaceted potential of video games as tools for inclusion, creativity, and lifelong learning. By leveraging game mechanics, educational strategies, and supportive communities, video games can address real-world challenges and enhance various aspects of life. The integration of video games into diverse domains highlights their role as catalysts for positive change, promoting cognitive development, social inclusion, and environmental awareness. As the gaming industry continues to evolve, it is crucial to harness these opportunities to create more inclusive, engaging, and effective learning and development environments.

3.3.2 AI in gaming

The integration of Artificial Intelligence (AI) in gaming has significantly transformed the industry, offering innovative methodologies and practices that enhance inclusion, creativity, and lifelong learning. This desktop research explores various AI-driven advancements in game design, serious gaming, and AI tools for game development. By examining key findings and features of AI applications in gaming, this research provides insights into the potential of AI to revolutionise gaming experiences and educational outcomes.

3.3.2.1 AI and Gaming

Artificial Intelligence has become a pivotal element in game development, providing new ways to enhance interactive experiences. The i-Game project's Task 4.2 focuses on developing AI algorithms to push the boundaries of gaming. Key innovative patterns include:

AI as Role-model: AI agents function as models for player behaviour, encouraging players to mimic AI actions, as seen in games like "Spy Party."

AI as Trainee: Players train AI agents through their actions, exemplified by "Black & White," where players mentor AI creatures.

Neuroevolution: This technique uses evolutionary algorithms to train neural networks, enhancing gameplay experiences but presenting challenges in interpretability and debugging.

3.3.2.2 Game Balance and Serious Gaming

Automated game balance is essential for maintaining player engagement and fair competition. The study by Beau and Bakkes (2016) introduces a framework using intelligent bots and machine learning to automate game balancing in real-time strategy games [68]. Serious gaming leverages the immersive nature of games for education, training, and healthcare, enhanced by AI technologies for personalised experiences [69].

3.3.2.3 Explainable AI (XAI) in Gaming

XAI ensures transparency and comprehension in AI systems, aiding game designers in leveraging AI outputs for improved gameplay. Frameworks like Local Interpretable Model-Agnostic Explanations (LIME) [70] and SHapley Additive exPlanations (SHAP)[37] provide local and global explanations for AI predictions, enhancing the interpretability of AI models. Neuro-Symbolic approaches and surrogate models further improve understanding of AI outputs, facilitating informed decisions and immersive gaming experiences.

3.3.2.4 AI Tools for Game Development

Unity ML-Agents[38]: This toolkit allows developers to integrate machine learning into Unity games, supporting reinforcement learning and other techniques. It provides tools for designing environments, defining agent behaviours, and training agents.

Unity Muse[39]: An AI tool designed to boost developers' productivity and creativity, offering capabilities for chat guidance, texture and sprite generation, animation, and behaviour creation.

[37] https://medium.com/@gauravagarwal_14599/explainable-ai-understanding-the-shap-logic-586fcf54c1b9
[38] Unity-Technologies / ml-agents - https://github.com/Unity-Technologies/ml-agents
[39] https://unity.com/products/muse

AI Tools for Storytelling: Platforms like Twine[40] and Inky[41] enable the creation of interactive, branching narratives without extensive coding knowledge. These tools support the development of rich, engaging stories with user-friendly interfaces.
While there is a large variety of tools, both platform-dependent but also stand-alone ones, the above are some examples that are relevant for i-Game due to their compatibility with the Unity platform.

3.3.2.5 Conclusion

The integration of AI in gaming signifies a major advancement, opening new avenues for creating immersive and engaging experiences. By employing AI and XAI frameworks, game designers can enhance gameplay mechanics and player engagement while maintaining transparency and interpretability. AI tools like Unity ML-Agents and Muse, along with storytelling platforms such as Twine and Inky, provide developers with powerful resources to innovate and refine game design. As AI technologies continue to evolve, they hold the potential to further transform gaming, making it more inclusive, creative, and conducive to lifelong learning.

3.3.3 Value co-creation in games

"Gamers do not just play video games; they also make them" [4]. Gamification and co-creation are closely related, not only due to their interlinkage, but also because they both enhance consumer engagement. Value co-creation – especially through video gaming – affects the customers' behaviour and – thus – their loyalty. Online video players (especially in gaming groups) can co-create and co-destroy value[42] . The motivation behind consumer engagement in the process of value co-creation (user-driven or sales incentives-driven) should be taken into serious consideration when designing video game platforms, digital distribution services or online retail. A new hybrid innovation model of a continuous dynamic customization turns co-creation into a win-win game[43].

3.3.3.1 Key insights

Treating videogames as services rather than products, leads to new value propositions while opening up new audiences. Gaming service providers should provide incentives to players, such as superior functionality, competition, sociability, personalization, and self-indulgence, to attract them in co-creating[44]. Co-creation extends beyond the initial game design phase and continues as an ongoing interaction between players and developers post-marketing (DAVIDOVICI-NORA, 2009).
Gamification facilitates the coordination of knowledge between different actors and the organisation of co-creation, especially in more complex innovation processes[45]. Also, through customers' value co-creation activities, valuable insights about the customer's preferences, capabilities, and expectations are gathered (Ali Hussain et al, 2023).
It is more than obvious that companies (not just in the gaming industry) should develop more gamified co-creation strategies; however, they must make clear the advantages of co-creation to the customers[46].
The vital user community in the gaming industry favours the creation of a collaborative environment among the players[47]. Engagement within online video game platform communities can be influenced by personal, hedonic, and social motivations. These motivations have a positive impact on cognitive, affective, and behavioural aspects, fostering consumer loyalty[48].

3.3.3.2 Conclusion

Gamification facilitates the collaborative development of innovative solutions, enhancing personalised consumer experiences. In video games, players become innovators, through co-creation. Highlighting the importance of value co-creation, of consumer/user engagement and of gamification, offers to the i-Game

[40] Twine - https://twinery.org/
41 ink - https://www.inklestudios.com/ink/
42 http://hdl.handle.net/10125/50031
43 https://ssrn.com/abstract=1427235
44 https://doi.org/10.1016/j.jretconser.2022.103128
45 https://doi.org/10.1111/caim.12356
46 https://doi.org/10.3390/admsci13010011
47 https://sites.les.univr.it/eisic/wp-content/uploads/2018/07/20-EISIC-Abrate-Menozzi.pdf
48 https://sciendo.com/article/10.2478/mmcks-2021-0022

project valuable insights for building the motivational narrative for attracting and engaging platform users and games co-creators from the targeted sectors.

3.3.4 Gamification as a driver for learning

Gamification serves as a powerful driver for learning and value creation, enhancing engagement, creativity, and professional development. In educational and professional contexts, game-based learning boosts motivation, fostering effective problem-solving and innovative thinking. Mentorship and reflective learning are essential for developing professional skills, guiding learners through real-world thinking processes. Gaming simulations create dynamic, problem-oriented learning environments, supporting inclusion and lifelong learning through interactive experiences. The scientific state of the art highlights these methodologies as crucial for effective education and organisational change, making them highly relevant for the i-Game project.

3.3.4.1 Key insights

Game-based learning significantly boosts intrinsic motivation and engagement, making the learning process more immersive. When combined with mentorship, it helps students connect gameplay mechanics, game concepts, and the overall content domain. This holistic approach not only makes learning enjoyable but also ensures that students gain a deeper, more comprehensive understanding of the subject matter (Maxwell Hartt, Hadi Hosseini & Mehrnaz Mostafapour, 2020[49]; Nash & Williamson Shaffer, 2012)[50].

Gamification enhances loyalty, motivation, and engagement by analysing consumer motivations and their impact on co-creation and brand commitment. This approach builds a loyal and engaged user base, driving both participation and long-term interest (Rodrigues, Soares, Oliveira & Lopes, 2021)[51].

Interaction in serious games stimulates active participation and meaningful engagement, encouraging players to reflect and change their perspectives. Reflective phases are critical for evaluating skills and experiences, allowing learners to consolidate knowledge and apply it effectively (Patti, 2018[52]; Kriz, 2003)[53].

Games facilitate a state of flow where players become fully immersed, losing track of time. This immersive state is crucial for fostering creativity and maintaining high engagement levels among participants (Gray, Brown, Macanufo, 2010)[54].

3.3.4.2 Conclusion

Gamification can enhance both intrinsic and extrinsic motivation, driving innovation and effective problem-solving. By integrating mentorship and reflective learning, individuals can cultivate professional aptitudes, guided by mentors through practical thinking procedures. Utilising gaming simulations will create dynamic, problem-oriented learning environments, fostering inclusion and lifelong learning through interactive, immersive experiences. These elements are crucial for bridging education and professional development, driving overall learning and innovation in the project.

3.3.5 Raising awareness through serious games

Game-based learning can be used as a tool for enhancing global change knowledge and promoting pro-environmental engagement in users. From training professionals in Supply Chain Management to making economists think like ecologists, gamified teaching has been proven to make players aware of the unsustainability of the current economy or supply chain model of the industry, while at the same time make them consider and rethink their own actions.

3.3.5.1 Key insights

A game offering multiple points of decision making, allows players to question themselves and gain a deeper

49 https://www.tandfonline.com/doi/full/10.1080/02697459.2020.1778859
50 https://link.springer.com/article/10.1007/s11251-012-9255-0
51 https://www.scielo.br/j/ram/a/96kcJH4hbWNYGC8tHXcmtzs/
52 https://link.springer.com/chapter/10.1007/978-3-319-96071-5_210
53 https://journals.sagepub.com/doi/abs/10.1177/1046878103258201
54 https://commonslibrary.org/gamestorming-a-set-of-innovative-co-creation-tools/

understanding of the drivers and barriers in a certain situation. As a result, we observe that players seek new solutions with raised awareness on their sustainability impact.[55]
Games use experiential learning, leading players to reflect on how their own actions and abilities could play a role in the result. Additionally, findings suggest that it is important to include debriefing sessions after playing a game to deepen participants' experience through group reflection.[56]
Game-based learning improves the capacity of the players to interiorise the current global socio-environmental state through an interdisciplinary approach. More specifically by linking the newly acquired knowledge to known challenges that participants already experience.[57]
Studies show that simulation games are a suitable method for training professionals in Supply Chain Management. By creating a complexity index for these games, we can classify them into categories and always be able to choose the most suitable game for each target group. For the purpose of i-Game project, we can set as a target group fashion consumers and enhance their awareness by educating them in the Supply Chain Management of the industry. Consequently, consumers will be able to make more educated decisions.[58]

3.3.5.2 **Conclusion**

Gamification has been proven to be a powerful teaching tool that enhances players' awareness. Tested in different teaching settings, both practical and theoretical, game-based learning allows players to reflect on their own actions and better interiorise socio-environmental aspects of the situation to which they are exposed. Within the context of the i-Game project, leveraging game-based learning, can motivate fashion consumers to learn the path of the products they choose and realise the difference between sustainable and not sustainable supply chains.

3.3.6 **Inclusive game co-creation**

Diversity in gaming extends beyond cultural and racial representation to encircle access for players with diverse abilities. The gaming industry's efforts to embrace diversity reflect not only a response to the needs of gamers with disabilities[59] but also an acknowledgement of games' power as a medium to bridge the distinction among different cultures. This involves creating games that are universally accessible and enjoyable to all. Recent advancements in technology have activated initiatives to make gaming more human centred, signifying a positive impact to society. According to a design driven Research that was conducted in 2017 within a PhD project that was part of the Creative Industry Scientific Programme (CRISP), stimulating collaboration between companies in the creative industries, industry at large, public sector organisations and knowledge institutes, a "game" was designed to activate the residents of nursing homes with dementia aiming to reduce apathy[60].
Co-creation of games by vulnerable young people working with video-game developers could build resilience[61]. The use of serious games as tools to engage and facilitate co-creation within diverse groups, particularly in contexts involving deaf communities, mental health people, migrants, ethnic groups, could be easily adopted by organisations and projects within EU[62].

3.3.6.1 **Conclusion**

To facilitate inclusivity in the co-creation process it is important to engage the community early (e.g. in brainstorming, play test), to avoid stereotypes and ensure accurate representation (e.g. through collaboration with relevant communities), and to consider different abilities.

55 https://www.mdpi.com/2071-1050/13/23/13277
56 https://www.sciencedirect.com/science/article/abs/pii/S0921344917301751
57 https://riunet.upv.es/bitstream/handle/10251/124443/Hoyos%3bSig%c3%bcenza%3bCapell%c3%a1n-P%c3%a9rez%20-%20A%20collaborative%20game-based%20learning%20to%20enhance%20ecological%20economi....pdf?sequence=1&isAllowed=y
58 https://www.igi-global.com/article/game-based-learning-for-supply-chain-management/319715
59 https://researchrepository.rmit.edu.au/esploro/outputs/9922111519601341
60 https://research.tudelft.nl/en/publications/playful-design-for-activation-co-designing-serious-games-for-peop
61 https://www.tech4community.org/copy-of-social-play-resources
62 https://library.oapen.org/bitstream/handle/20.500.12657/45769/IRS_4_Serious_Games.pdf?sequence=1&isAllowed=y

3.3.7 **Inclusive capacity building**

Inclusive capacity building refers to the fact that every individual, community, and organisation has potential to acquire new knowledge, and develop new skills or evolve existing ones, as long as the training program and tools are designed to accommodate the diversity of needs, preferences, and abilities, such that no one is left behind. As a result, all individuals will have equal chances to develop their capacity to face existing or new challenges in the targeted domain, and at the same time people that were usually left behind will be able to contribute back to their communities and to the society, and to benefit from collective growth and progress.

The design and development of an inclusive approach for adult education involves identifying and bridging gaps in knowledge, skills and resources through sustainable practices and collaboration across different disciplines and sectors. It requires a deepening of understanding about learner's identities, their specific needs and abilities, to abide by human rights and ethics, to design learning materials and environments that support these rights for all members of the community [71]. Thus, the key elements towards an inclusive capacity building approach are:

- **Identifying disparities** - assess and recognize the uneven distribution of capacity across the different sectors and communities.
- **Engaging stakeholders** - identify and involve all relevant stakeholders, ensuring these represent the identified disparities.
- **Leveraging technology** - exploit digital tools to improve access to knowledge to the often marginalised.
- **Fostering collaborative networks** - share resources and expertise is the cornerstone of capacity expansion, as it can amplify the impact beyond what an organisation can achieve alone.
- **Adapting to local context** - provide the flexibility and tools for solutions to be tailored to fit the cultural and environmental context of each community.

Today, technology plays a key role in both formal and informal education, at all education levels. In particular, digital tools have the power to overcome barriers related to distances and differences, not only bridging the gaps, but building new pathways for inclusive capacity building. However, similar to human-based training, capacity building approaches based on technology are also prone to bias (e.g. may favour participants from a particular demographic). Furthermore, digital accessibility must be ensured, e.g. digital learning environments (e.g. platforms), tools and software should be compatible with assistive technologies.

Serious games have great potential to help people develop new skills or improve previously existing ones in an appealing and engaging manner. However, due to personal physical or cognitive limitations, or to other social constraints (e.g. education, language barriers, etc.), some people may be unable to experience all the elements that are present in these games. In particular, this occurs when organisations with commercial interests don't develop games with such audiences in mind or have other constraints such as having a reduced size and/or resources [72]. This inability to access and fully participate in games has resulted in the surge and establishment of the inclusive games, as being proactively designed to optimally fit and adapt to the diverse gamer characteristics and to be concurrently played among people with diverse abilities, and all gamers, without requiring particular adjustments or modifications [73].

3.3.7.1 **Approaches and Strategies for Inclusive Training**

The major serious game frameworks that focus on the successful linking of pedagogy and entertainment, each of them providing a unique perspective to game design, include:

The Games Eules scEnario Model (GREM) [74], which provides a conceptual game model that organises games' features that can produce an engaging serious game experience, and helps developers reuse serious game design characteristics. GREM contains two sub models: the game rules model, which describes the game scenarios model, and the game scenarios model, which defines a game's virtual environment and user interface.

The Activity Theory-based Model for Serious Games (ATMSG) [75], which examines the connection between a serious game's educational and entertainment factors at different levels of detail, considering the learning activity, the gaming activity and the instructional activity.

The Design, Play and Experience (DPE) framework [76], which builds on five main components, including learning, storytelling, gameplay, user experience and technology, linking them to the respective layers.

However, the above-mentioned frameworks have a generic character, and do not particularly address issues of accessibility and inclusive serious game design.
The main strategies for Effective and Inclusive Training [77] focus on:

- **Tailored Learning Paths** - to cater to diverse learning styles and interaction needs
- **Cultural Competence** - to embrace cultural diversity
- **Feedback Mechanisms** - to incorporate regular, anonymous surveys to gather insights regarding the effectiveness of the training program
- **Mentorship Programs** - to pair novices with seasoned professionals to bridge the knowledge gap and foster organic collaboration
- **Accessibility** - to ensure that training materials and tools are accessible to all, including those with diverse abilities, needs, and preferences.

A recently proposed framework for tailorable games targets inclusive end-user development of inclusive games, and builds on the strategy towards universalizing the play by enabling more diverse people to develop their own games [78]. The hypothesis beyond this framework is that if end-users are using game creation tools that are suitable for their interaction needs, and follow a collaborative work model to iteratively improve accessibility features to be inserted into a software architecture able to modify human-computer interaction at use-time, then they would be able to create games satisfying heterogeneous interaction needs of possible players. A **game creation platform, Lepi** (used together with a haptic board **Lepi-Board** to design scenes [79]), was designed to **support inclusive storytelling game creation and play activities by users with different needs and barriers** (e.g. low literacy, low digital skills, cognitive barriers, physical and sensory barriers, cultural barriers, socio-economic barriers, etc.), and provides opportunities for contributions based on skills, interests and knowledge. As pointed out by this research, the collaborative work model is essential when creating inclusive game content, regardless of the mechanics and genres, and two possibilities should be considered, and ideally mixed in iterative cycles of inclusion:

- The creation tool may provide interaction alternatives for its default features. In this case the developers of the tools are responsible for creating and providing interaction alternatives, which is somehow limiting in respect to content and features (mainly re-using existing game assets)
- The creation tool may support user generated content, where the creators make their own game assets (e.g. code, media, story), which provides greater creation flexibility, but there are no guarantees that new content will be accessible to heterogeneous interaction needs.

The takeaway from Lepi platform testing and validation is that in order to generate inclusive games suitable for different interaction needs, there are two essential **requirements for the co-creation platform**: (i) there should be a way to determine who can interact with the currently existing features; and (ii) at an architectural level, there should be alternatives to transform abstract elements and features (mechanic, aesthetics, story, and technology) into concrete accessible game elements.
The Design for somebody approach [80] targets iterative, user-oriented development of motivating serious games for special user groups, which can be adjusted according to the user's abilities. The research pointed out the importance of: (i) designing adaptable content and games in regard to difficulty level and the location of the control points; (ii) in-game social interaction among people with different abilities; (iii) device-adaptable buttons (e.g. simplification, change of size); (iv) use of dedicated functions, such as "safety zone" for people with cognitive disabilities, a panic button, reminders and video phone call features for support; (iv) entertainment features, such as game elements (badges, scores and even real-life prices), music, guided indoor tours at museums, information about places visited, etc.; (v) consideration of real-time real-life changing contexts (e.g. seasonal changes in the weather) which make the game more interesting for users that have limited chances to go out; (vi) paying particular attention to accessibility aspects, such as minimal use of animation, colours used conservatively with high contrast, simple one-view display, placing important information in the middle of the screen. The research also pointed out that games should be designed in a modular fashion from the beginning, and the overall design should be easily personalised. While experimental and iterative development is crucial with special user groups, the tested prototypes should be complete to avoid user frustration. While at the very early stages user proxies could be considered (e.g. normal player that mimics a certain limited ability), the iterative testing should include participants with different needs and abilities, in particular with more advanced prototypes.
More recent research differentiates between accessibility and diversity aspects in the context of inclusive

game design development, and proposed different frameworks applicable for these two aspects [81]. As pointed out, "All players should have the opportunity to play, engage with and enjoy a game, especially games that are designed to educate or transform the player. In addition to the game interface, mechanics and artwork, high quality games must also ensure that all players can use the controls, understand the context, receive information from the game, and have a sense of belonging to the world of the game, or ability to identify with messages and in-game worlds." The proposed framework for designing games for diversity looks into Equity, Inclusion and Diversity (EID) from the perspective of the development team: who is part of the team, who is making decisions, who has the power, and how this design team portrays game worlds, environments, storylines, and characters in their games.

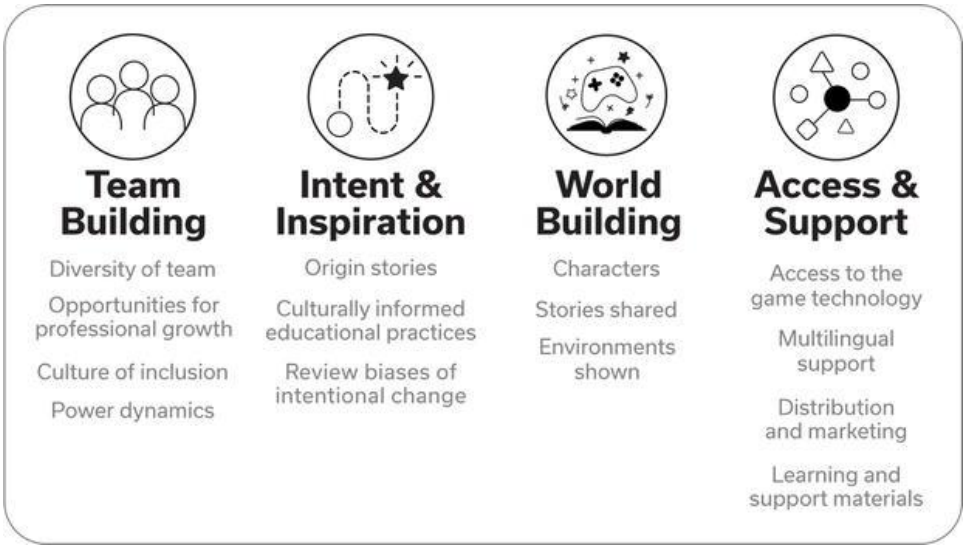

Figure 2. Framework for designing games for diversity (from [81])

As shown in Figure 2, there are 4 main elements to consider when designing games for diversity:

- Team building: diversity of the team, opportunities for professional growth, culture of inclusion, power dynamics
- Intent and inspiration: origin stories, culturally informed educational practices, review biases of intentional change
- World building: characters, stories shared, environments shown
- Access and support: access to the game technology, multilingual support, distribution, and marketing, learning and support materials.

3.3.7.2 **Conclusion**

While a multitude of general frameworks and models for serious games development exist, such as the major ones mentioned above, the approaches towards design of inclusive serious games must take into account additional elements, related to accessibility, diversity, and the potential to provide at the architectural level the necessary tools to facilitate access and use, and transform abstract elements and features into concrete accessible game elements. When it comes to diversity, it is essential to try to achieve all 4 elements of the framework proposed by [81], as this guarantees truly inclusive design. While this section highlighted the major elements to consider when building inclusive serious games from the design phase, the discussion is taken one step further in section 3.6, which is focused on game accessibility.

3.4 Game co-creation, design, and management: frameworks, platforms, and tools

Game development is a multifaceted process that benefits from the collaboration of professionals and individuals with diverse knowledge, skills, perspectives, and abilities. One of the most efficient ways to gather all these views is Game co-creation, which involves project managers, players, artists, designers, programmers, domain experts (e.g. museum professionals, fashion designer, etc.) and other stakeholders (e.g. accessibility experts, testers, social integration experts, etc.) coming together to collaboratively develop a game or app. This approach brings various viewpoints to the table, resulting in more robust, relevant, and

efficient projects tailored to the target audience and the particular scope, in particular when it concerns serious games and gamification.
Co-creation sessions unlock the creative potential of participants, allowing for the development of game-based solutions that extend beyond mere entertainment to include educational, awareness-raising, and exploratory goals. During these sessions, participants address specific questions or problems, working in teams to generate ideas, share perspectives, and decide on fundamental game elements for subsequent development. These sessions are conducted within a constrained timeframe and must incorporate specific topic requirements and boundaries, introducing a structured yet creative approach to game development. The iterative nature of co-creation requires clear definition of team roles and balanced team composition, combining varying levels of experience to enhance the session's outcomes. Involving professionals from multiple disciplines is crucial for effective co-creation, as it ensures comprehensive development across technical, artistic, and business aspects. Experts and industry professionals provide relevant context and maintain alignment with project goals, while problem owners support co-creators in developing prototypes that meet the assignment's objectives. Co-creation not only helps in identifying and resolving potential issues early but also fosters a clear vision and defined goals, facilitating creative and innovative design from the start.
By engaging diverse stakeholders early on, co-creation allows for early feedback, helping to ensure that the final product meets market expectations. It also strengthens team cohesion and internal communication, aligning everyone with project objectives and reducing future misunderstandings or conflicts. This collaborative approach supports efficient resource planning and prevents scope creep.
Additionally, co-creation lays a solid foundation for detailed design and prototyping. With a clear vision, design teams can produce aligned documents and prototypes, streamlining iterative refinement and minimizing risks. This process also builds trust with stakeholders, demonstrating a transparent and committed planning process that can attract and secure financial support. Moreover, co-creation integrates well with agile methodologies, enabling iterative development and continuous improvement based on feedback. Its flexibility allows ideas to evolve and adapt throughout the game's development, ensuring ongoing alignment with new insights and changing circumstances.
In the realm of game co-creation, design, and management, various frameworks, platforms, and tools play pivotal roles in facilitating collaborative development on various aspects. Understanding their impact requires an exploration of how these technologies support and influence team dynamics, creativity, and efficiency. In section 3.4.1 an overview of the main aspects of the collaborative development is provided, while in section 3.4.2 an in-depth analysis at how these platforms and tools contribute to these aspects is provided.

3.4.1 Collaborative development principles

Collaborative development in game design is underpinned by the principles of collective intelligence and shared expertise. This approach suggests that the integration of diverse perspectives and skills enhance problem-solving capabilities and foster innovation. Tools and platforms that enable real-time communication, shared workspaces and joint problem-solving are essential in leveraging collective intelligence, thereby facilitating a more cohesive and efficient development process.

3.4.1.1 Efficiency and Coordination

The efficiency of collaborative development is closely related to the principles of project management and workflow optimization. Task decomposition and resource allocation are critical in understanding how teams can manage complex projects. Effective coordination is achieved through the use of frameworks that streamline task assignment, track progress, and ensure timely delivery. Theoretical models like Agile and Scrum emphasize iterative development and continuous feedback, which are supported by platforms that provide visibility into project status and facilitate adaptive planning.

3.4.1.2 Creativity and Innovation

Creativity in game design is often nurtured through environments that promote experimentation and iterative learning. Platforms that enable brainstorming, prototyping and iterative refinement allow teams to explore and develop innovative ideas. Constructs such as divergent and convergent thinking highlight the

need for environments that balance freedom of exploration with structured evaluation.

3.4.1.3 Integration and Interactivity

The integration of different tools and platforms into a cohesive development environment is vital for facilitating effective collaboration. Systems theory and integration theory emphasize the importance of creating interconnected systems that support seamless interaction between various components. Platforms that offer integrated workflows and interoperability between design, development, and management tools enable teams to work harmoniously, reducing friction and enhancing overall efficiency.

3.4.1.4 Feedback and Iteration

Iterative design process and feedback loops illustrate how regular evaluation and adaptation contribute to refining game design and development. Platforms that support iterative cycles and facilitate feedback collection play a crucial role in enabling teams to respond to changing requirements and improve their work incrementally.

3.4.1.5 Communication and Knowledge Sharing

Effective communication and knowledge sharing are fundamental to successful collaborative development. Theoretical frameworks such as communication theory and knowledge management emphasize the need for clear and structured communication channels. Tools and platforms that facilitate real-time discussions, document sharing, and collaborative editing are essential in ensuring that team members are aligned, and that knowledge is effectively disseminated and utilized.

3.4.1.6 Stakeholder Engagement and Alignment

The involvement of various stakeholders, including users, designers and developers is critical in aligning the development process with project goals and user needs. Theoretical perspectives on stakeholder theory and participatory design highlight the importance of engaging stakeholders throughout the development lifecycle. Platforms that enable stakeholder collaboration and feedback integration help ensure that the project meets the needs and expectations of all involved parties.

3.4.2 Co-creation platforms and tools

This section presents a list of the most used and well-known platforms and tools for co-creation purposes or that may help manage a co-creation project, classified by their main scope and function, along with an analysis of their functionalities and characteristics, as well as their strengths and weaknesses in relation to the targeted scope.
The objective of this analysis is to identify Best Practices and provide a clear understanding of which functionalities are essential, which are optional, and which are innovative differentiators. This may help later to prioritize technical development efforts and resources allocation.

3.4.2.1 Communication and team collaboration tools

3.4.2.1.1 Microsoft teams

Microsoft Teams[63] is a collaboration and communication platform developed by Microsoft, designed to integrate people, content, and tools to enhance efficiency and productivity within work teams. It combines chat, video calls, file storage, and Office 365 applications into a single solution. It is considered a great tool for daily communication and virtual meetings.

Main features:

- **Communication Channels:** Creation of specific channels for projects, teams, or topics, accessible by team members.
- **Integration with Other Applications:** Integration with Office 365 applications and third-party tools such as Trello, Asana, and more.
- **File Sharing:** Users can share and collaborate on documents and files directly within the platform.
- **Chat and Direct Messages:** Real-time communication through group chats or one-on-one direct messages.

[63] https://www.microsoft.com/en-us/microsoft-teams/group-chat-software

- **Conversation History:** Automatic saving of chats and files for easy access and future reference.
- **Threaded Conversations:** Allows responses to specific messages within a channel without interrupting the main flow.
- **Video Calls and Voice Calls:** Conducting video calls and voice calls with features such as screen sharing.
- **Real-Time Document Collaboration:** Joint editing of documents in real-time through integration with Office 365 applications.
- **Bots and Automation:** Integration of bots and automated workflows to improve team efficiency.
- **Security and Access Control:** Advanced security features such as data encryption, multi-factor authentication, and user permission control.

Pros:

- **Integration with the Microsoft Office ecosystem:** Facilitates collaboration on documents.
- **Video calls**: Advanced video conferencing and virtual meeting features.
- **Integrations**: Wide range of integrations with other applications and services.
- **Compliance**: Secure platform compliant with Microsoft's security standards.

Cons:

- **Learning Curve**: It may have a learning curve for new users due to its wide range of features.
- **Cost**: Some advanced features may require premium subscription plans.
- **Integration**: Integration with third-party applications may not be as seamless as in other specialized platforms.

3.4.2.1.2 Slack

Slack[64] is an instant messaging platform designed for team communication, with channels organized by topics, projects, or teams. It is a multifunctional platform for project management and note-taking, allowing the creation of databases, tables, and task lists. It is considered a great tool for daily communication and virtual meetings.

Main features:

- **Communication Channels**: Public and Private Channels: Creation of channels accessible to everyone or restricted to certain users.
- **Direct Messages**: One-on-one or small group communication through direct messages.
- **Integrations with Other Tools**: Slack integrates with various applications and services, centralizing the necessary information and tools.
- **File Sharing**: Users can share files in channels or direct messages, facilitating real-time collaboration.
- **Conversation History**: Slack keeps a history of conversations and files, allowing users to search and retrieve past information.
- **Threaded Conversations**: Threads allow responses to specific messages without interrupting the main conversation.
- **Real-Time Collaboration Tools**: Features like polls, emojis, mentions, and reactions facilitate quick decisions and instant feedback.
- **Video Calls and Voice Calls**: Integration of voice and video calls, including screen sharing, essential for real-time co-creation.
- **Bots and Automation**: Incorporation of bots and automated scripts to improve efficiency and focus on creative tasks.
- **Security and Access Control**: Offers two-factor authentication, data encryption, and administrative controls to manage access and permissions.

Pros:

- **Real-Time Communication**: Facilitates rapid and efficient communication among team members.
- **Channel Organization**: Allows projects to be divided into thematic channels to keep discussions organized and focused.
- **Integrations with Other Tools**: Connects with a wide range of applications and services to automate workflows.

[64] https://slack.com/

- **Search and Archiving of Messages**: Provides powerful search features to quickly find old messages or shared files.
- **Customization and Flexibility**: Allows for notification customization, creation of keyboard shortcuts, and integration of bots according to team needs.

Cons:

- **Learning Curve**: May be difficult to master for users unfamiliar with instant messaging tools.
- **Cost**: Advanced features may require premium subscriptions, which can be costly for large teams.
- **Potential Communication Dispersal**: Multiple channels may make it challenging to track discussions and decisions.
- **Security and Privacy**: While robust encryption is implemented, there may be concerns about data security and privacy.

3.4.2.1.3 Mattermost

Mattermost[65] is a collaboration and communication platform designed primarily for team communication. It provides a good self-hosted alternative to other popular messaging platforms like Slack.

Main features:

- **Team Communication Channels:** Organize conversations into public or private channels based on teams, projects, or any other criteria.
- **Team Communication Direct Messages:** Allows one-on-one or group conversations outside of channels.
- **On-Premises Deployment:** Unlike many other collaboration tools that are cloud-based, Mattermost can be hosted on your own servers, giving you full control over your data.
- **Data Privacy and Security:** Offers enhanced security features suitable for enterprises that need to maintain strict control over their data.
- **Integrations:** Compatible with a wide range of third-party tools and services, allowing teams to integrate their workflows seamlessly.
- **Custom Plugins:** Supports custom plugins to add or extend functionality according to specific needs.
- **Flexible and Extensible:** Highly customizable in terms of interface and features, suitable for various organizational needs.
- **APIs and Webhooks:** Provides APIs and webhooks (event-driven communication procedures to send data between applications) for integrating with other software and automating workflows.
- **File Sharing:** Easily share files, images, and documents within channels or direct messages.
- **Searchable Archives:** Powerful search functionality that helps you quickly find past messages and shared files.
- **Task Management:** Includes tools for managing tasks and projects within the communication platform.
- **Collaboration Boards:** Similar to Kanban boards[66] for visual task management.
- **Cross-Platform Support:** Available on Windows, macOS, Linux, iOS, and Android, ensuring team communication is accessible across various operating systems and devices.
- **Compliance:** Meets various regulatory compliance standards, making it suitable for industries with strict compliance requirements.
- **Audit Logs:** Provides detailed audit logs for tracking user activity and system changes.

Pros:

- **Open Source and Customizable**: Provides flexibility and the ability to tailor the platform to fit specific workflows and integrate with other tools.
- **Self-Hosting Capabilities**: Organizations can host Mattermost on their own servers, to ensure complete control over data, enhancing privacy and security, and ensuring compliance with internal security policies.
- **Advanced Messaging Features**: Offers a variety of messaging features, including public, private, and group channels, powerful search capabilities.
- **Integration with Other Tools**: It integrates with a wide range of applications and services, such as Jira,

[65] https://mattermost.com/
[66] https://en.wikipedia.org/wiki/Kanban_board

GitHub, and Slack, and streamlines workflows and enhances functionality through the use of plugins and third-party applications.

Cons:

- **Learning Curve:** May require initial training sessions to help users become proficient, which can be time-consuming and resource-intensive.
- **Cost:** The cost can be significant for larger teams or organizations needing enterprise-level features and support.
- **Integration Complexity:** The setup and maintenance of these integrations can be complex and time-consuming.

Resource Intensive: Maintaining the necessary server infrastructure and technical support can be costly and demanding for IT teams.

3.4.2.1.4 Discourse

Discourse [67] is an open-source discussion platform designed for creating community forums, team collaboration spaces, and discussion boards. It aims to foster meaningful conversations, collaboration, and content sharing among users.

Main features:

- **Modern Interface**: Discourse offers a clean, user-friendly interface with infinite scrolling, dynamic notifications, and a responsive design that works well on both desktop and mobile devices.
- **Community Building**: Users can create topics, post replies, like comments, and mention other users to foster community interaction.
- **Moderation Tools**: Discourse includes robust moderation tools such as spam detection, user trust levels, and administrative controls to manage discussions and ensure a healthy community.
- **Search Functionality**: Advanced search features help users find relevant discussions and content easily.
- **Customizable and Extensible**: It supports plugins and themes, allowing for customization to meet specific needs. Developers can extend its functionality by adding new features or integrating with other tools.
- **Email Notifications**: Users receive email notifications for replies, mentions, and updates, ensuring they stay engaged even when not actively browsing the forum.
- **User Trust Levels**: The platform has a trust system that encourages positive behaviour by granting users more privileges as they participate and contribute positively to the community.

Pros

- **User-Friendly Interface:** The user-friendly design encourages participation and engagement from all community members, reducing the learning curve for new users.
- **Strong Community Management Features:** These features help maintain a healthy and respectful community environment, making it easier for moderators to manage discussions and user behaviour.
- **Open-Source Platform:** The open-source nature provides flexibility and customization options, enabling users to tailor the platform to their unique community requirements without being locked into proprietary solutions.
- **Advanced Search and Analytics:** These tools enable community managers to understand user behaviour, identify trends, and make data-driven decisions to improve the community experience.

Cons

- **Technical Setup and Maintenance:** Users without technical backgrounds might find it challenging to install, configure, and update the platform, potentially necessitating external support or managed hosting services.
- **Cost for Hosted Solutions:** The cost of managed hosting solutions might be a barrier for some users, especially those who prefer an all-in-one package but need to control expenses.
- **Resource Intensive:** Ensuring optimal performance might require investing in more powerful server infrastructure, which can be an additional cost and logistical concern.
- **Learning Curve for Advanced Features:** Users might need to invest time in learning how to effectively

[67] https://www.discourse.org/

utilize and configure these advanced features, which can be time-consuming and require additional training.

3.4.2.2 Productivity and document collaboration suites

3.4.2.2.1 Google workspace

Google workspace [68] is a suite of cloud-based productivity and collaboration applications that offers integrated tools such as Gmail, Google Drive, Google Docs, Sheets, Slides, Blackboards, and Meet. Google Workspace provides a comprehensive suite for document creation and sharing.

Main features:

- **Real-Time Collaboration**: Allows multiple users to work simultaneously on documents, spreadsheets, and presentations.
- **Cloud Storage**: Google Drive offers centralized storage accessible from any device with an internet connection.
- **Integrated Communications**: Includes professional email (Gmail), chat (Google Chat), and video conferencing (Google Meet).
- **Security and Access Control**: Robust user management tools, permission controls, and data protection features.
- **Integration with Other Applications**: Compatible with numerous third-party applications and services, facilitating extended functionalities.

Pros

- **Ease of Use:** Intuitive and accessible interface, minimizing the learning curve.
- **Access from Anywhere:** Enables remote collaboration seamlessly, ideal for geographically dispersed teams.
- **Automatic Updates:** Users always have access to the latest version of tools without managing manual updates.
- **Scalability:** Suitable for teams of all sizes, from small businesses to large corporations.
- **High Availability:** Reliable uptime and guaranteed availability of services.

Cons

- **Internet Dependency:** Requires an internet connection for most functions, which can be problematic in areas with limited connectivity.
- **Recurring Costs:** Subscription model can be expensive in the long term compared to one-time payment solutions.
- **Customization Limitations:** Less flexible in advanced customization compared to some on-premises solutions.
- **Privacy and Security:** Concerns about data privacy and security stored in the cloud, especially in projects with sensitive data.

3.4.2.2.2 Nextcloud

Nextcloud[69] is an open-source platform designed to provide a self-hosted alternative for cloud storage and collaboration. It is similar in functionality to commercial services like Google Drive, Dropbox, and Microsoft OneDrive, but with a focus on privacy, security, and control over data.

Main features:

- **File Storage and Sharing**: Users can upload, store, and share files and folders with others. It supports public and private sharing links, with various permission levels.
- **Nextcloud Talk**: For audio/video calls and messaging.
- **Nextcloud Office**: Integrated with OnlyOffice or Collabora Online, allowing real-time collaborative editing of documents, spreadsheets, and presentations.
- **Nextcloud Deck**: A Kanban-style project management tool for organizing tasks and projects.
- **Synchronization**: Files can be synchronized across multiple devices, ensuring that users have access to their files from anywhere and any device.

[68] https://workspace.google.com/
[69] https://nextcloud.com/

- **Calendar and Contacts**: Users can manage their calendars and contacts, which can be synchronized with various devices and applications.
- **Security and Privacy**: Nextcloud provides robust security features, including end-to-end encryption, two-factor authentication, and comprehensive access control settings.
- **Customization and Extensibility**: The platform is highly customizable, with a wide range of plugins and apps available to extend its functionality. Users can tailor the platform to meet their specific needs.
- **Self-hosting**: Unlike commercial cloud services, Nextcloud allows users to host the software on their own servers, providing full control over their data and infrastructure. This is particularly important for organizations with stringent privacy and data security requirements.
- **Compliance**: Nextcloud helps organizations comply with various data protection regulations by providing tools to control data access and monitor data usage.

Pros

- **Open Source and Customizable:** Users have control over their data and the flexibility to modify the software as needed.
- **Self-Hosted and Secure:** Ensures data sovereignty and compliance with data protection regulations.
- **Comprehensive Collaboration Tools:** Enhances productivity by providing a unified workspace for team collaboration.
- **Active Community and Regular Updates:** Users benefit from ongoing enhancements, security patches, and new features.

Cons

- **Complex Setup and Maintenance:** Organizations may need dedicated IT resources or expertise to effectively deploy and manage Nextcloud.
- **Performance Issues:** Ensuring optimal performance may require significant hardware resources and technical tuning.
- **Limited Support for Mobile Apps:** Users may encounter inconsistencies and limitations when using Nextcloud on mobile devices.
- **Lack of Advanced Enterprise Features:** Large enterprises with complex needs might find Nextcloud lacking in certain advanced functionalities and integrations.

3.4.2.3 Project and task management tools

3.4.2.3.1 Trello

Trello[70] is a visual project management and collaboration tool based on boards, lists, and cards, designed to organize tasks and projects in an intuitive and flexible way. It is a Kanban-based project management application that allows users to organize tasks and projects using cards.

Main features:

- **Boards:** Create boards for different projects or teams, where tasks are organized.
- **Lists:** Lists within boards represent different stages of the project or task categories.
- **Cards:** Cards on the lists represent individual tasks, where details and comments can be added.
- **Labels:** Use colour-coded labels to categorize and prioritize tasks easily.
- **Due Dates:** Assign due dates to cards to manage deadlines and schedules.
- **Attachments:** Ability to attach files and documents to cards to centralize necessary information.
- **Comments and Real-Time Collaboration:** Team members can leave comments and discuss tasks directly on the cards.
- **Member Assignment:** Assign team members to specific cards to clarify responsibilities.
- **Power-Ups and Integrations:** Integrate with other tools and applications through Power-Ups, such as Google Drive, Slack, and more.
- **Notifications:** Automatic notifications about changes, updates, and due dates to keep everyone informed.

[70] https://trello.com/

Pros

- **Ease of Use:** Intuitive interface and easy to learn, suitable for users of all levels.
- **Flexibility:** Adaptable to various projects and work styles, from simple task lists to complex projects.
- **Multi-Platform Access:** Available on web, mobile, and desktop, facilitating collaboration from any device.
- **Affordable Cost:** Offers a free version with robust features and premium options at reasonable prices.
- **Visual Collaboration:** Its visual approach facilitates understanding the status and progress of tasks.

Cons

- **Limitations in Complex Projects:** May not be sufficient for exceptionally large projects or those with advanced management needs.
- **Lack of Advanced Features:** Lacks some advanced project management features, such as Gantt charts and detailed analytics.
- **Internet Dependency:** Requires an internet connection for most functionalities, which can be a drawback in areas with limited connectivity.
- **Limited Organization:** The board-based structure can become chaotic and difficult to manage in projects with many tasks and subtasks.

3.4.2.3.2 Asana

Asana[71] is a project and task management tool designed to facilitate collaboration and organization within teams. It offers both organization and scalability. As a project and task management platform, Asana allows teams to plan, organize, and track their work. It is commonly used for project planning and monitoring, alongside tools like Trello.

Main features:

- **Task Management:** Allows users to create, assign, and track the progress of tasks and subtasks with deadlines.
- **Projects and Timelines:** Provides views such as list, board (Kanban), calendar, and timeline (Gantt) to manage projects.
- **Collaboration:** Facilitates communication through comments on tasks, mentions, and status updates.
- **Integrations:** Compatible with various tools like Slack, Google Drive, Microsoft Teams, and other productivity applications.
- **Automation:** Offers tools to automate repetitive workflows and processes within the project.

Pros

- **Centralized Organization:** All project work can be organized in one place, improving visibility and tracking.
- **Flexibility:** Adaptable to various types of projects and work styles.
- **Ease of Use:** Intuitive interface that simplifies adoption by teams.
- **Efficient Collaboration:** Enhances communication and collaboration among team members by centralizing project information.
- **Scalability:** Suitable for both small and large organizations.

Cons

- **Internet Dependency:** Requires an internet connection for most functions, which may be a drawback in areas with limited connectivity.
- **Costs:** The free version has significant limitations, and premium versions can be costly.
- **Learning Curve:** Some advanced features may require time to fully master.
- **Limited Customization:** Less customizable compared to some industry-specific solutions or very particular needs.

3.4.2.3.3 Jira

Jira[72] is a Project Management and Issue Tracking tool developed by Atlassian, widely used in software development and other technical projects. It supports agile methodologies. Jira is a tool for issue tracking

[71] https://asana.com/
[72] https://www.atlassian.com/software/jira

and project management, especially popular in agile software development. Software development teams extensively use it to manage the project lifecycle.

Main features:

- **Task and Issue Management:** Allows users to create, assign, and track the progress of tasks, issues, and bugs.
- **Agile Methodologies:** Supports agile frameworks such as Scrum and Kanban with boards, sprints, and backlogs.
- **Customizable Workflows:** Offers workflows that can be adapted to different processes and team needs.
- **Reports and Analytics:** Provides advanced reporting and analytics tools for monitoring project performance and progress.
- **Integrations:** Compatible with various tools like Confluence, Bitbucket, GitHub, and other development and productivity applications.
- **Scalability:** Suitable for teams of various sizes, from small startups to large corporations.

Pros

- **Powerful and Flexible:** Highly configurable and adaptable to a wide range of processes and work methodologies.
- **Focus on Agile Development:** Ideal for teams using agile methodologies, improving sprint and task management.
- **Extensive Integration:** Easily integrates with other development and management tools, facilitating a continuous workflow.
- **Visibility and Tracking:** Enhances transparency and tracking of project progress through detailed reports and visual boards.
- **Scalability:** Can grow with the team and organization, offering solutions for both small businesses and large corporations.

Cons

- **Learning Curve:** Can be complex and require time for new users to master completely.
- **Costs:** Advanced versions can be costly, especially for large teams.
- **Initial Setup:** Customization and initial setup can be complicated and time-consuming.
- **Feature Overload:** May be overwhelming for smaller or less technical projects due to its wide range of features.

3.4.2.3.4 TeamMapper (collaborative mind map)

The TeamMapper[73] platform is designed for collaborative mapping and project management. It allows teams to create and share interactive maps, plan, and organize projects visually, and collaborate in real-time. This platform is useful for managing complex projects that require spatial visualization and collaborative input.

Main features:

- **Visual Mapping**: TeamMapper allows teams to create visual maps of their projects and workflows, making it easier to understand and track progress.
- **Collaboration Tools**: The platform includes tools for real-time collaboration, enabling team members to work together seamlessly on the same maps.
- **Customizable Templates**: Users can choose from a variety of templates to quickly set up their projects and tailor them to their specific needs.
- **Task Management**: It provides features for managing tasks and responsibilities, ensuring that everyone knows their roles and deadlines.
- **Integration with Other Tools**: TeamMapper integrates with other popular tools and platforms, facilitating smooth workflow integration.
- **Cloud-Based Access**: Being a cloud-based platform, it allows team members to access their maps and collaborate from anywhere with an internet connection.

Pros

- **Collaborative Mind Mapping:** Teams can visualize and structure their ideas more effectively, fostering

[73] https://www.teammapper.org/

better collaboration and creativity.

- **User-Friendly Interface:** Users can quickly get started with the tool, leading to higher productivity and minimal training requirements.
- **Real-Time Collaboration:** Enhanced teamwork and immediate feedback lead to more efficient decision-making and project development.
- **Integration with Other Tools:** Users can streamline their processes and improve efficiency by linking TeamMapper with their existing toolset.

Cons

- **Limited Advanced Features:** Users needing advanced functionalities such as detailed analytics, task management, or extensive customization might find TeamMapper lacking.
- **Performance with Large Maps:** Users working on intricate or highly detailed maps might encounter performance bottlenecks, impacting their efficiency.
- **Dependence on Internet Connection:** Users without reliable internet access might face interruptions, making it difficult to work offline or in low-connectivity environments.
- **Subscription Costs:** Small teams or individuals with limited budgets may find the subscription costs a barrier to fully utilizing the tool.

3.4.2.4 Documentation and knowledge-management tools

3.4.2.4.1 Notion

Notion[74] **is a one-stop tool for note-taking, project management, and collaborative databases**. It is a multifunctional platform for project management and note-taking that allows users to create databases, tables, and task lists. Notion is a tool useful for documentation and knowledge management during the collaborative co-creation activities.

Main features:

- **Notes and Documentation:** Allows for flexible creation and organization of documents and notes.
- **Databases:** Offers customizable databases for managing tasks, projects, contacts, and more.
- **Real-Time Collaboration:** Facilitates simultaneous collaboration, with comments and mentions to enhance communication.
- **Integrations:** Integrates with various applications such as Google Drive, Slack, and more, and allows for the insertion of multimedia content.
- **Templates:** Provides a wide range of templates for different needs, from project management to personal documentation.

Pros

- **Versatility:** Combines several tools into a single platform, eliminating the need to switch between applications.
- **Customization:** Highly customizable to fit the specific needs of each project and team.
- **Cross-Platform Access:** Available on web, mobile, and desktop, allowing access from any device.
- **Ease of Use:** Intuitive interface that facilitates organization and collaboration without a steep learning curve.
- **Cost-Effective:** Offers a fairly functional free version, with premium options at competitive prices.

Cons

- **Learning Curve:** While intuitive, the high degree of customization can be overwhelming at first.
- **Internet Dependency:** Requires an internet connection for most of its functionalities, which can be a limitation in areas with poor connectivity.
- **Performance with Large Projects:** Can become slow or complicated to manage with a large amount of data or users.
- **Advanced Features:** Lacks some advanced project management features that other specialized tools might offer.

3.4.2.4.2 Confluence

[74] https://www.notion.so/

Confluence is a collaboration and knowledge management tool developed by Atlassian, designed to facilitate the creation and organization of content within teams. It is a collaboration software for creating, sharing, and managing team documents and content. Similar to Notion, Confluence is useful for documentation and knowledge management.

Main features:

- **Collaborative Documentation:** Allows users to create, share, and edit documents and pages in real-time.
- **Hierarchical Structure:** Organizes content into spaces and pages, making navigation and access to information easier.
- **Integrations:** Integrates with other Atlassian tools like Jira, and with various external applications such as Google Drive, Slack, and more.
- **Templates:** Offers predefined templates for different types of content, such as project plans, meeting notes, and more.
- **Permissions and Security:** Provides detailed control over permissions and access, ensuring that only authorized individuals can view or edit specific content.
- **Collaboration and Comments:** Features for commenting and mentioning facilitate communication and feedback within documents.

Pros

- **Efficient Collaboration:** Enhances real-time collaboration with comments and simultaneous editing of documents.
- **Clear Organization:** The hierarchical structure of spaces and pages facilitates organization and access to information.
- **Integration with Jira:** Ideal for teams already using Jira, improving synergy between project management and documentation.
- **Flexibility and Customization:** Highly customizable with macros and plugins that extend its functionalities.
- **Robust Security:** Offers granular permission control and security, suitable for projects handling sensitive information.

Cons

- **Learning Curve:** Can be complex for new users due to its wide range of functionalities.
- **Cost:** Premium versions can be expensive, especially for large teams.
- **Internet Dependency:** Requires an internet connection for most functions, which can be a drawback in areas with limited connectivity.
- **Performance:** Can become slow with a large amount of content or users, affecting the user experience.

3.4.2.5 Online collaborative whiteboards

3.4.2.5.1 Miro

Miro[75] is a visual collaboration tool that facilitates co-creation and organization of ideas through online whiteboards. It is an online whiteboard that allows for real-time visual collaboration, ideal for brainstorming, planning, and design sessions. Such tools are essential tools for the design teams.

Main features:

- **Collaborative Whiteboards:** Allows for the creation and editing of whiteboards in real-time, where users can add sticky notes, drawings, diagrams, and other visual elements.
- **Templates:** Offers a wide variety of predefined templates for different uses, such as flowcharts, mind maps, and project planning.
- **Integrations:** Integrates with various tools such as Slack, Google Drive, Microsoft Teams, Jira, and more.
- **Real-Time Collaboration:** Supports simultaneous collaboration with integrated communication tools like chat and video calls.
- **Infinite Canvas:** Provides an infinite canvas that allows for expanding and organizing ideas without

[75] https://miro.com/

spatial limitations.

Pros

- **Ease of Use:** Intuitive and user-friendly interface that facilitates adoption and use by diverse teams.
- **Dynamic Collaboration:** Ideal for brainstorming sessions, workshops, and strategic planning with real-time collaboration.
- **Flexibility:** Adaptable to a wide variety of projects and work methodologies, from project management to product design and development.
- **Multi-Platform Access:** Available on web, mobile, and desktop, allowing for collaboration from anywhere and any device.
- **Clear Visualization:** Enhances visualization and organization of ideas, making it easier to understand and track progress.

Cons

- **Internet Dependency:** Requires an internet connection for most functions, which can be a drawback in areas with limited connectivity.
- **Cost:** Premium versions can be expensive, especially for large teams requiring advanced features.
- **Learning Curve:** While intuitive, some advanced features may take time to fully master.
- **Performance with Large Projects:** Can become slow or complicated to manage with a large amount of visual elements and users on a single board.

3.4.2.5.2 Excalidraw

Excalidraw[76] is an open-source virtual collaborative whiteboard tool designed for creating and sharing diagrams, sketches, and visual notes. It offers a simple and intuitive interface that enables users to draw freehand, add shapes, text, and connectors, making it ideal for brainstorming, mind mapping, and visual collaboration.

Main features:

- **Collaborative Drawing**: Multiple users can draw on the same canvas simultaneously, making it great for team brainstorming sessions.
- **Intuitive Interface**: Easy-to-use tools that mimic the experience of drawing on a physical whiteboard.
- **Offline Mode**: Users can continue working without an internet connection, and changes will synchronise once reconnected.
- **Export Options**: Diagrams can be exported in various formats such as PNG, SVG, or as an Excalidraw file for later editing.
- **Integrations**: Excalidraw can be embedded in other applications and integrated with various productivity tools.

Pros

- **Intuitive and User-Friendly Interface:** Users can start creating visual content without a steep learning curve, enhancing productivity and creativity.
- **Real-Time Collaboration:** Teams can collaborate efficiently, share ideas, and provide immediate feedback, improving the overall quality of the final output.
- **Open Source and Customizable:** Users have the flexibility to adapt the tool to their workflows and benefit from continuous improvements from the open-source community.
- **Cross-Platform Availability:** Users can work on their projects on the go, maintaining productivity regardless of their location or device.

Cons

- **Limited Advanced Features:** Users requiring more advanced design capabilities might find Excalidraw insufficient for their needs.
- **Performance Issues with Large Drawings:** Users working on extensive or complex projects might encounter difficulties in maintaining smooth performance.
- **Dependency on Internet Connection:** Offline work is limited, which can be a drawback for users in areas with poor connectivity or those needing to work without internet access.

[76] https://excalidraw.com/

- **Limited Integration Options:** Users who rely on integrated ecosystems for their work might find Excalidraw's standalone nature a hindrance, necessitating manual processes to transfer data between tools.

3.4.2.5.3 Mural

Mural[77] is a digital platform that enables online collaboration through an interactive visual canvas. Designed for teams seeking to work together creatively and systematically, Mural facilitates brainstorming, planning, and problem-solving in real-time.

Main features:

- **Infinite canvas:** An unlimited workspace for organizing ideas and projects.
- **Predefined templates:** A variety of templates for different activities, such as brainstorming sessions, flowcharts, and SWOT analysis.
- **Real-time collaboration:** Multiple users can work simultaneously on the same mural, with real-time updates.
- **Integrations:** Compatible with tools like Microsoft Teams, Slack, and other productivity platforms.
- **Ease of use:** Intuitive and user-friendly interface with drag-and-drop tools.
- **Comments and voting:** Features for leaving comments, sticky notes, and conducting votes.
- **Sharing and exporting:** Ability to share murals with other users and export content in various formats.

Pros

- **Enhances collaboration:** Facilitates communication and teamwork, even from a distance.
- **Flexibility:** Suitable for a variety of applications, from project planning to creative sessions.
- **Visualization:** Helps to visualize ideas and complex processes clearly and organized.
- **Accessibility:** Available on multiple devices, allowing work from anywhere.
- **Integrations:** Works well with other popular tools, improving productivity.

Cons

- **Learning curve:** Although intuitive, some users may need time to become familiar with all functionalities.
- **Cost:** Can be expensive for small businesses or startups with limited budgets.
- **Internet dependence:** Requires a stable internet connection to leverage all real-time features.
- **Storage capacity:** Limitations on storage and the number of murals in some plans.

3.4.2.6 Interface and prototype design tools

3.4.2.6.1 Figma

Figma[78] is a web-based design and prototyping tool that allows real-time collaboration, especially popular among interface designers and digital product development teams. It is a cloud-based collaborative design tool primarily used for creating interfaces and prototypes.

Main features:

- **Collaborative Design:** Allows multiple users to work simultaneously on the same design file.
- **Interactive Prototyping:** Facilitates the creation of interactive prototypes for usability testing and presentations.
- **Comments and Feedback:** Users can leave comments directly on designs, making feedback and review easier.
- **Reusable Components:** Allows for the creation of reusable components and shared design libraries.
- **Integrations:** Integrates with various tools and services such as Slack, Jira, Trello, and additional plugins to extend its functionalities.
- **Cloud-Based Access:** All work is saved in the cloud, accessible from anywhere with an internet connection.

Pros

[77] https://www.mural.co/
[78] https://www.figma.com/

- **Real-Time Collaboration:** Enhances teamwork among distributed teams by allowing instant edits and feedback.
- **Intuitive Interface:** Easy to use with a clean interface and powerful features, suitable for both novice and experienced designers.
- **Efficient Prototyping:** Facilitates the creation of interactive prototypes without needing additional tools.
- **Multi-Platform Access:** Available on the web, eliminating the need for local installations and allowing access from any device.
- **Component Libraries:** Increases efficiency and design consistency through the use of reusable components and shared libraries.

Cons

- **Internet Dependency:** Requires an internet connection for most functionalities, which can be a limitation in areas with poor connectivity.
- **Cost:** Advanced versions and premium features can be expensive for large teams or companies.
- **Performance:** May experience performance issues with exceptionally large or complex files, especially on slower internet connections.
- **Learning Curve:** Although intuitive, some advanced features may require time to fully master.

3.4.2.6.2 Sketch

Sketch[79] is a widely-used vector design and prototyping tool for creating user interfaces and user experiences (UI/UX), especially in the development of applications and websites. It is a vector design application for user interfaces and prototyping, with collaboration capabilities through plugins and additional services. Similar to Miro, Figma is among the essential tools for design teams.

Main features:

- **Vector Design:** Allows the creation of precise and scalable vector graphics and designs.
- **Reusable Symbols and Components:** Facilitates the creation and reuse of symbols and components, enhancing design consistency and efficiency.
- **Basic Prototyping:** Provides tools for creating interactive prototypes and linking different screens and states.
- **Integrations and Plugins:** Compatible with a wide variety of plugins and applications, extending its capabilities (e.g., with InVision, Zeplin).
- **Cloud Collaboration:** Sketch for Teams enables real-time collaboration, cloud storage, and version control.
- **Export and Compatibility:** Eases the export of assets in multiple formats and integrates with development tools.

Pros

- **Intuitive Interface:** User-friendly design optimized for UI/UX designers.
- **High Fidelity:** Allows for the creation of high-fidelity designs that are precise and detailed.
- **Design Efficiency:** Tools such as symbols and shared styles enhance design efficiency and consistency.
- **Plugin Ecosystem:** A large number of plugins are available to extend and customize its functionalities.
- **Export Fidelity:** Accurate export of assets and resources, facilitating the transition from design to development.

Cons

- **macOS Only:** Available exclusively for macOS users, excluding Windows and Linux users.
- **Limited Collaboration:** Real-time collaboration is not as advanced as in other tools like Figma, although Sketch for Teams improves this aspect.
- **Plugin Dependency:** Many advanced features require third-party plugins, which can increase complexity and additional costs.
- **Cost:** The cost of Sketch and additional fees for Sketch for Teams can be significant, especially for large teams.

[79] https://www.sketch.com/

3.4.2.6.3 Penpot

Penpot[80] is an open-source design and prototyping platform aimed at providing designers and teams with a collaborative environment for creating user interfaces and user experience (UI/UX) designs. It offers tools for vector design, prototyping, and real-time collaboration, making it suitable for both individual designers and teams working on web and mobile application projects. Penpot is particularly beneficial for teams looking for a free, open-source alternative to commercial design tools like Figma or Sketch, with a focus on collaborative and efficient design processes.

Main features:

- **Vector Design Tools**: Penpot provides a range of vector design tools that allow designers to create detailed and scalable graphics.
- **Prototyping**: Designers can create interactive prototypes to visualize the flow and functionality of their designs.
- **Real-time Collaboration**: Multiple users can work on the same project simultaneously, making it easier for teams to collaborate and provide feedback in real time.
- **Cross-platform Compatibility**: Being a web-based tool, Penpot works across different operating systems and devices, ensuring accessibility and flexibility.
- **Open-source**: As an open-source platform, Penpot is free to use and can be customized according to the needs of the users or organizations.
- **Integration with Other Tools**: Penpot supports integration with other design and development tools to streamline the workflow.

Pros

- **Open Source and Free:** Users can save on licensing costs and have the freedom to adapt the tool to their specific workflows or contribute to its development.
- **Cross-Platform Compatibility:** Teams with diverse hardware setups can collaborate without worrying about platform compatibility issues.
- **Collaborative Features:** Teams can work together seamlessly, share feedback instantly, and make collective decisions quickly, improving productivity and project outcomes.
- **Integration with Other Tools:** Users can create a more cohesive workflow by linking Penpot with other tools they use regularly, reducing the need for manual data transfers and improving efficiency.

Cons

- **Learning Curve:** Time and effort are required to become proficient with Penpot, which could slow down initial productivity.
- **Performance with Complex Projects:** Users working on intricate or highly detailed designs might encounter performance bottlenecks, impacting their efficiency.
- **Limited Feature Set Compared to Leading Competitors:** Users who need cutting-edge features for high-end design work might find Penpot's current capabilities insufficient.
- **Dependence on Internet Connection:** Users without reliable internet access might face interruptions, making it difficult to work offline or in low-connectivity environments.

3.4.2.7 Storytelling and interactive narratives

3.4.2.7.1 Twine

Twine[81] is an open-source tool used for creating interactive, nonlinear stories and games. It is especially popular for creating text-based adventure games, interactive fiction, and choose-your-own-adventure style stories.

Main features:

- **Nonlinear Narrative:** Allows writers to create branching narratives where the reader's choices influence the story's direction and outcome.
- **Hyperlinks:** Uses hyperlinks to connect different passages of text, making it easy to navigate through different story paths.

[80] https://penpot.app/
[81] https://twinery.org/

- **Visual Story Mapping:** Provides a visual interface to map out story branches, making it easy to see and manage the structure of your story.
- **Drag and Drop:** Simplifies the process of creating and organizing story nodes (passages).
- **Scripting (HTML, CSS, and JavaScript):** Stories created with Twine are published in HTML format, allowing creators to use HTML, CSS, and JavaScript for advanced customization and interactivity.
- **Story Formats:** Supports multiple story formats, each offering different features and customization options.
- **No Coding Required:** Basic stories can be created without any programming knowledge, making it accessible to writers and storytellers of all levels.
- **Code Support for Advanced Users:** For those who want to add more complex features, Twine supports scripting and can integrate with other web technologies.
- **HTML Export:** Stories can be exported as standalone HTML files, which can be easily shared or hosted on any web server.
- **Embedding:** Twine stories can be embedded in websites or shared directly via web links.
- **Active Community**: A strong community of users and developers who contribute tutorials, examples, and story formats.
- **Documentation and Tutorials:** Extensive documentation and tutorials available to help new users get started and learn advanced features.

Pros

- **Ease of Use:** This ease of use makes it accessible to a wide range of users, including writers, educators, and hobbyists, allowing them to quickly start creating interactive narratives.
- **Open-Source and Free:** Users can access, modify, and distribute their stories without any cost, making it an ideal choice for those with limited budgets or who value the freedom to customize their work.
- **Flexible Storytelling:** This flexibility enables creators to produce rich, immersive stories with multiple pathways and endings, enhancing the storytelling experience.
- **Strong Community Support:** New users can benefit from the wealth of knowledge available, and experienced users can contribute to and learn from the community, fostering a collaborative environment.

Cons

- **Limited Built-in Features:** Users may need to learn HTML, CSS, and JavaScript to fully utilize the tool's potential and add more complex interactions and customizations to their stories.
- **Performance Issues with Large Projects:** Managing large projects might require significant optimization efforts and can be cumbersome, potentially affecting the user experience and development workflow.
- **Limited Collaboration Features:** For teams working on the same project, coordinating changes, and maintaining version consistency can be difficult, requiring external tools or workflows to manage collaboration effectively.
- **Learning Curve for Advanced Customization:** Users who want to implement more sophisticated features may need to invest time in learning additional coding skills, which can be a barrier for some.

3.4.2.7.2 Inkle

Inkle[82] is a platform and toolset primarily used for creating interactive narrative games and interactive fiction. The company behind it, Inkle Studios, developed it to facilitate the writing of complex, branching stories with a focus on narrative and user choice.

Main features:

- **Interactive Story Creation:** Inklewriter is an easy-to-use web-based tool that allows writers to create interactive stories without needing any programming skills.
- **Automatic Tracking:** It tracks story paths automatically, making it easy to manage branching narratives and ensure all paths are covered.
- **Real-Time Writing and Editing:** Allows for real-time writing and editing of the story, which helps in immediate iteration and testing.

[82] https://www.inklestudios.com/

- **Scripting Language for Interactive Fiction:** Ink is a powerful scripting language developed by Inkle for writing interactive narratives. It is designed to be easy to read and write, making it accessible for writers.
- **Integration with Unity:** Ink integrates seamlessly with the Unity game engine, allowing for the creation of more complex and visually rich interactive games.
- **Flow Control and Variables:** Supports complex flow control and the use of variables to create dynamic and responsive narratives.
- **Flexible Text Options:** Supports rich text formatting, including options for bold, italic, and other text styles to enhance storytelling.
- **Browser-Based:** Inklewriter stories can be published and played directly in web browsers, making them easily accessible.
- **Export Options:** Stories created with Ink can be exported and integrated into various platforms, including mobile and desktop applications via Unity.
- **Choice-Based Interactions:** Allows for complex choice structures where player decisions can significantly affect the story's direction.
- **Story State Management:** Manages story state effectively, allowing for persistent choices and consequences throughout the narrative.
- **Debugging Tools:** Provides tools for testing and debugging stories to ensure all narrative branches work as intended.

Pros

- **User-Friendly Interface:** This makes it accessible for writers and creators who may not have a technical background but want to build engaging narrative experiences.
- **Branching Narrative Support:** This allows creators to develop intricate and engaging stories where choices and consequences play a crucial role, enhancing the interactive experience.
- **Integration with Inklewriter:** This integration allows for easy migration and management of stories between platforms, expanding the functionality and versatility of the tools available to users.
- **Export Options:** These options make it easy to publish and share interactive stories across different platforms and devices, ensuring wider accessibility and distribution.

Cons

- **Limited Built-In Features:** Users may need to rely on additional coding or external tools to implement advanced features and customizations, which can be a barrier for some.
- **Learning Curve for Advanced Scripting:** Users looking to create more intricate interactions or narrative mechanics may need to invest time in learning the tool's scripting language, which can be challenging.
- **Performance with Large Projects:** Managing large branching narratives and ensuring smooth performance may require optimization and careful project management.
- **Community and Support:** Users might find it harder to get help or find resources and tutorials compared to tools with larger, more active communities.

3.4.2.8 Feedback surveys and online forms

3.4.2.8.1 SurveyJS

SurveyJS[83] is an open-source JavaScript library designed to create, render, and manage surveys, quizzes, forms, and polls in web applications. It provides a flexible and customizable platform for collecting user feedback and data.

Main features:

- **Easy Integration**: SurveyJS can be easily integrated into web applications, supporting frameworks like Angular, React, Vue.js, and Knockout.js.
- **Customizable Surveys**: The library allows for extensive customization of survey elements, including questions, pages, and navigation controls, to fit specific needs and design preferences.
- **Rich Question Types**: It supports a variety of question types such as multiple-choice, text input, rating scales, matrices, and more, enabling the creation of complex and detailed surveys.

[83] https://surveyjs.io/

- **Data Binding and Validation**: SurveyJS offers robust data binding and validation features to ensure accurate data collection and enforce rules for user responses.
- **Localization**: The platform supports multiple languages, making it easy to create surveys for a global audience.
- **Responsive Design**: Surveys created with SurveyJS are responsive and work well on various devices, including desktops, tablets, and smartphones.
- **Results Analysis**: It provides tools for collecting, storing, and analysing survey results, which can be integrated with back-end systems or third-party services.

Pros

- **Customizable Surveys:** This flexibility enables the creation of surveys that align with the branding and functional requirements of different projects, enhancing user engagement and data quality.
- **Integration Capabilities:** This facilitates the collection, processing, and analysis of survey data within existing workflows, streamlining data management and improving efficiency.
- **Support for Multiple Platforms:** This cross-platform support allows developers to use SurveyJS in diverse environments and integrate it into a wide range of applications, expanding its utility.
- **User-Friendly Interface:** This ease of use simplifies the survey creation process and ensures a positive experience for respondents, potentially increasing response rates and the quality of collected data.

Cons

- **Complexity for Advanced Features:** Users may need to invest time in learning the advanced features and scripting options to fully leverage SurveyJS's capabilities, which can be a barrier for some.
- **Performance with Large Surveys:** Managing and optimizing performance for extensive surveys may require additional effort and technical expertise.
- **Pricing for Premium Features:** The cost of accessing these features can be significant for smaller projects or organizations with limited budgets, potentially limiting the tool's accessibility.
- **Limited Out-of-the-Box Templates:** Users may need to create their own templates from scratch or modify existing ones, which can be time-consuming and require additional design effort.

3.4.2.8.2 Form.io

Form.io[84] is a comprehensive form and data management platform designed for building, deploying, and maintaining forms, surveys, and data collection applications. It offers a wide range of features that cater to developers and organizations looking to create and manage forms with robust data handling capabilities.

Main features:

- **Form Builder**: Form.io provides an intuitive drag-and-drop form builder that allows users to create complex forms without writing code. This builder supports a variety of form elements, including text fields, checkboxes, radio buttons, dropdowns, and more.
- **Data Management**: The platform allows for seamless data management, including data storage, retrieval, and integration with other systems. Form.io supports both cloud-based and on-premises data storage options.
- **API Integration**: Form.io automatically generates RESTful APIs for the forms and data models created within the platform. This makes it easy to integrate forms and data with other applications and services.
- **Customizable Workflows**: Users can define custom workflows and business rules to automate processes and handle data submissions, validations, and notifications.
- **Security and Compliance**: Form.io offers robust security features, including data encryption, access controls, and compliance with industry standards such as GDPR, HIPAA, and more.
- **Extensibility**: The platform supports custom plugins and extensions, allowing developers to add new functionalities and integrations tailored to their specific needs.
- **Multiplatform Support**: Forms created with Form.io are responsive and can be embedded in web applications, mobile apps, and other digital platforms.
- **Real-time Collaboration**: Teams can collaborate in real-time when designing forms and managing data,

[84] https://form.io/

enhancing productivity, and ensuring consistency.

Pros

- **Flexible Form Builder:** This flexibility enables users to create forms tailored to specific needs and integrate complex data capture scenarios without extensive coding.
- **Integration Capabilities:** This integration capability enhances data management and connectivity, streamlining processes and improving operational efficiency.
- **Support for Advanced Features:** These features allow for sophisticated form behaviours and user interactions, improving the form experience and ensuring data accuracy.
- **Cross-Platform and Responsive:** This ensures that forms are accessible and functional on various devices, enhancing user experience and increasing form accessibility.

Cons

- **Learning Curve:** Users may need to invest significant time in training and experimentation to fully utilize all of Form.io's capabilities.
- **Complexity in Customization:** This complexity can be a barrier for users with limited technical skills, potentially leading to slower implementation times.
- **Cost for Advanced Features:** The cost of these premium options can be prohibitive for smaller organizations or projects, limiting access to some functionalities.
- **Performance with Large Forms:** Managing and optimizing performance for extensive forms may require additional effort and technical resources.

3.4.3 Conclusion

The i-Game co-creation platform should be a comprehensive ecosystem designed to centralize communication, project creation, visual collaboration, and documentation in one place. It might combine the best features of leading tools like Slack, Google Workspace, Trello, Jira, Notion, Miro, Twine and Figma, creating a seamless and personalized experience for non-technical users, such as museum- or fashion-related teams. Its key features should combine:

1. **Real-time communication**: Organized channels, direct messaging, and integrated video calls, similar to Slack, to keep teams connected.
2. **Project creation**: Collaborative spaces (like Trello and Jira) supporting task development, deadlines, and prioritization capabilities.
3. **Visual collaboration**: Interactive spaces for diagrams, prototypes, and brainstorming (inspired by Miro and Figma), ideal for creative and strategic teams.
4. **Centralized documentation**: Flexible databases and hierarchical pages, akin to Notion, to keep all relevant information organized and easily accessible.
5. **Collaborative editing**: Real-time editing tools for the project's related documents, similar to Google Workspace, fostering uninterrupted collaboration.
6. **Automation and connectivity**: Advanced integrations with other platforms and customizable workflows to boost productivity.

This platform should aim to become a practical, accessible, and inclusive solution for multidisciplinary teams designing Serious Games, simplifying the ecosystem of tools, and enabling participants to focus on what truly matters: creating, planning, and executing their ideas efficiently and collaboratively, by building video games that align to their organization's needs and goals.

3.5 Gamer experience

3.5.1 Videogame genres, skills training, and positive effects of gaming

The i-Game project seeks to engage different stakeholders in game co-creation processes, aiming to bring truly needed human motivators to the game play experience by means of intrinsic feelings that can be developed via technology, psychology, art, and storytelling. The challenge is to build on these factors to achieve a real "learning by discovery" memorable experience in the targeted domains (museum, fashion, and

textile industry) that can have the form of a video game. Videogames have genres as it happens with other cultural elements, such as music, books, and movies. These are categories that serve to organize the different videogame manifestations and practices according to common characteristics in terms of gameplay, controls, narrative structures, goal, winning and losing conditions, etc.
Skills are trained when playing video games because these are designed on the top of challenge solving. There is always some sort of ultimate objective that needs to be fulfilled, and several challenges need to be overcome to do so. And solving these challenges either individually or in groups requires putting all our skillset under proof.
Because video games can be selected by genre according to our preferences and motivational characteristics, and thanks to the added value of the skillset training through them, there are several effects that can be seen as clearly positive in relation to playing videogames. Research[85] suggests that some of the top positive effects of video games are:

- Improved Cognitive Abilities.
- Enhanced Problem Solving and Logic.
- Intense planning and strategic thinking.
- Increased Hand-to-Eye Coordination.
- Greater Multi-Tasking Ability.
- Faster and More Accurate Decision-Making.
- Enhanced Prosocial Behaviours.
- Better Eyesight.
- Higher Accuracy and Faster Completion of Tasks.

These positive aspects are clearly connected to the development of the skills of the individual playing the game, either these are hard skills (task and learning based) or soft (social, cognitive, operational, etc.) ones. In a game, the individual plays to solve problems in a similar way to solving work tasks. There are eleven major categories, which correspond to most popular game genres[86]:

- **Action-Adventure Games:** In these games, the player is the protagonist of the story, solving puzzles to advance the narrative. These puzzles often involve manipulating and interacting with in-game objects and characters.
- **Fighting Games:** These games recreate combats, viewed from a lateral perspective or in third person. There are many characters and arenas to select from.
- **Shooter Games:** The primary objective is to eliminate enemies, typically with firearms. Shooter games often require a high level of interaction and strategic planning at a high speed.
- **Platform Games:** Players control a character who must navigate a stage, avoiding physical obstacles through actions like jumping, climbing, etc. This genre balances elements of action and adventure.
- **Puzzle Games:** These games test the player's intelligence and problem-solving skills with activities that can be mathematical, spatial, and/or logical.
- **Racing Games:** Also known as driving games, where players compete in races, aiming to reach a goal before opponents or within a time limit. Typically, players drive motor vehicles, though other possibilities exist.
- **Role-Playing Games (RPGs):** Characterized by deep storytelling and character evolution, these allow players to embark on adventures to acquire weapons, experience, allies, and special powers.
- **Simulation Games:** These aim to represent real-life situations as credibly as possible, often without a definite end goal, serving as realistic experiences that last for long.
- **Sports Games:** Real-world sports such as golf, tennis, soccer, boxing, basketball, and hockey, among others. The mechanics mirror those of the actual sports, sometimes with additional features that can be fictional.
- **Strategy Games (Turn-Based and Real-Time):** Players manipulate large groups of characters, objects, or data, requiring intelligence and planning to achieve goals. While many are military-themed, there are

[85] National Institutes of Health (NIH), Psychology Today, PLOS ONE, Medical Xpress, London School of Economics and Political Science (LSE), British Psychological Society (BPS).
[86] +1! Level Up: Relationship between video game genres and soft skills: https://gecon.es/game-genres-and-soft-skills/

also economic, business, and social strategy games.

- **Survival Games:** Players must gather resources to survive in hostile or complex environments, utilizing their ability to combine environmental elements to create tools or produce resources.

There is no straight-forward relationship between a game genre and the trained skills, as a game indifferent of the genre can relate to any of the major skill categories. The skills can be grouped into 4 main categories, referred as Basic, Cognitive and Physical, Cross-Functional and Emotional. The categories encompass several specifics that can be found in video games, like:

- **Cognitive Flexibility (cognitive and physical skills)**: It allows a person to switch between different concepts or to think about multiple ones simultaneously.
- **Communication (basic skills):** Ability to speak in real life situations (i.e.. lectures, participation in groups) in a manner that transmits ideas, thoughts, or feelings to one or more individuals.
- **Complex Problem Solving (cross-functional skills):** Developed capacities used to solve novel, ill-defined problems in complex real-world circumstances.
- **Stress Management (emotional skills):** Being able to keep the performance up while being stressed by certain stimuli.
- **Creativity (cognitive and physical skills)**: The ability to contribute unusual or clever ideas about a given topic or situation and to develop creative ways to solve a challenge.
- **Monitoring Self & Others (basic skills):** Monitoring/assessing performance of yourself or other individuals or organizations to make improvements or to take corrective actions.
- **People/Team Management (cross-functional skills)**: Motivating, developing, and directing people as they work, identifying the best people for a job/task.
- **Frustration Tolerance (emotional skills)**: Ability to tolerate the frustration failing over and over, trying to achieve an objective.
- **Logical Reasoning (cognitive and physical skills)**: The ability to combine pieces of information to set general rules or conclusions and/or to apply general rules to specific problems to produce answers that make sense.
- **Time Management (cross-functional skills)**: Managing one's own time and the time of others.
- **Self-Discipline (emotional skills)**: To control yourself and to make yourself work hard or behave in a particular way without needing anyone else to tell you what to do.
- **Induction (cognitive and physical skills):** Ability to discover the underlying characteristic in a specific problem or a set of observations, or to apply a previously learned rule to it.
- **Judgment & Decision Making (cross-functional skills):** Considering the relative costs and benefits of potential actions to choose the most appropriate one.
- **Self-Motivation (emotional skills):** The internal drive that leads a person to act towards a goal.
- **Speed of Reasoning (cognitive and physical skills):** Speed or fluency in performing reasoning tasks in a limited time.
- **Coordinating with Others (cross-functional skills):** Adjusting your own actions in relation to others' ones.
- **Organizational Skills (emotional skills):** The ability to use your time, energy, resources, etc., in an effective way so you achieve the things you want.
- **Problem Sensitivity (cognitive and physical skills):** The ability to tell when something is wrong or is likely to happen in a bad way.
- **Self-Confidence (emotional skills):** Confidence in oneself and in one's powers and abilities. To not doubt oneself.
- **Goal Setting (emotional skills):** The process of taking active steps to achieve a desired outcome.
- **Visualization and Spatial Management (cognitive and physical skills)**: To mentally imagine, manipulate or transform 2D and 3D objects or visual patterns and to predict how they would appear under altered conditions.

We can envision the relationship between skills and genres by using a concrete example. It can be taken from Action-Adventure Games where players make choices from several options, face the consequences, and can rewind if the desired result is not achieved. These actions link to specific soft skills such *as Creativity, Logical Reasoning, Induction, Communication and Complex Problem Solving. Examples of video games u*nder this

category include the Uncharted saga[87], the Tomb Raider saga[88], the God of War saga[89], the Assassin's Creed[90] saga, the Professor Layton[91] saga, the Syberia[92] title and the games Detroit[93]: Become Human, American Arcadia[94], Endling[95], The Room[96] or Superliminal[97], to mention some. In fact, some video games have been investigated for their potential to engage players in educational contexts (The Sims[98] or Assassin's Creed), impact on health and well- being (Gris[99], Arise[100] or Animal Crossing[101]: New Horizons), activate mirror neurons, which play a role in learning and enhancing empathy (PeaceMaker[102] or That Dragon, Cancer[103]) and reducing prejudices about mental illness (Hellblade: Senua's Sacrifice[104]). Videogames can also enhance cognitive skills such as spatial memory (Monument Valley[105] and Braid[106]).

Due to neural plasticity, videogames can induce changes in the brain, as stated by one of the first studies based on the commercial video game Super Mario[107] and research is ongoing to determine whether certain games can improve working memory or selective attention. We know that negative effects can also occur, particularly for individuals predisposed to impulse control disorders. These individuals may experience intense anxiety in response to sad or anger-inducing situations and may attempt to alleviate these emotions through behaviours such as sex, gambling, shopping, or gaming. This cycle of temporary pleasure followed by guilt is known as inhibitory control deficit. In such cases, some video games have proven beneficial like the game for health PlayMancer[108] [82] that utilized a 3D gaming environment with biosensor monitoring to help patients improve frustration tolerance, emotional regulation, task planning, and problem-solving skills [79], [80]. And gamers use the visual motion-sensitive area of their brains less frequently than non-gamers, suggesting that gamers can sort visual information more efficiently.

In fact, studies show that comparing the behavioural and brain responses of video game- players (VGP) and non-video game-players (NVGP) during decision-making tasks, gets VGP to be overall faster by approximately 190 ms and more accurate by 2% than NVGP [83]. These results underlie improvements in sensorimotor decision-making abilities due to video game playing. Additional research conducted across six weeks by using 7 games and impacting 38 935 players suggests that time spent playing video games has limited if any impact on well-being. The effects of playing are negligible because they are very unlikely to be large enough to be subjectively noticed as the authors state. The study shows that 1 h day−1 increase in play results in 0.03 unit increase in well-being which means that the average player would have to play 10 h more per day than typical to notice changes in well-being. The results also suggest that intrinsic motivation positively and extrinsic motivation negatively affects well-being which links with the motivational models presented in this text. This aligns with a perspective that the motivational experiences during play may influence well-being: the subjective qualities of play may be more important than its quantity [84].

When it comes to expression and regulation of emotion, video games are powerful tools for fostering positive experiences and promoting positive social behaviour (If Found[109], Life is Strange[110]). They facilitate daily positive interactions, which are essential for building collaborative relationships and fostering creativity. They

[87] https://en.wikipedia.org/wiki/Uncharted
[88] https://en.wikipedia.org/wiki/Tomb_Raider
[89] https://en.wikipedia.org/wiki/God_of_War_(franchise)
[90] https://en.wikipedia.org/wiki/Assassin%27s_Creed
[91] https://en.wikipedia.org/wiki/Professor_Layton
[92] https://en.wikipedia.org/wiki/Syberia_(video_game)
[93] https://en.wikipedia.org/wiki/Detroit:_Become_Human
[94] https://en.wikipedia.org/wiki/American_Arcadia
[95] https://en.wikipedia.org/wiki/Endling:_Extinction_is_Forever
[96] https://en.wikipedia.org/wiki/The_Room_(video_game)
[97] https://en.wikipedia.org/wiki/Superliminal
[98] https://en.wikipedia.org/wiki/The_Sims
[99] https://en.wikipedia.org/wiki/Gris
[100] https://en.wikipedia.org/wiki/Arise:_A_Simple_Story
[101] https://en.wikipedia.org/wiki/Animal_Crossing:_New_Horizons
[102] https://en.wikipedia.org/wiki/PeaceMaker
[103] https://en.wikipedia.org/wiki/That_Dragon,_Cancer
[104] https://en.wikipedia.org/wiki/Hellblade:_Senua%27s_Sacrifice
[105] https://en.wikipedia.org/wiki/Monument_Valley_(video_game)
[106] https://en.wikipedia.org/wiki/Braid_(video_game)
[107] https://en.wikipedia.org/wiki/Super_Mario
[108] https://idibell.cat/en/2011/10/playmancer-project-awarded-as-the-best-european-serious-game-on-health/
[109] https://en.wikipedia.org/wiki/If_Found...
[110] https://en.wikipedia.org/wiki/Life_Is_Strange

also offer a safe environment for players to learn emotional regulation, and this is particularly beneficial for regular players, who tend to express emotions more intensely within the familiar context of gaming.

3.5.2 **Positive psychology theories and game design**

Game Design is built upon the Motivational Design paradigm which seeks for growth in terms of competencies and skills, in addition to a true change in behaviour. It has to be sustained over time and selected by our participants. Like what happens in video games. In fact, if we design experiences like games are, our audiences will prefer them because they will feel autonomous when presented with a set of alternatives to select from.

Game Design techniques are based on the use of immersive, smart, online, and mobile technologies plus a storytelling layer and a well-implemented set of content along with some positive psychology. If we add the technical rigor and a sufficient amount of surprise, we can guarantee that motivation will be present, and the engagement will start flowing. And when engagement is there, transference stays. Education happens. It is about designing from Psychology first to implement via Technology afterwards.

Therefore, positive psychology evidence that Motivational and Game Design can be used to create video games that:

- Operate on the basis of engagement triggering.
- Can be designed specifically for different segments, audiences, targets, and users' typologies.
- Guarantee measurement, KPIs and indicators, because there is interaction and the implementations can
- Can be as analogue or digital, as necessary.
- Start as a powerful communicative capsule where both metaphor and narrative play an important role.
- Their activities (missions) should be chosen, never forced.
- Implement "learning by doing" which flows within a game since it focuses on solving challenges.
- Connect with our new realities where the experience layer is at the top of the product.
- Allow the audience to express themselves as needed because it can happen at any moment and via different platforms.
- Promote cooperation between several individuals and this helps building communities that support their actions and progress.
- Are fully adaptive processes that have already been applied successfully to improve both the engagement and the results achieved with the training in all kinds of educational contexts.

The cognitive basis for gaming is the Social Cognitive Theory affirming that change in behaviours are a combination of enhanced skills and confidence as a true intrinsic motivator of self-efficacy [85], [86]. Among the several cognitive behaviour models there are the following:

- Transtheoretical Model (TTM) [87].
- Social cognitive theory (SCT) [85].
- Theory of planned behaviour (TPB) [88].
- Health belief model (HBM) [89].
- Self-determination theory (SDT) [90].
- Precaution adoption model (PAM).
- Goal Setting Theories [91].
- Elaboration Likelihood model [92].
- Behavioural Self-Regulation Model [93].

The gamification community agrees that the SDT has a great application on video games, design, and implementation. The model has three elements. First of all, the fact that people are motivated when they feel a sense of control and then, determining the outcome of their actions. This is what we understand as autonomy. Secondly, people are motivated if they feel competent because they master a certain task. This is called domain. Lastly, people need to feel related to others. This is community and relationship. The SDT is the basis for game design and creation because it directs players to:

- Share, what they do.
- Decide, what to do.
- Master, the whole activity.

There is an additional and well-known model called PERMA that delineates the key components that contribute to human happiness and offers a comprehensive framework to better understand what constitutes happiness [94], [95]. It consists of five fundamental elements: Positive Emotions, Engagement, Relationships, Meaning, and Achievement. A heightened level of positive emotions is correlated with increased creativity, courage, and optimism, which collectively enhances performance in various activities, including the playing of video games. If positive emotions are present, there is a greater satisfaction and happiness, and it is clearly derived from gameplay. Engagement grows. The latter lies underneath the concept of flow that encapsulates a state of deep immersion and focus where individuals become so engrossed in an activity that they lose track of time. For players to achieve flow in gaming, several conditions must be met:

- The game must be intrinsically rewarding and engaging to players.
- Challenges within the game should be balanced with the player's abilities, ensuring that tasks are neither too easy nor too difficult.
- Players should experience a sense of control over their actions within the game. They understand the ruleset and feel comfortable with it.
- Therefore, a good game encompasses autonomy and control as the two minimum ingredients for it to work as it should. And additionally, we need to respect that humans are inherently social beings who thrive on connections with others.

When it comes to competition or cooperation within a game, game designers deal with positive interpersonal relationships that contribute to broader perspectives, stronger support systems, and greater psychological stability. The diverse range of contemporary games often explores various social dynamics and relationships, enriching the gaming and vital experience.

Meaning and purpose are perceived clearly in a game because players are the protagonists. They are more likely to engage in reflective thinking and strive for better performance, entering a positive feedback loop where the game helps them foster resilience and optimism. And with this condition it becomes easier to confront challenges. In gaming, providing players with opportunities for small and significant achievements can enhance their acceptance of challenges, resilience, and overall sense of accomplishment and satisfaction, thereby motivating them to overcome obstacles which is the main purpose.

There is a correlation between playing video games and cognitive growth, particularly in problem-solving skills. Video games facilitate learning through trial and error, because they can be seen as simulators, applied games or gamified training experiences, and these allow for a training that starts with an initial “tutorial” phase that is followed by the simulation experience, in which the gameplay rules do not have to be linear, but dependant on the decisions of the user. And he or she focuses and concentrates the efforts on certain tasks while using the imagination as an essential part. In general terms, learning actively helps improve and progress through abilities and skills growing. Simulators and video games are great tools that require players to try multiple approaches to solve problems.

The majority of existing studies suggest a clear relationship between video games and the player's behaviour [85], [86], [87], [88], [89], [90], [91], [92], [93]. These can impact on their personality, summing up emotions, reflexes, behaviours, motivations, needs, the way of thinking and their approaches to situations. And behaviours can be changed for better or worse. The changes are much more visible in teenagers because they are growing, not fully formed yet mentally speaking. The truth is that playing a specific video game offers different conclusions depending on the person, the way the content of the video game is displayed and the interpretation of it in the player's mind. The personality of the person is definitive on how to think and behave for each condition and therefore on the in-game behaviour. We are dealing with positive effects through this document, related to the improvement of their social and mental skills when finding solutions for the challenges. But we know that effects might be also negative on their personality side, showing violence, aggression, anxiety, and stress in some cases. Balance when game designing is key.

Besides the model itself, there is clear evidence that suggests no connection between gaming and poor mental health, distinguishing between gamers that play because they want to and those to whom feel they have. Again, not the quantity, but the quality which counters because if I choose to do so, data does not suggest that it affects mental health. A recent study [84] used a variety of video games including Animal Crossing: New Horizons, Gran Turismo Sport, Apex Legends and Eve Online confronting 40k gamers. In fact, evidence suggests that most players engage in gaming with friends, enhancing social interaction and teamwork. Games like League of Legends or Fortnite demonstrate the potential for building strong social

bonds through collaborative gameplay. While violent video games are often criticized for their potential negative impact, recent studies have contradicted much of this rhetoric because it is frustration due to lack of control and not the content itself that can drive negative behaviours, always assuming that games are played at the appropriate age and avoiding excessive play.

3.5.3 **Motivators Contributing to the Engagement**

The benefit of a playful approach to learning in a framework that combines teamwork with competition between team-members is undoubtable. It has been said that autonomy and control are the pillars of educational memorable experiences while combined with a social approach of gamification, which uses social networking elements. This sum up allows combining the long-term motivational benefits of social approach with the collaborative and participative capabilities offered by gamification. We should not forget that enjoyment is an important factor contributing to learning improvements and gamification can help accomplishing it because it generates motivation, which becomes especially relevant in the three types of activities that we seek in non-specifically ludic contexts such as museums: creative work, mundane tasks and behaviour change for the visiting audiences.
In fact, video games are a format, whereas serious (applied) games in museums are a concept with pillars such as storytelling and gamified design. These can be utilized in museums to create engaging, memorable, and educational experiences that allow museums to transform traditional exhibitions into dynamic environments that encourage exploration, learning and emotional connection. These design pivot around the four axes of the Design of Memorable Experiences, namely:

- The definition of the aesthetic criteria.
- The creation of a set of rules or game mechanics.
- A good story.
- A suitable technological approach.

The ruleset is an essential part that should be defined in a consistent manner, connecting with the skillset of the visiting participants and their fundamental motivations. Regarding the latter and according to the MDA model, motivations like:

- Feelings (Game as sense/pleasure).
- Fantasy (Game as make-believe).
- Storytelling (Game as unfolding story).
- Challenge (Game as obstacle course).
- Community (Game as social framework).
- Discovery (Game as uncharted territory).
- Way of Expressing (Game as soap box).
- And Submission (Game as mindless pastime).

We need to consider that the experience does not have to be linear because video games are non-linear. The alternatives that come up are taken on the player's decisions in real-time and based on their own will. After each movement, the system evaluates the overcoming of the challenge, and the user receives an award that can be shared socially. This is the major loop that can be improved with the use of progress elements and levelling up game mechanics to illustrate and engage the audiences.
As learners progress through various game levels, they experience a heightened sense of achievement and advancement, which in turn stimulates a robust desire to continue learning and progressing. Users need to understand what they finalized and what comes next in order not to get lost. The inherent appeal of game levels is rooted in the intrinsic motivation they provide, leveraging the same psychological mechanisms that keep gamers engrossed. By presenting museum-related content in an engaging and immersive format, game-based learning effectively harnesses these motivational drivers.
Game levels introduce structure and progression to the gaming experience. They enable players to gauge their progress, confront new challenges, and attain a sense of accomplishment. Remember the importance of the mastering effect as situated by the previously mentioned SDT theory. Levels can be designed as distinct stages or environments that present unique challenges. This linear progression helps sustain engagement and motivation by offering a clear pathway for advancement, with increasing difficulty serving as a motivator,

which is necessary according to the flow theory. Furthermore, advancing to higher levels often rewards players with new abilities or tools, enhancing their overall gaming experience. Rewarding schemes state the importance of delivering status instead of extrinsic stuff solely based on prizes.
Levels can also signify a player's progression within the game's mechanics, such as a character's overall experience or skill set. This type of levelling is prevalent in some of the genres that were presented in this document such as RPG games, where players accumulate experience points through diverse individual or in-group actions related to the completion of tasks. They have greater freedom to explore and make choices, remember the importance of autonomy, and these impact their own gameplay experience. Open-world and (Sand Box) games (Red Dead Redemption) provide expansive environments filled with multiple quests and activities that can be approached in any order. These games often incorporate environmental elements that can be manipulated, creating opportunities for puzzle-solving and strategic decision-making. Additionally, some games introduce extra levels with unique obstacles or gameplay mechanics, adding layers of excitement and surprise.
In the Generative AI era that we are experiencing, a significant advancement in game design is the integration of procedural generation techniques, which allow levels to be created algorithmically. This results in unique and unpredictable gameplay experiences each time, enhancing replayability and keeping the game fresh for players.
To effectively integrate levels into a game, several steps must be followed:

- Establishing clear, achievable goals to guide player progression.
- Designing levels that offer a coherent and engaging progression.
- Providing immediate feedback to players to reinforce learning and progress.
- Incorporating social features to enhance engagement through competition and collaboration.
- Tailoring the game experience to individual player preferences and abilities.

The benefits of game levels are manifold. They provide structured progression with clear milestones, fostering a sense of accomplishment and encouraging players to strive for further success. Levels can be accompanied by rewards and incentives, enhancing motivation. Additionally, levels promote friendly competition among players, who can compare their progress and achievements via leader boards or social media integration.

3.5.4 Best Practices in real gaming experiences

Good practices in Game Design should avoid the so-called “dark patterns” that resemble or stimulate gambling behaviours. In fact, these rely on intrinsic motivation before giving prizes and extrinsic rewards. A consistent and sustainable model takes several factors into account:

- **The story that emotionally impacts the audience while mapping knowledge within their mindsets.** Rational argumentation can be supported by non-fiction narrative, if needed. Empathy and metaphor can be present for the sake of understanding, keeping a perfect balance between both parts.
- **The technology that leads to a transmedia plan.** The final implementation can be placed in several online platforms, if we understand that every audience niche resides in a different set of vehicles (such as cinema, comic, books, music, social media, apps, etc.) to deploy and increase the number of impacts on the target and, therefore, amplify the reading of the message. As a result, the probability of success is maximized.
- **The game aesthetics** need to be considered too, since interest happens when we like what we see only. It is inherent to human beings that attraction responds to beauty.
- **The game mechanics that guide the experience itself.** Game elements ensure fun and pleasure, since they are key elements to achieve engagement, behaviour change and knowledge transfer amongst the targets.

Video games induce the formation of social communities, and there are best practices that can be identified, applied, and maintained for the sake of a continuous engagement:

- **Employ a framework with appointment dynamics** (winning by showing up at specific times) and reputation-based levelling (leaderboards that are better relative and connected to a collection of skills than absolute and cumulative only).
- **Track and show the progress** thanks to the real-time monitoring of the participants against the existing

goals.

- **Encourage in-game cooperation** via guilds allowing players to compete among them and encouraging participants to contribute meaningfully through cooperative gameplay.
- **Link extrinsic to intrinsic motivation**, by taking PBL (Points, Badges, and Leaderboards) and connecting them with altruistic and social impact actions.
- **Extend gameplay into real life**. Offline settings can help sharing with the community.
- **Incorporate environment, economics, and social motivation** into gaming strategies to gain competitive advantage and appeal to diverse motivational triggers.
- **Personalize goals and foster social interaction** to help individuals achieve personal aspirations while reinforcing community bonds.
- **Utilize game mechanics for peer trust-building** by implementing mechanisms like share ratios and rating systems to establish and verify trustworthiness.
- **Be adaptive and align game elements with community preferences and behaviours**, avoiding artificial motivational schemes that contradict natural incentives within the community. Customization is key.
- **Contextualize advertising** to enhance rather than disrupt the gaming experience, maintaining relevance and value.
- **Account for simplicity**, by designing game elements that enhance enjoyment without adding unnecessary complexity or burdensome tasks for players.
- **Leverage mobile platforms** to innovate and integrate gaming into traditionally offline experiences, creating tangible value through seamless online-offline interactions.

There are several player types existing in gaming communities. These motivational profiles need tailored strategies to be attracted and remain interested in a game. Categories used in Gamification rank from 4 to 12 possibilities for these profiles and every participant will be strong in at least one or two of them and the gameful experiences should be designed so that several are fed for everybody to enjoy. It is the total guest experience concept as defined by Walt Disney for their theme parks a while ago: everyone should have fun regardless of their role, age, or motivation. The player types can be seen as the different motivational categories for our participants in the museum. Additional studies aggregate and identify up to 9 really distinct player types as a meta-synthesis of all the previous existing frameworks: Completionists, Socializers, Suicide Squad-Fiends, Pathfinders, Collectors, Belligerents, Explorers, Deep-Gamers, and Casual Gamers. These typologies primarily reflect behaviours observed in digital game environments and can be mapped with the types of participants that will visit our museums.

Educational initiatives linked to museums should leverage gaming by prioritizing the identification of player types and customized instructional strategies. These motivational profiles encompass cognitive, social, behavioural, and psychological dimensions, highlighting the need to establish relational frameworks that align well.

3.5.5 **Accessible experience**

Accessibility is a core discipline to consider if accounting for diversity in our interactive productions and serious games and it has been truly documented since 2014 although the industry incorporated its guidelines during the 2018–2023 period. Section 3.6 provides more details on standards, recommendations, and frameworks for digital and game accessibility, along with an overview of accessibility tools for game creators and examples of accessible games.

In the context of player experience, it is important that video games and serious or applied games are designed to tackle the different profiles when dealing with accessibility, including usage without or with limited vision; without perception of all or some colours; without or with limited hearing; with no or limited vocal capability; with limited manipulation or strength; with limited reach; with limited cognition, language or learning; and minimizing photosensitivity seizure triggers.

The serious games that we can design as “edugames” for culture/museums/fashion should include accessibility specifications according to their final targeted audience requirements in terms of inclusion. Because we are identifying player types and pedagogical models as our instructional methods, we need to include these guidelines and rulesets to guarantee that a truly diverse audience can enjoy the game experience. And like in the case of the motivational profiles, the accessibility variables to analyse and

implement should connect with cognitive, social, behavioural, and psychological axes.

3.5.6 **Main factors (positive and negative) in game design**

This section presents categorized lists of potential positive and negative factors that should be considered in the videogame design process.

Risk factors in video game design:

- Increase the hours intended to play
- Infinite play: There is no cut or 'stop and go'
- Daily Rewards: Incentive to enter the game
- Variable reward: Intermittent positive reinforcement
- No narrative arcs: The perception of having achieved goals is eliminated
- Mobile devices: Make it possible to play at any moment
- Encourage economic spending
- Boosters: To advance faster
- Unlockers: To keep playing or access game elements
- Improvement of avatars: Equipment, skins
- Being exposed to dynamics of harassment
- Voice chat: Conversations that can lead to discrimination
- Violent narratives: Beautification of violence. Whitewashing of historical facts

Risk factors in personal characteristics:

- Psychological
- Poor social skills
- Low digital literacy
- Cognitive and educational challenges
- Financial risks (as micro-transactions)
- Online safety and cybersecurity
- Low self-esteem
- Feeling of loneliness
- Low frustration tolerance
- impulsivity
- Family issues
- Lack of support from families
- Difficulties in establishing rules and limits
- Using video games as a reward or punishment
- Pressure towards families to buy games for the kids to play with friends

Consequences

- Sedentarism
- Alteration of sleep
- Addiction
- Vision, auditory, joint-related, muscle-related problems
- Alteration of the nervous system
- Alteration of feeding patterns

Protective and beneficial factors in video games:

- Promotion of psychological and cognitive skills
- Spatial reasoning and rotational cognition
- Visual processing, reduced reaction time
- Work on certain skills (logic, mathematics)
- Learning languages and other language skills
- Increase in digital literacy

- Creation of social network
- Have a social space where to relate
- Multiplayer games help develop relational skills such as assertiveness, delegation, leadership, acceptance of diversity, etc.
- Exposition to diversity and to positive narratives
- Stories, characters, or plots in which elements of sexual diversity are incorporated
- Gender equality and/or respect for the environment

3.6 Game accessibility

This section focuses on reviewing state of the art in relation to game accessibility, with particular focus on people who have diverse abilities, digital or language accessibility needs (e.g. minorities, people with disabilities, people with low digital skills, etc) when it comes to game play. It aims to explore the barriers these people face when accessing digital games, and the design strategies that can mitigate these challenges. The study will evaluate existing standards, recommendations and frameworks for game accessibility that must be considered in the game design process. Furthermore, existing tools for game creators and relevant digital accessibility features and technologies, such as customizable user interfaces (audio descriptions, captioning, colour contrast), are analysed, to determine their effectiveness in making games more inclusive. The main scope is to provide the ground for designing games with accessibility in mind, in order to accommodate a broader range of abilities (e.g. physical, cognitive). This will be achieved by establishing the guidelines and best practices that ensure gaming is a universally enjoyable experience, promoting inclusivity and equality within the i-Game gaming community.

3.6.1 Definition and context relevance

Games, in all their forms (video, mobile, computer or board ones), are part of our culture and reflect the ideas of their creators and the society in a similar way that music, cinema or literature do, being currently considered as one of the most significant cultural artefacts of this century [96]. Given their significance and value, in an inclusive society, it is important that all people can participate in and play games, which can be made possible by creating well-designed environments that provide inclusive opportunities to game for people with diverse abilities (e.g. people with disabilities, people with language accessibility needs, people with low digital skills, etc.).

Accessibility in games represents a set of characteristics that developers design into a game to provide players access, considering players needs related to vision, hearing, motor skills and cognition [81]. By understanding game accessibility from the social model of disability, in contrast to the medical model, accessibility lives in the product and not in the user. It means that the disability is a mismatch between the design and the person's needs, instead of a personal health condition. Thus, a good game design that matches user's needs enables players, and a bad game design that does not match user's needs disables players.

Accessibility Guidelines have been established along with the digitalization of every aspect of our society (work, government, health, finances, etc.), with a wide range of recommendations and frameworks being in place. A comprehensive analysis of existing standards, guidelines, recommendations, and frameworks which are relevant for game accessibility is presented in section 3.6.2.

The game industry, being mostly driven in its choices by the market demand (the paying majority), is making efforts towards meeting some of the accessibility guidelines (e.g. colour-blind-friendly palettes, configurable controls, subtitles, compatibility with screen-readers, enhanced visuals). Accessible games are usually falling into one of two categories: (i) mainstream games that include accessibility features, and (ii) games that are purposely designed for people with disabilities (e.g. audio games). While there are a variety of accessible video games, it is acknowledged that besides being accessible, the game must remain enjoyable for all players, which is particularly important in a mixed-ability gaming setup [97]. Section 3.6.4 provides an overview of existing accessible games, focusing on the extent to which they accommodate diverse abilities, and which are the main barriers and gaming experiences for the players.

3.6.2 Standards, recommendations, and frameworks for digital and game accessibility

This section focused on identifying existing standards, recommendations and framework for game accessibility and digital accessibility for online platforms, at international, European, and national level.

3.6.2.1 European Standard EN 301 529

The European Standard *EN 301529* "Accessibility requirements for ICT products and services" defines the requirements that products and services based on Information and Communication Technologies (ICT) should meet to enable their use by all EU citizens, with particular focus on persons with disabilities. It has been created to support the European Directive EU 2016/2102[111] in regard to the accessibility of the websites and mobile applications of public sector bodies, to ensure that these are made more accessible to all users on the basis of common accessibility requirements. This standard, and the corresponding directive, placed the ground for the development of the European Accessibility Act presented in section 3.6.2.2.

3.6.2.2 European Directive EU 2019/882

The European Directive EU 2019/882, *The European accessibility act*[112], basically represents an update of the European Directive 2016/2102, defining minimum accessibility requirements for key products and services. This directive expands to all actors participating in the European digital market, including applicability to online identification methods, electronic signature, and payment services, and more generally e-commerce services, e.g. services provided at a distance (without the parties being simultaneously present), through websites and mobile device-based services, by electronic means. The four major principles of accessibility, as also defined in Directive EU 2016/2102, are:

- **Perceivability:** the information and user interface components must be presentable to users in ways they can perceive
- **Operability:** the user interface component and navigation must be operable
- **Understandability:** the information and the operation of the user interface must be understandable,
- **Robustness:** the content must be robust enough to be interpreted reliably by a wide variety of user agents, including assistive technologies

In order to achieve these principles in practice, the Directive EU 2019/882, Article (50) indicates that:
"Accessibility should be achieved by the systematic removal and prevention of barriers, preferably through a universal design or design for all approach, which contributes to ensuring access for persons with disabilities on an equal basis with others."
Although the Accessibility Act has been issued and published a long time ago, it will take effect starting with June 28, 2025, in all EU Member States. As a result, the iGame platform, and respectively the games developed in the iGame project, must be compliant with the European Accessibility Act.

3.6.2.3 Harmonised European Standard EN 301 549

The Harmonised European Standard EN 301 549 [113] "Accessibility requirements for ICT products and services", is a consequence of the European Directive EU 2019/882, and was adopted in March 2021, covering a wide range of requirements for a variety of ICT solutions, being relevant for all organization who buy, develop, or manufacture ICT products or services that are used by EU citizens. These solutions must meet functional performance that enable people to locate, identify and operate ICT functions, and to access the information provided, regardless of physical, cognitive, and sensory abilities, either these differences in abilities are permanent, temporary, or situational. The defined functional performance statements include:

- **Usage without vision**: where the solution provides visual modes of operation, it provides at least one mode of operation that does not require vision (e.g. well-formed semantic structure, audio interface).
- **Usage with limited vision:** where the solution provides visual modes of operation, it provides features that enable users to make better use of their limited vision (e.g. magnification, non-visual access, etc.)
- **Usage without perception of colour:** where the solution provides visual modes of operation, it provides a mode that does not require user perception of colour.

[111] **European Directive 2016/2102:** https://eur-lex.europa.eu/eli/dir/2016/2102/oj
[112] **European Accessibility Act:** https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019L0882
[113] https://www.etsi.org/deliver/etsi_en/301500_301599/301549/03.02.01_60/en_301549v030201p.pdf

- **Usage without hearing:** where the solution provides auditory modes of operation, it provides at least one mode that does not require hearing (e.g. visual user interface).
- **Usage with limited hearing:** where the solution provides auditory modes of operation, it provides enhanced audio features (e.g. enhanced audio clarity, reduction of background noise, increased range of volume).
- **Usage with no or limited vocal capability:** where the solution requires vocal input from users, it provides at least one mode that does not require them to generate vocal output (e.g. keyboard, pen, or touch interfaces).
- **Usage with limited manipulation or strength:** where the solution requires manual action, it provides options for alternative actions that do not require manipulation, simultaneous action, or hand strength. Examples of actions that users may not be able to perform action that require fine motor control, path dependant gestures, pinching, twisting of the wrist, tight grasping, or simultaneous manual actions.
- **Usage with limited reach:** where the solution is free-standing or installed, all elements required for operation are within reach of all users.
- **Minimize photosensitive seizure triggers:** where the solution provides visual modes of operation, at least one mode minimizes the potential for triggering photosensitive seizures (e.g. limiting the area and number of flashes per second).
- **Usage with limited cognition, language, or learning:** provide features and/or presentation that make it simpler and easier to understand, operate and use (e.g. adjustable timing, error indication, suggestion, logical focus order).
- **Privacy:** where the solution provides features for accessibility, it maintains the privacy of users of these features at the same level as other users.

The standard demands that the provided accessibility features of an ICT solution must be documented, and it must be made possible to activate those that are required to meet a specific need.
Similar to most international web accessibility laws, the Harmonised European Standard EN 301 549 is based to a large extent on the Web Content Accessibility Guidelines (WCAG) v2.1, which are discussed in section 3.6.2.4 of this deliverable. However, this standard includes requirements that are not part of WCAG 2.1 (e.g. accessibility requirements of hardware solutions). Furthermore, while the WCAG v2.2 has been published, the process to update and reference the harmonized standard has started, but it is expected to be completed in 2025 the earliest.

3.6.2.4 **Web Content Accessibility Guidelines**

The Web Content Accessibility Guidelines (WCAG)[114], developed and published by the World Wide Web Consortium (W3C), are technical standards that help make the digital world accessible to people with disabilities. While the standard is not a law per se, it has been adopted by many national laws all over the world, and it has been integrated in the Harmonised European Standard 301 549 for accessibility. All versions of the WCAG standards, the latest being v2.2, are rooted in the four main principles for ICT solutions, as mentioned in section 3.6.2.2: perceivable, operable, understandable and robust.
The conformance to the standard is structured around three levels:

- **Level A**: the minimum level requirements that any website should be able to meet. Some of the most important requirements include keyboard-only content access, clearly labelled forms with instructions so users know what the forms require, content compatibility with assistive technologies, and providing clear information or instructions in additional ways to using just shape, size, or colour.
- **Level AA**: the mid-range conformance level that represents strong accessibility and it satisfies all Level A and Level AA criteria. Requirements include text and background must have the proper colour contrast (a minimum of 4.5 to 1), content organization must have a clear heading structure and follow a logical order, and navigation elements must be consistent throughout every webpage.
- **Level AAA**: the highest level of conformance, providing exceptional accessibility, but unachievable for certain content. It satisfies both Level A and Level AA criteria, and another 28 additional criteria. Example of additional requirements: a minimum of 7 to 1 contrast ratio for text and backgrounds, sign

[114] https://www.wcag.com/resource/what-is-wcag/

language translation for pre-recorded video content, expanded audio descriptions for pre-recorded video content, etc.

The WCAG have been analysed in detail in relation to the iGame project context (e.g. development of an accessible online game co-creation platform), along with the procedures applied to test and evaluate[115] a solution against the guidelines, and the potential report tool[116] that can be used to turn the evaluation findings into a report. The result of this analysis is a project specific accessibility assessment guide, which can be used by the iGame designers and developers to check in an easier manner the level of conformance of the co-creation platform in relation to the relevant aspects (see annex 8.3).

3.6.2.5 Game Accessibility Guidelines

The Game Accessibility Guidelines[117], represent a comprehensive reference for inclusive game design, providing three options of conformance: basic, intermediate, and advanced. Each level is based on the balance among three aspects: (i) reach, namely the number of people who benefit; (ii) impact, seen as the difference made to those people; and (iii) value, by considering the cost to implement the solution.

- **Basic Level:** recommendations are easy to implement, have wide impact and apply to almost all game mechanics. It is indicated that the most commonly complained issues about game accessibility include remapping of controls, text size, colour-blindness, and subtitle presentation. When these issues are addressed, the result will be a significant difference to a large number of players. However, more issues should be considered[118] in order to be fully compliant with the Basic Level.
- **Intermediate Level:** require some planning and effort, but still simply good general game design. Depending on the type of disability considered (motor, cognitive, vision, hearing, and speech), a significant number of requirements must be considered[119].
- **Advanced Level:** Complex adaptations for profound impairments and specific niche mechanisms. These are applicable to certain game mechanics, require more budget and specialist knowledge/advice to implement, or do not benefit a wide range of people. However, they have very high value for the people who do benefit from them.

An important point is that a set of General recommendations are included for each level, which are meeting the requirements for an inclusive game design in general, by addressing potential needs of a much wider population, which are not necessarily linked to disability, in particular for the intermediate level. These include:

- Allow gameplay to be fine-tuned by exposing as many variables as possible
- Allow a preference to be set for playing online multiplayer with/without others who are using accessibility features that could give a competitive advantage
- Provide an auto-save feature
- Provide a manual save feature
- Include assist modes such as auto-aim and assisted steering
- Offer a means to bypass gameplay elements that are not part of the core mechanic, via settings or in-game skip option
- Allow difficulty level to be altered during gameplay, either through settings or adaptive difficulty

These general recommendations are of particular importance for iGame, where besides targeting to develop games for people with disabilities, a wider inclusion is targeted (e.g. digital skills, age, social background, etc.).

3.6.2.6 XBox Accessibility guidelines

XBox Accessibility guidelines[120] (XAGs), are a set of best practices that have been developed by Microsoft in partnership with industry experts and members of the Gaming & Disability Community, and are intended for designers, developers, and test teams to be employed while generating ideas, developing games, or validating the accessibility of games. These guidelines seek to ensure that the user experience in a game is

[115] https://www.w3.org/WAI/test-evaluate/
[116] https://www.w3.org/WAI/eval/report-tool/
[117] https://gameaccessibilityguidelines.com/
[118] https://gameaccessibilityguidelines.com/basic/
[119] https://gameaccessibilityguidelines.com/intermediate/
[120] https://learn.microsoft.com/en-us/gaming/accessibility/guidelines

enjoyable and playable for everyone. Along with the guidelines, a dedicated guide, the Gaming and Disability Player Experience Guide[121], has been developed, which helps game developers to gain a more holistic understanding of the barriers that players with certain types of disabilities may experience when game mechanics, display, content, and other aspects of the game's design are not developed with these players in mind. Common barriers to gameplay and related best practice guidelines found in XAGs are organized by type of disability in the Experience Guide.

XAGs provides a total of 23 guidelines, each of them being prefaced by an overview for the developer to understand which players it concerns, and which are the scoping questions in relation to the particular issue addressed. Furthermore, the aspects which contribute to addressing accessibility in relation to an issue are reviewed, along with the key area in the game where the particular issue is important. The guideline provides recommendations per type of device for which the game is developed (e.g. console, PC/VR, mobile/Xbox game streaming). The main issues addressed by the guideline include: text display, contrast, additional channels for visual and audio cues, subtitles and captions, audio accessibility, screen narration, input, game difficulty options, objective clarity, haptic feedback, audio descriptions, User Interface (UI) navigation, UI focus handling, UI context, error messages and destructive actions, time limits, visual distractions and motion settings, photosensitivity, Speech to Text (STT) or Text to Speech (TTS) chat, communication experiences, accessible feature documentation, accessible customer support, and mental health best practices. In addition, a set of Accessibility Feature Tags[122] has been created, which provides the developers with a common method to identify accessibility features in their games by tagging the features in the Gaming Metadata module. The tags are usually composed of two parts, indicating the main issue addressed and the exact accessibility feature implemented, such as: Audio: Custom volume controls; Audio: Narrated game menus; Visual: Adjustable text size; Visual: Colour options; etc.

While the XAGs have been developed by Microsoft in the context of game development for the XBox gaming console, their applicability is much wider, as the concepts and issues addressed are relevant for the development of any video game.

3.6.2.7 **Accessible Player Experiences**

The Accessible Player Experiences (APXs)[123] framework is shifting the aim of accessible design from access, and respectively accessibility, to the actual player experience. The main concept has to do with actually making the in-game experiences possible for players with disabilities through a variety of different options and well-conceived patterns. This framework is built around the APX triangle (see Figure 3), and considers that before anyone can play a game they need access to the game (e.g. perceive what is going on and take control of actions in the game), and 12 Access Patterns[124] are guiding the design of the game to ensure the necessary access for players with diverse abilities. Once the player has access, they need to be able to play the game by making sure that the in-game challenges are not overwhelming (e.g. enemy is too fast, puzzle is too hard, content is too intense), and these issues are addressed by the 10 Challenge Patterns [125], which illustrate different ways designers have adapted challenges for accessibility. Each pattern is defined in regard to the design problem addressed and the solution to the identified problem, and examples of how these patterns work in practice are provided. By addressing both Access and Challenge, only then the player will have the

Figure 3. The APX triangle (from APX80)

[121] https://aka.ms/GDPlayerExperienceGuide
[122] https://learn.microsoft.com/en-us/gaming/accessibility/accessibility-feature-tags
[123] https://accessible.games/accessible-player-experiences/
[124] https://accessible.games/accessible-player-experiences/access-patterns/
[125] https://accessible.games/accessible-player-experiences/challenge-patterns/

desired in-game experience, and the task of creating an Accessible Player Experience is achieved.

3.6.2.8 Other initiatives

A white paper on accessibility for developers[126], was written by the Spanish Video Game association[127] and the ONCE Foundation[128] in order to: (i) Raise society's awareness about accessibility/disability; (ii) Provide a reference on accessibility guidelines in video games; (iii) Correctly relate the functional provision profiles with their accessibility guidelines; (iv) Explain how accessibility guidelines can be developed; (v) Identify the difficulties studios face in implementing accessibility guidelines; (vi) Provide video game developers with tools to assess their products' accessibility themselves; (vii) Make information on hardware accessibility and peripherals available; (viii) Discuss the importance of 3D printing in hardware and adapted peripherals. While the white paper is based on the various accessibility guidelines already analysed in this document (e.g. WCAG, XAGs, etc.), it is a good stand-alone resource, as it provides 1-page summaries for the most important accessibility aspects to be addressed per disability profile, and it marks with a star the guidelines that are strictly necessary in order to allow a certain profile to play. Furthermore, self-assessment tools are included per disability profile, which support developers in the compliance assessment phase.
The International Game Developer's Association (IGDA)[129] has established a set of Platform level accessibility recommendations[130], which provide guidance on how and why gaming hardware and operating systems can enable access for games with disabilities. While not directly targeting the game design process, these guidelines are important for the developers to understand certain hardware and software options in an effort to reduce unnecessary barriers and increase the number of gamers who can take part. These recommendations particularly focus on software options available at game console system level, e.g. system level button remapping for gamers who are not physically able to reach some areas of the controller or voice commands that are used as shortcuts for common actions (opening a game or sending a message).

3.6.3 Accessibility tools for game creators and developers

This section focuses on identifying existing game accessibility tools, which enable game creators (designers, developers, testers, etc.) to make games accessible in a faster and easier manner. The analysis showed that there are tools which are built into the game engines, to facilitate the work of the developers in particular when using the most known commercial platforms (e.g. Unity, Unreal). At the same time, various independent developers, in particular coming from the academic or research fields related to accessibility, have created stand-alone tools, which can be used to create in-game accessibility features and elements with some of the existing game engines, or are used to simulate, test, and adjust accessibility features. In the following, a non-exhaustive list of such tools is presented, being grouped by type of disability addressed.

3.6.3.1 Visual Accessibility Tools

Colourblindness Simulators are used to simulate various types of colour blindness, helping developers to adjust the in-game colour schemes used to be more inclusive. Different types of colour vision deficiency[131] may cause problems with seeing different colours, including red-green colour vision deficiency (e.g. deuteranomaly, protanomaly, protanopia, and deuteranopia), blue-yellow colour vision deficiency (tritanomaly and tritanopia), and complete colour vision deficiency (monochromacy or achromatopsia). Such tools are:

- **Colour Oracle**[132] is a free colour blindness simulator for Windows, Mac, and Linux, which applies a full screen colour filter to the art designed, independently of the software in use. It shows in real time what people with common colour vision impairments will see.
- **Coblis**[133] is an online which provides a drag and drop, along with the upload functionality, for designers and game creators to test their images for accessibility in regard to the various potential types of

[126] https://www.aevi.org.es/web/wp-content/uploads/2023/09/01_libro_blanco_de_accesibilidad_inglesdigital_ac.pdf
[127] https://www.aevi.org.es/web/
[128] https://www.fundacionONCE.es/en
[129] https://igda.org/
[130] https://igda-gasig.org/how/platform-level-accessibility-recommendations/
[131] https://www.nei.nih.gov/learn-about-eye-health/eye-conditions-and-diseases/color-blindness/types-color-vision-deficiency
[132] https://colororacle.org/
[133] https://www.color-blindness.com/coblis-color-blindness-simulator/

colour blindness.

Contrast Checkers are used to check the contrast ratios between text and background colours, ensuring readability.

- **WCAG Colour Contrast Checker**[134] is an online tool allowing the user to enter colour combinations and to check if they pass conformance or not. The results are also linked to the text size, and examples of the small and large text size are provided. The tool can also be integrated in the local browser, as a free Google Chrome extension can be downloaded.
- **WebAIM Contrast Checker**[135] is a similar online tool which allows the user to select a foreground and background colour in RGB hexadecimal format or using the colour picker, and also set the lightness of these, and calculates the contrast ratio, indicating to which WCAG Level is conforming.
- **Stark**[136] is more than just a contrast checker, as it also integrates a vision generator and simulator, and it includes a suggestion tool for levels AA and AAA passing colour alternatives. The most important aspect is that it is possible to integrate it into various game design and prototyping tools, such as Figma, Sketch, and Adobe XD, but also in the Google Chrome browser.

Text Scaling Tools ensure in-game text readability with adjustable sizes based on player preference.

- **Unity TextMesh Pro**[137] is a tool integrated into the Unity game engine, which allow for more flexible font adjustments, making text more readable and scalable for players.

SeeingVR[138] is a set of 14 tools developed by Microsoft, that enhance a VR application for people with low vision by providing visual and audio augmentations [98]. The tools are integrated into a Unity toolkit, and a developer can select, adjust, and combine different tools based on their needs. Some of these tools modify an existing VR application post hoc, via a plugin, without any developer effort, while the rest require simple inputs.

Steam Audio SDK[139] is a free full-featured audio solution that integrates environment and listener simulation. It provides spatial audio support, allowing developers to add 3D audio cues that can aid visually impaired players navigate the game world. It is easy to implement and deploy for all major audio engines, game engines (e.g. Unity, Unreal, C API, FMod Studio) and platforms (e.g. Windows, Linux, Android, MacOS), facilitating natural sounding immersion and providing full control over spatial effects.

3.6.3.2 Audio Accessibility Tools

Subtitles and Closed Captions are essential for players who have auditory impairment. While subtitles are primarily intended to be used for dialogue translation in another language, they may also be used as an accessibility tool when used in the same language as the dialogue. Closed Captions are the most appropriate accessibility tool for people who have auditory impairment, as beside the spoken part of the audio information, they also capture and convey other important sounds of a video. For video games, these tools help synchronize text with in-game audio. Both Unity and Unreal have plugins or tools that allow for flexible subtitles, caption management or customizing audio cues as visual elements.

Visual Sound Cues are used in order to represent sound effects visually, like vibrations or on-screen cues. Both platforms, Unity and Unreal, provide such tools for developers to make such in-game visual effects that correlate with sounds (e.g. footsteps, environmental noises).

3.6.3.3 Motor Accessibility Tools

Input Remapping Tools allow players to customize controls according to their needs. These include:

- **Rewired**[140] is an advanced input system for Unity, which supports various controllers and custom control schemes.
- **InControl**[141] is a cross-platform input management tool in Unity, which supports remappable controls and various controller types. InControl is for programmers, as it will not work out-of-the-box, and it

[134] https://accessibleweb.com/color-contrast-checker/
[135] https://webaim.org/resources/contrastchecker/
[136] https://getstark.webflow.io/
[137] https://docs.unity3d.com/Packages/com.unity.ugui@2.0/manual/TextMeshPro/index.html
[138] https://www.microsoft.com/en-us/research/publication/seeingvr-a-set-of-tools-to-make-virtual-reality-more-accessible-to-people-with-low-vision-2/
[139] https://valvesoftware.github.io/steam-audio/
[140] https://guavaman.com/projects/rewired/
[141] https://www.gallantgames.com/pages/incontrol-introduction

requires actual code to use it and personalize input mappings.

On-Screen Controls implement touch-friendly or alternative controls for players with limited mobility:

- **Virtual Joystick** has plugins for Unity, Unreal[142] and Godot[143] to allow on-screen joystick controls, particularly useful for mobile games or touch interfaces.

3.6.3.4 Cognitive Accessibility Tools

Simplified User Interfaces facilitate customizable or alternative UI options that can make a game more accessible for players with cognitive disabilities.

- **Unity Accessibility Plugin** can be customized to help reduce visual clutter, making navigation more straightforward for players who may struggle with complex UIs.
- **Axure RP**[144] prototyping software allows for building simplified, user-friendly interfaces and testing them with player feedback. Its dynamic panels and conditional logic enable designers to create personalized, simplified views, focusing on only the essential UI elements players need.

Guided tutorials and game hints are used to provide progressive hints or simplified navigation options.

- **Inky** from **Inkle**[145] is a narrative scripting tool for games, which can be used to create such step-by-step tutorials or guided storytelling, helpful for players who benefit from extra guidance. It is open source, and it is integrated with Unity[146].

Usability and Cognitive Load Testing Tools:

- **Maze**[147] is a usability testing tools which allows developers to track how players interact with different UI elements and identify areas of confusion or components that players may struggle with.
- **Lookback.io**[148] allows for real-time testing and feedback from users with cognitive disabilities, helping developers understand pain points in their UI design.

3.6.4 Accessible games

The current game market is on a steep increase curve, with a huge number of games being released every year (e.g. over 14000 games were released only of Steam in 2023[149]), makes it impossible to actually review all existing games. The desktop domain knowledge sampling and analysis performed in this section concerns a selection of (i) mainstream games that implement some accessibility features, and (ii) games designed with accessibility in mind (e.g. targeting particular abilities or mixed-ability playing). Existing scientific reports and literature is considered, along with community-driven reviews published in dedicated magazines or blogs, in order to establish a short list of games that have taken positive steps towards accessibility. The recognition from the community is highly important, as players with diverse abilities have played the games and provided review articles on various sites, such as:

- **Can I Play That?**[150], a website that provides all forms of accessibility information on video games and the industry, targeting to inform disabled players and educate both players and developers.
- **Access-Ability**[151], a blog discussing accessibility and representation in video games.
- **TripleTapTech**[152], a blog targeting to advice, help, support, and train people with a visual impairment on everything that has to do with technology, including accessible gaming.
- **Game Accessibility Nexus**[153]**,** a site with various resources for accessibility in videogames, game reviews, guidelines, articles on assistive software and hardware, and recommendations of games with high level of accessibility.

Before 2020, mainstream video games were considered far from being accessible, as the main research

[142] https://www.unrealengine.com/marketplace/en-US/product/advanced-virtual-joystick-widget
[143] https://github.com/MarcoFazioRandom/Virtual-Joystick-Godot
[144] https://www.axure.com/
[145] https://www.inklestudios.com/ink/
[146] https://github.com/inkle/ink-unity-integration
[147] https://maze.co/
[148] https://www.lookback.com/
[149] https://steamdb.info/stats/releases/
[150] https://caniplaythat.com/
[151] https://access-ability.uk
[152] https://tripletaptech.org/games-reviews-and-accessibility/
[153] https://www.gameaccessibilitynexus.com/

outcomes in the field of Human-Computer Interaction (HCI) were not adopted by the professionals of the sector at the same pace as it happened to the web environment[99].

The Last of Us Part II[154] (2020) is an action-adventure game, which received acclaim for its gameplay, audio design, score, performances, characters, and visual fidelity. It was the first game with a strong accessibility impact on a large scale, being considered still to date as one of the most accessible games. It features more than 60 accessibility settings, with expanded options focused on fine-motor and hearing, as well as completely new features that benefit low-vision and blind players. Key features include a high-contrast mode that highlights enemies and allies, audio cues for navigation, screen reader support for on-screen text, and a variety of colour-blind modes. Players can also fully customize controls, adjust text size, and use navigational assistance, which makes complex environments easier to explore. Despite its success and recognition as an accessible game, it is considered that not all interaction barriers are prevented [100].

Forza Motorsport[155] (2023) is the latest version of the popular racing simulation series, known for its detailed graphics and realistic car physics. While well-received by the players due to its visuals, which include real-time ray tracing and dynamic weather, a wide variety of cars and customizable tracks, it is also considered as the most accessible racing game. It introduces Blind Driving Assists for visually impaired players, which provides audio cues that help players navigate tracks. The one-touch driving options enable customizable controls for simplified gameplay for players with limited mobility. It also provides colour-blind modes and customizable text size and contrast.

Street Fighter 6[156], the latest of the well-known fighting game series, brings expanded accessibility features. It offers unique audio cues for each character (e.g. for actions like hits, throws and character distances) and visual prompts to assist with timing, allowing visually impaired players to gauge combat situations more accurately. Additional options include various controller layouts which simplify move execution, customizable subtitles, high-contrast settings, and colour-blind adjustments.

Diablo IV Vessel of Hatred[157] (2024), is a recently released expansion for which accessibility was considered from the very beginning, in close collaboration with the disability community. The features include colour-blind modes and customizable controls, but also some very specific ones, like the auto-pin (e.g. automatic drop of a map pin on the destination of a selected task/quest) and the audio navigation assistance (e.g. spatial audio pings for direction).

God of War: Ragnarok[158] (2022), is an action-adventure game that offers extensive options for visual aids, including high-contrast modes, larger text sizes, audio cues for navigation and customizable controls.

Other recent releases of games that include accessibility features to some extent include **Spider-Man 2**[159] (e.g. TTS and high-contrast modes) and **Star Wars Jedi: Survivor**[160] (e.g. featuring one of the most robust subtitle option, with ambient sound effects and story dialogue being possible to be captioned separately and including optional sound indicators for the speakers).

3.6.5 Conclusion

The WCAG, although developed with the web in mind, represents the technical standard placing the ground for digital accessibility of all digital platforms and services. Conformance to the defined levels and information on conformance, are mandatory for all digital platforms and services of public bodies and organizations (e.g. including public museum and cultural organizations) in the European Union. The i-Game relevant accessibility recommendations have been extracted and prepared as a project specific accessibility assessment guide to be used in the design and development activities in future project activities (e.g. WP3, WP4, WP5). However, these should be complemented by the APXs framework, in order to ensure that besides accessibility, the i-Game challenges are not overwhelming for the player.

[154] https://www.playstation.com/en-gr/games/the-last-of-us-part-ii/
[155] https://forza.net/motorsport
[156] https://www.streetfighter.com/6
[157] https://news.blizzard.com/en-us/diablo4/24139219/a-crucible-for-all-accessibility-features-in-vessel-of-hatred
[158] https://store.steampowered.com/app/2322010/God_of_War_Ragnark/
[159] https://www.marvel.com/games/marvels-spider-man-2
[160] https://store.steampowered.com/app/1774580/STAR_WARS_Jedi_Survivor/

3.7 Policy, legal and ethical frameworks for game co-design

This research area delves into the policy, legal, and ethical frameworks that govern the co-design of games. It seeks to identify the regulatory challenges and ethical considerations involved in collaborative game development, particularly to embed legal and ethical requirements at early stages of game design. The study aims to examine how intellectual property rights are managed in co-design scenarios, issues related to data privacy and dark patterns, the implications of user-generated content and the considerations associated with AI & Gen AI technology from an IT/IP perspective.
Furthermore, the research will explore policy recommendations to support a fair and sustainable collaboration while ensuring that all participants' rights are protected, including minors.
This research analysis presented in this section is a preliminary overview for the more detailed and focused analysis that is conducted and reported in task T2.6 Ethical and legal analysis.

3.7.1 Context: gaming and the law

The video game industry became the largest entertainment sector globally, driven by rapid technological advancements. Innovations in cloud gaming, esports, and virtual reality are contributing to this significant growth[161]. The video game industry now generates more revenue annually than Hollywood[162] and reaches 110.000 jobs in Europe[163]. Despite this success, the video game industry appears to be "still largely unknown and even denigrated by public authorities, who sometimes remain unaware of its assets."
The sector has also evolved rapidly, shifting from traditional one-time purchase towards "freemium" business models[164]. Today, various gameplay models exist, including free-to-play, play-to-earn, and pay-to-play[165].
This dynamic landscape raises important policy and legal questions. Regulating gaming within the European Union is particularly complex due to the interplay of diverse national laws, EU-wide directives, and the industry's ever-evolving nature. Video game regulation is based on a scattered legal landscape counting provisions on consumer protection, data protection, intellectual property regulation, children's rights and so forth.

3.7.2 IT considerations: ethical and legal game creation

In this section, the impact of game design on individuals and society from an ethical and legal perspective is discussed, with specific attention being accorded to the iGame relevant legal disciplines, as presented in the following.

3.7.2.1 Human rights

Games can serve as powerful enablers of fundamental rights, offering platforms for free expression, creativity, and social interaction. They are key tools for exercising key fundamental rights such as freedom of expression, freedom of association, the right to education and development and also the children rights, including the right to play [101]. However, these benefits come with significant challenges and concerns, particularly regarding the protection of other fundamental rights, including data protection, children's rights, the protection of intellectual property, freedom of expression abuses, etc.

[161] https://www.linklaters.com/en/knowledge/publications/alerts-newsletters-and-guides/2024/january/15/gaming-legal-trends-in-2024
[162] https://www.brookings.edu/articles/a-guide-to-reining-in-data-driven-video-game-design-privacy/
[163] https://www.robert-schuman.eu/en/european-issues/724-the-video-games-industry-in-europe-current-situation-issues-and-prospects
[164] https://policyreview.info/articles/news/unmasking-dark-patterns-video-games/1739
[165] https://www.techopedia.com/definition/27039/free-to-play-f2p

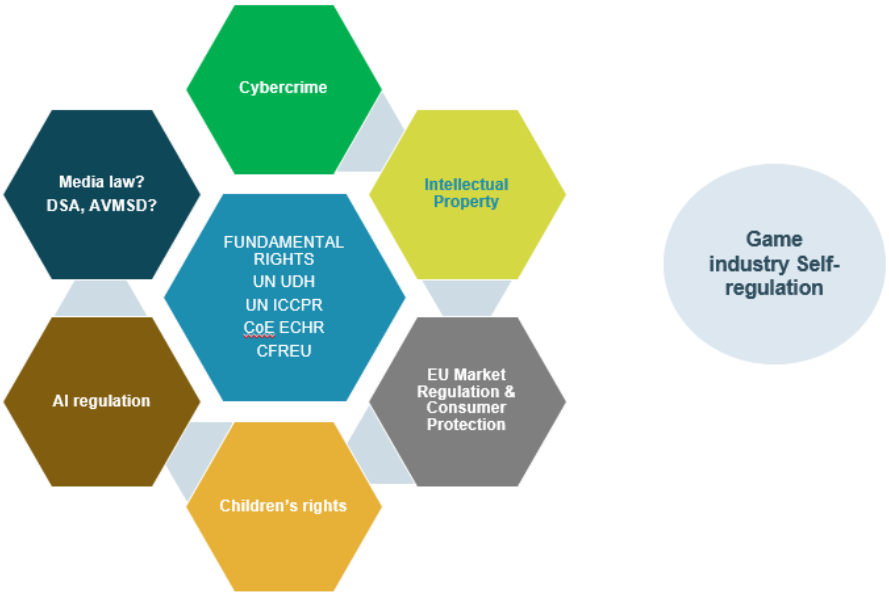

Figure 4. Overview of relevant regulations applicable to the gaming sector

3.7.2.2 Children's rights

Online games offer great potential for children, but also present significant risks. They can make children vulnerable to addiction, exploitation, and exposure to inappropriate content. Children can be subject to harassment and cyberbullying within gaming communities. This can have severe impacts on their mental health and emotional well-being. There is a need to protect children from exposure to and involvement in Child Sexual Abuse Material (CSAM) production and mitigate the risks of grooming by potential predators.
Children are considered as active holders of rights in the digital environment [102]. Protecting children's rights and ensuring their safety online has been highlighted by international instruments such as the United Nations Convention on the Rights of the Child (UNCRC)[166], the sectoral EU legislations like the General Data Protection Regulation(GDPR)[167] and the Digital Services Act (DSA)[168]. Core children's rights principles include the right to development, the right to non-discrimination, the best interests of the child and the right of the child to express his or her views [102]. Specific children's rights such as the right to play and the right to safety (to live and develop healthily) are also crucial in that context.

3.7.2.3 Safety risks

Safety is traditionally understood as a compound concept in EU policy and legal instruments. Indeed, game players can be exposed to a number of safety risks while playing. It can include exposure to harmful or illegal content, inappropriate advertising, cyberbullying or harassment or other cyber-attacks, such as ransomware [101]. In this context, the DSA was adopted to strive towards a safer online environment. While online games were not the primary target of the DSA (which mainly addresses social media platforms such as Instagram, Facebook, and X), the obligations contained in the text could be highly relevant to protect players, especially children.

3.7.2.4 Data protection & privacy

With the shift towards online and mobile gaming, the collection of players' data has become easier for gaming companies. This data includes not only what players like to play, but what they read online, who they play with, and what makes them spend money. Data is crucial for game companies, allowing them to analyse player behavior and preferences to enhance products and develop targeted strategies for in-game purchases and player retention[163]. This data collection has therefore contributed to personalized game design, experiences, and data driven monetization[162].

[166] https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=IV-11&chapter=4&clang=_en
[167] https://gdpr-info.eu/
[168] https://www.eu-digital-services-act.com/

The right to data protection is a fundamental right in the EU. The data collection and personal data collection is triggering the application of data protection regulations including the GDPR. Privacy risks can arise from these invasive techniques, such as the behavioural tracking, geolocalisation or even data-driven manipulation [101]. Players often do not fully understand neither the reach of the tracking techniques used, nor their privacy implications. The amount and the sensitivity of data collected raises concerns, especially when it comes to data security and third-party transfers.

3.7.2.5 Consumer protection - Dark patterns & manipulative design

Numerous consumer protection considerations arise in the realm of gaming, such as unfair commercial practices, exposure to gambling, and economic exploitation [101]. Games can involve real money, but also virtual currencies, which can trick players into spending more and losing sight of the actual financial costs of in-game purchases[162]. The extensive data collection discussed above can also lead to hyper-personalization, raising consumer protection and gambling regulation concerns.

While a substantial part of video games are now free-to-play (F2P), the use of personalized persuasive techniques to manipulate players into increased engagement and spending, often through "dark patterns," is becoming more prevalent F2P games [103]. Dark patterns can be defined as “tricks used in websites and apps that make you do things that you didn’t mean to, like buying or signing up for something” [104]. Dark patterns are crafted to exploit user vulnerabilities, such as cognitive biases like the sunk cost fallacy and fear of missing out, nudging players into making choices they would not typically consider, often for profit-making purposes. In the EU, dark patterns are covered by a patchwork of different legal frameworks: the Unfair Commercial Practices Directive[169], the GDPR, the DSA, the Digital Markets Act (DMA)[170] and, to some extent, the AI Act[171].

3.7.2.6 Gaming self-regulation

Traditionally, the gaming sector has had a lower level of regulation [105]. The European video game industry is reported to face challenges, including difficulties in collective organization and collaboration at the EU level. This has led to uneven development across countries with varying levels of political support and visibility. However, the gaming industry has various self-regulation entities and instruments to ensure responsible content and conduct. The Pan European Game Information (PEGI)[172] and the Entertainment Software Rating Board (ESRB)[173] are prominent rating systems that provide age-appropriate content labels for games in Europe and North America, respectively. Another component of game’s self-regulation is the fact that the big app stores like Google Play, Apple's App Store, and Steam, enforce their own Terms and Conditions (T&C), setting guidelines for content and conduct on their platforms, ensuring games meet specific standards before being distributed. The role of self-regulation for the gaming industry will be further explored in task T2.6.

3.7.2.7 Conclusion

In light of all of the abovementioned legal considerations, the i-Game project will work towards establishing guidance on how design games can implement ethical and legal requirements at early stages of their development, and even from their inception onwards.

3.7.3 IP considerations : games co-creation and copyright

The game industry is driven by innovation and creation. Video games are complex creations that combine various forms of art, including software, music, graphics, and narratives, all of which are subject to copyright [106]. IP law plays a crucial role in protecting and commercializing creative works to further incentivize innovation and creativity, as piracy in the video game industry is estimated to result in significant financial losses on an annual basis. This research explores copyright considerations related to co-creation in video games, focusing on platform and user liability, co-ownership conditions, and fair exploitation strategies to

[169] https://commission.europa.eu/law/law-topic/consumer-protection-law/unfair-commercial-practices-and-price-indication/unfair-commercial-practices-directive_en
[170] https://digital-markets-act.ec.europa.eu/about-dma_en
[171] https://artificialintelligenceact.eu/
[172] https://pegi.info/
[173] https://www.esrb.org/about/

ensure transparent IP rights and fair remuneration.

3.7.3.1 Complicating factors

A primary complicating factor arises from the contract between the territoriality of intellectual property regimes and the global business that video games represent. While copyright has been harmonized for some part internationally by the Berne Convention for the Protection of Literary and Artistic Works[174] and the World Intellectual Property Organization (WIPO) Copyright Treaty[175], and at EU level through the adoption of numerous directives and two regulations[176], co-creation in copyright and co-ownership of copyrighted works have not been fully harmonized at the EU level. Consequently, somebody who qualifies as a co-author in one country, may lack such a qualification under the laws of another country.
Complexity is also inherited from the complex video games ecosystem (including platforms, first party companies, publishers and developers) [106] and from the fact that every video game is "a mix of newly created (by developers/artists) IP and third-party IP". These are not mutually exclusive, but it is of paramount importance to bring clarity in authorship and IP ownership for game co-creation.

3.7.3.2 Co-ownership conditions

The gaming value chain is complex, and the detailed research that will be further conducted in the project (task T2.6) will analyse legal criteria for co-ownership claims in co-created video games. It will also assess how co-ownership affects the management and exploitation of IP rights. In this context, case law and examples of successful co-ownership claims will be investigated in order to bring clarity to the actors involved in games co-creation and explore fair exploitation strategies for co-created works.

3.7.3.3 Platform and User Liability

The i-Game project aims to create a game co-creation platform, and this goal involves navigating platform rules, regulations on user-generated content, and considerations regarding copyright associated with third-party intellectual property (IP) materials used in video games. Significant effort will be resolute in task T2.6 to designing clear and appropriate terms and conditions that provide clarity for both platform users and owners.

3.7.4 Artificial Intelligence & Generative AI considerations: Information Technology and Intellectual Property perspective on games creation

Games have evolved from being short-lived products created by small teams for a few hours of entertainment to becoming ongoing services that necessitate constant updates and new content, and as a result, hiring more human staff had to be combined with the use and integration of AI to meet the sector's needs[177]. AI provides significant opportunities to enhance player experience, improve game development and productivity, and offer new revenue streams. However, "games is an application domain of AI research that is often overlooked when discussing responsible AI"[105], as game industry cares mostly about privacy and robustness of AI tools rather than bias, transparency, or explainability.
While many considerations developed in the IT sector are still valid when it comes to AI & Gen AI, the technology reinforces some of these challenges and also creates unique ones. The use of AI & Gen AI in games comes with ethical and legal considerations which include the following: data quality and accuracy, transparency, bias outputs, and privacy. In the gaming sector, the use of AI reinforces the opacity present in the game industry and questions around the addictiveness and safety concerns [105]. The use of AI along the gaming value chain also blurs the line of responsibility in the industry, further reinforcing the lack of transparency.
Many IP considerations arise from AI, from the content being used to train the model, to the legal status of Gen AI output to the impact on working contracts for gaming industry workers [107]. In the following, some example of AI used for games and their ethical and legal considerations can be found.

[174] https://www.wipo.int/treaties/en/ip/berne/
[175] https://www.wipo.int/treaties/en/ip/wct/
[176] https://digital-strategy.ec.europa.eu/en/policies/copyright-legislation
[177] https://www.ai4media.eu/whitepapers/ai-for-video-game-testing-and-music-processing

3.7.4.1 Gen AI & Non-Player Characters (NPCs)

Large language models (LLMs) and Gen AI are used in Non-Player Characters (NPCs), which can stem away from game script to real time conversation with the players, and suggest actions to perform and increased human behaviours and details for the NPCs, making them extremely realistic [103]. However, these NPC's can hallucinate, generate false information or inappropriate behaviours, reproduce stereotypes and discrimination[178], which may trigger increased risks of dependency, manipulation and in game purchases, risk of AI anthropomorphism, and risks of being exposed to illegal or harmful content.

3.7.4.2 NPCs: game breakers

The game has its own world and for the LLM to be relevant and fit for purpose, it has to understand the "reality" of the constructed world and not diverge (e.g. hallucinate) from it. On the other side, LLMs tend to please the user, and an NPC based on Gen AI could unveil that a quest is in vain or disclose too many details from the game story or generate some expectations which do not match the game mechanisms or design. Therefore, in order not to ruin the game, specific care should be taken to understand the world story and rules, characters' limits in terms of knowledge and actions, and respect the game mechanisms.

3.7.4.3 IP: AI-generated content and player-created content

While using generative AI to generate text, images, and videos seems tempting in light of the creative potential, it comes with IP risks, such as the risk of violating third-party copyright in the materials used for training the Gen AI model. While raw data is not protected per se by copyright, when "data" is understood in a broader way, it may encompass videos, music, images etc., which may be protected under copyright. Data can be legally protected, including by copyright and database rights. When developing the AI models, it is essential to ensure that AI systems are trained on legal data and, therefore, that lawful access has been respected.

There is also a risk that the asset created with AI might not be protectable by copyright, and in particular in the EU, the question of protection of AI output is not straightforward. The Court of Justice of the European Union confirmed that copyright protection requires originality, including some form of human input, to reflect the author's personality and the need for the work to express the author's own intellectual creation[179].

The AI Act adopted in 2024 establishes a risk-based framework completed by obligations for foundational models (including generative AI systems). The i-Game research will explore how Gen AI use in video games falls under the regimes established by the AI Act and how the liability of gaming value chain actors would split, especially in a co-creation environment. In addition, best practices will be explored concerning how to mitigate the ethical risks and comply with legal requirements.

Policy recommendations specific for games will be developed on the interface between AI technology and the field of IT/IP law. Particular focus will lie with the question whether the AI Act is fit for purpose or if clarification from the AI Office or through delegated acts should be brought for the application of AI in the gaming sector, as well as whether other legislation should be leveraged or clarified.

3.8 Impact assessment methods and metrics in serious games projects

This section explores impact assessment methodologies for serious games within the cultural, creative, fashion, and textile sectors. It aims to enhance understanding of how serious games contribute to social, economic, and environmental goals. By examining methodologies like Theory of Change and Social Return on Investment, and sector-specific trends, this study identifies challenges and opportunities for improvement. The goal is to provide actionable insights and recommendations for stakeholders to effectively measure and enhance the impact of serious games.

The i-Game project aims to harness the potential of SGs to drive positive social, economic, and environmental impacts within cultural and creative industries, museums, the fashion and textile sector, and the gaming industry, thus the particular focus in this section is on the impact evaluation methods and metrics in serious games across the cultural, creative, fashion, and textile sectors. It aims to develop robust methodologies to evaluate the effectiveness and reach of these serious games.

In the cultural and creative sectors, SGs can enhance visitor engagement, promote cultural heritage, and

[178] https://medium.com/curiouserinstitute/ai-powered-npcs-hype-or-hallucination-11ddfc530e33

[179] Infopaq International A/S v Danske Dagblades Forening [2009] ECJ Case C-5/08

support educational goals[180]. The fashion and textile industry can leverage SGs to promote sustainable practices and engage consumers in meaningful ways[181]. Meanwhile, the gaming industry itself benefits from evaluating user experience, behavioural impacts, and ethical design frameworks to ensure games contribute positively to societal goals [108].
By exploring and analysing existing methodologies, identifying emerging trends, and addressing sector-specific challenges, this research will provide valuable insights to inform the development and deployment of serious games within these industries. With this focus, the section will explore various impact assessment methodologies, including Theory of Change (ToC) and Social Return on Investment (SROI), and examine how they can be applied to measure the impact of serious games. Additionally, it will delve into sector-specific trends, technological advancements, and the challenges and opportunities that lie ahead.

3.8.1 Impact Assessment Methodologies

This section explores the various methodologies used to assess the impact of serious games, focusing on their applicability and effectiveness in different sectors, in order to evaluate how serious games contribute to social, economic, and cultural outcomes.
Impact assessment is critical for understanding how serious games achieve their intended outcomes. It involves evaluating the social, economic, and environmental impacts of these projects. General methodologies like Cost-Benefit Analysis (CBA), Social Impact Assessment (SIA), and Life Cycle Assessment (LCA) are commonly used across various sectors to measure these impacts. These frameworks help in identifying the benefits and drawbacks of interventions, guiding strategic decision-making, and demonstrating accountability to stakeholders [109], [110].

3.8.1.1 Theory of Change

Theory of Change (ToC) is a strategic planning framework that outlines the pathway from project activities to long-term goals. It involves defining the desired impacts, identifying necessary preconditions, and mapping out the interventions required to achieve these impacts. ToC is particularly useful for the i-Game project as it provides clarity and transparency, focusing on outcomes and allowing for flexibility and adaptation. By continuously collecting feedback and making adjustments, ToC ensures that serious games remain effective and relevant in achieving their intended social, economic, and environmental outcomes [111], [112].

3.8.1.2 Social Return on Investment

Social Return on Investment (SROI) quantifies the social, economic, and environmental value created by a project in monetary terms. The SROI process involves several steps: establishing scope, identifying stakeholders, mapping outcomes, evidencing, and valuing outcomes, and calculating the SROI ratio. This methodology provides a comprehensive view of social impact, engaging stakeholders in the evaluation process and facilitating informed decision-making. SROI's ability to translate social outcomes into financial metrics makes it an effective tool for demonstrating the value of serious games and securing support from funders and partners [113], [114].

3.8.1.3 Sector-specific methodologies

This section explores methodologies tailored to the specific needs of different sectors relevant for the i-Game project. By examining the cultural and creative industries (CCI) including museums, the textile and fashion industry, and the gaming industry, we gain insights into how impact assessment tools and approaches can be effectively applied. Focus areas include cultural impact assessment, visitor studies and surveys, engagement metrics for CCI and museums, sustainability assessments and consumer behaviour analysis for textile and fashion, and user experience studies for the gaming industry. These methodologies ensure that the unique characteristics and goals of each sector are addressed comprehensively.

3.8.1.3.1 Cultural and Creative Industries & Museums

The cultural and creative industries (CCI) and museums play a vital role in preserving cultural heritage, promoting education, and fostering community engagement. Serious games in these sectors can enhance

[180] https://www.videogameseurope.eu/
[181] https://textileexchange.org/knowledge-center/

visitor experiences, increase accessibility, and drive innovation. Methodologies for assessing impact in CCI and museums include Cultural Impact Assessment (CIA), visitor studies and surveys, and engagement metrics[182]. For instance, museums can use augmented reality (AR) and virtual reality (VR) games to create immersive experiences that attract diverse audiences and provide deeper educational value [115].

3.8.1.3.2 Fashion & Textile Industry

The fashion and textile industry can leverage serious games to promote sustainable practices and engage consumers. Sustainability assessments evaluate the environmental and social impacts of fashion practices, including the use of sustainable materials and ethical labour practices. Consumer behaviour analysis examines how gamification influences purchasing decisions and promotes eco-friendly choices. Life Cycle Assessment (LCA) assesses the environmental footprint of fashion products, guiding brands in making more sustainable choices in materials and production processes[183, 184].

3.8.1.4 Gaming Industry

The gaming industry benefits from evaluating user experience (UX), behavioural impacts, and ethical design frameworks. UX and engagement studies analyse player interactions and preferences, informing the design of more engaging and effective games (see section 3.5.3). Behavioural impact studies examine the broader social and psychological effects of gaming, such as skill development and health outcomes, as already discussed in section 3.5.1. Ethical design frameworks ensure that games promote inclusivity and positive behaviour, addressing social issues and fostering community engagement (see section 3.7.2). In the following, some examples of games adopting such theories and principles are presented.

Game Example focused on UX: The game "Never Alone"[185] (Kisima Ingitchuna) is an example of a game designed with strong UX principles. It tells the story of an Iñupiat girl and her arctic fox companion, incorporating traditional Alaskan Native stories. The game's development involved extensive user research and collaboration with the Iñupiat community to ensure cultural accuracy and engagement.

Game Example focused on behavioural impact: "Re-Mission"[186] is a game developed by HopeLab for young cancer patients. Studies have shown that playing the game improves treatment adherence and health outcomes by enhancing patients' understanding of their disease and treatment.

Game Example integrating strong ethical design principles: The game "Life Is Strange"[187] addresses complex social issues such as bullying, mental health, and identity. It has been praised for its ethical approach to storytelling and character development.

3.8.2 Emerging trends and considerations in impact assessment

This section explores the latest trends and considerations in impact assessment for serious games. By examining current trends, technological advancements, and sector-specific trends, we gain insights into how impact assessment practices are evolving and their implications for future research and practice. Current trends in impact assessment reflect a growing emphasis on comprehensive, nuanced, and dynamic methods for evaluating the impact of serious games. Influenced by technological advancements and evolving stakeholder expectations, these trends enhance the effectiveness and relevance of impact assessments.

3.8.2.1 Trends in methodologies and metrics

Recent trends in impact assessment methodologies are characterised by a shift towards more holistic and integrated approaches. Traditional methods like Cost-Benefit Analysis (CBA) and Social Impact Assessment (SIA) are increasingly being complemented by innovative frameworks that capture a wider range of impacts.

- **Integrated frameworks**: Combining various assessment methodologies, such as Social Return on Investment (SROI) with environmental impact assessments, provides a more comprehensive evaluation of projects. This approach offers a fuller picture of both social and environmental

[182] https://whc.unesco.org/en/guidance-toolkit-impact-assessments/
[183] **https://www.patagonia.com/sustainability/**
[184] **https://www.stellamccartney.com/experience/en/sustainability/**
[185] https://store.steampowered.com/app/295790/Never_Alone_Kisima_Ingitchuna/
[186] https://hopelab.org/case-study/re-mission/
[187] https://store.steampowered.com/agecheck/app/319630/

outcomes[188].

- **Multi-Criteria Analysis (MCA)**: MCA evaluates multiple, often conflicting criteria simultaneously, making it particularly useful for assessing complex projects where social, economic, and environmental impacts need to be balanced [116].
- **Participatory approaches**: Engaging stakeholders in the assessment process ensures that the perspectives and values of those affected by the project are incorporated, leading to more accurate and accepted outcomes [116].
- **Dynamic and adaptive assessments**: Dynamic and adaptive assessment frameworks allow for ongoing monitoring and flexibility, enabling timely adjustments based on real-time data and feedback. This approach is particularly relevant for projects operating in rapidly changing environments[188].

3.8.2.2 Technological advancements influencing impact assessment

Technological advancements are significantly enhancing the field of impact assessment by providing new tools and methods for data collection, analysis, and visualisation.

- **Big Data and Analytics**: The use of big data and advanced analytics enables the processing of large volumes of data to uncover patterns and insights that were previously unattainable, allowing for more accurate and detailed assessments of project impacts[189].
- **Artificial Intelligence (AI) and Machine Learning (ML)**: AI and ML predict outcomes and identify correlations that are not immediately apparent, automating parts of the assessment process and making it faster and more efficient[189].
- **Geospatial technologies**: Geographic Information Systems (GIS) and remote sensing technologies provide spatial data crucial for environmental and social impact assessments, allowing for the mapping and analysis of impacts across different regions and communities[190].
- **Digital platforms and dashboards**: Online platforms and dashboards enable real-time monitoring and reporting of project impacts. Tools like Microsoft Power BI and Tableau help visualise data in a user-friendly way, making it easier for stakeholders to understand and interact with the assessment results[191].

3.8.2.3 Sector-specific trends

3.8.2.3.1 Cultural and Creative Industries & Museums

Museums and cultural institutions are increasingly integrating digital technologies and gamification to enhance visitor experiences and engagement, as already discussed in section 3.1. Museums use VR, AR, interactive touch screens, and mobile apps to create more immersive and engaging visitor experiences. For example, the British Museum's "Life in VR" offers virtual tours of ancient artefacts[192], while the Smithsonian Institution uses interactive screens to provide detailed exhibit information[193]. Museums also employ gamification to make learning more engaging and interactive. This includes educational games, treasure hunts, and interactive storytelling experiences that transform passive observation into active participation. The Museum of London's "Streetmuseum" app overlays historical images and information onto modern-day locations, creating an educational treasure hunt[194].

3.8.2.3.2 Fashion & Textile Industry

The fashion and textile industry is focusing on sustainability and innovative consumer engagement strategies. Sustainable fashion initiatives aim to reduce the environmental impact of clothing production and consumption, while gamification enhances consumer engagement and marketing efforts. Sustainable fashion initiatives focus on using eco-friendly materials, ethical labour practices, and waste reduction through recycling and upcycling. Brands like Patagonia[195] and Stella McCartney[196] lead by incorporating sustainable

[188] https://impactmanagementproject.com/
[189] https://sustainableinfrastructure.org/envision/use-envision/
[190] https://www.esri.com/en-us/industries/humanitarian/solutions/response
[191] https://powerbi.microsoft.com/
[192] https://www.britishmuseum.org/blog/how-explore-british-museum-home
[193] https://www.si.edu/exhibitions/online
[194] https://treasuretrovescotland.co.uk/
[195] https://www.patagonia.com/our-responsibility-programs.html
[196] https://www.stellamccartney.com/it/it/sustainability/sustainability.html

materials and promoting eco-friendly practices. Programs like Eileen Fisher Renew[197] collect and resell gently worn clothing, promoting circular fashion and reducing waste. Gamification enhances consumer engagement and marketing in the fashion industry through loyalty programs, interactive campaigns, and virtual try-ons. Nike's "Run Club" app[198] gamifies fitness by allowing users to set goals and track progress, while the "Adidas Creators Club"[199] rewards members for engaging with the brand.

3.8.2.3.3 Gaming Industry

The gaming industry continues to innovate in game design and user interaction, with a growing focus on ethical gaming and social impact. Innovations in VR, AR, AI, and haptic feedback are enhancing the gaming experience, making it more immersive and interactive. Games like "Half-Life: Alyx"[200] and "Pokémon GO"[201] set new standards for interactive gameplay. The gaming industry recognizes the importance of ethical gaming and its potential for positive social impact. This involves developing inclusive games, addressing social issues, and promoting positive behaviour. Games like "The Last of Us Part II" offer extensive accessibility options[202], while "Hellblade: Senua's Sacrifice"[203] addresses mental health issues.

3.8.2.4 Considerations for future research and practice

As the field of serious games continues to evolve, ongoing research and practice improvements are essential. This section emphasises the importance of continuous innovation in assessment methods and the benefits of cross-sectoral learning and adaptation. By integrating new approaches and insights from various sectors, we can enhance the effectiveness and impact of serious games, ensuring their relevance in addressing contemporary challenges.

Continuous innovation in assessment methods is crucial to keep pace with the dynamic landscape of serious games. Traditional methods may not fully capture the complex and multifaceted impacts of these games. Thus, developing, and refining methodologies that provide a comprehensive evaluation of social, economic, and environmental outcomes is essential. Innovative approaches such as integrating big data analytics, AI, and real-time feedback mechanisms can offer more precise and actionable insights. By continually updating assessment methods, we ensure that they remain relevant and effective, helping stakeholders make informed decisions and demonstrate the value of serious games.

Cross-sectoral learning and adaptation involve leveraging insights and best practices from different industries to enhance the development and assessment of serious games. Each sector, whether cultural, creative, fashion, or gaming, offers unique perspectives and methodologies that can inform and improve others. For instance, the rigorous sustainability assessments used in the fashion industry can be adapted to evaluate the environmental impacts of game production. Similarly, the engagement metrics used in museums can inform user experience studies in gaming. By fostering collaboration and knowledge exchange across sectors, we can create more robust and comprehensive assessment frameworks, driving innovation and improving the overall effectiveness of serious games[204].

3.8.3 Challenges and opportunities

This section addresses the key challenges and opportunities associated with the impact assessment of serious games. By identifying these challenges and exploring potential opportunities for innovation and improvement, we aim to provide actionable insights for stakeholders involved in the development and assessment of serious games.

3.8.3.1 Common Challenges in Impact Assessment

Methodological limitations: Traditional impact assessment methods may not fully capture the complex and multifaceted impacts of serious games. Developing methodologies that consider the unique characteristics

[197] https://www.eileenfisherrenew.com/
[198] https://www.nike.com/nrc-app?referrer=singular_click_id%3Dd5349d09-9cfb-47b1-816c-b26bd4a1ffa0
[199] https://www.adidas.co.uk/creatorsclub?msockid=21ad1e5dab876dcf3ec00a2eaaf06c8c
[200] https://en.wikipedia.org/wiki/Half-Life:_Alyx
[201] https://www.pokemongo.com/
[202] https://www.playstation.com/en-us/games/the-last-of-us-part-ii/accessibility/
[203] https://www.hellblade.com/
[204] https://www.oecd.org/cfe/leed/Cross-Sectoral-Learning.htm

of serious games is crucial. Integrating qualitative and quantitative data remains challenging but necessary for comprehensive evaluations.
Data collection and analysis issues: Collecting reliable and valid data on the impact of serious games can be difficult, particularly when measuring intangible outcomes such as behaviour change or social impact. Ensuring participant engagement and honest feedback during data collection processes is another challenge.
Stakeholder engagement difficulties: Engaging stakeholders throughout the impact assessment process is essential but complex. Different stakeholders may have varying interests, expectations, and levels of understanding about impact assessment methodologies and results. Building and maintaining trust to ensure active participation and honest feedback is critical.

3.8.3.2 Sector-specific challenges

Cultural and Creative Industries & Museums

- **Measuring intangible cultural impacts**: quantifying the cultural value and intangible benefits of serious games in these sectors is challenging.
- **Ensuring visitor feedback**: obtaining consistent and meaningful feedback from visitors can be difficult, as in any consumer and visitor studies targeting diverse and dispersed user groups.

Fashion & Textile Industry

- **Balancing sustainability with economic goals**: implementing sustainable practices while maintaining economic viability is a significant challenge.
- **Engaging consumers in impact-driven initiatives**: encouraging consumer participation in sustainability initiatives and measuring their impact can be complex.

Gaming Industry

- **Addressing ethical concerns in game development**: ensuring that games promote positive behaviour and inclusivity while avoiding ethical pitfalls is a key challenge.
- **Measuring long-term behavioural impacts**: assessing the long-term behavioural and psychological effects of games on players requires innovative methodologies.

3.8.3.3 Opportunities for Improvement and Innovation

- **Advancements in Data Analytics and AI for impact assessment:** Leveraging advanced technologies like AI, machine learning, and big data analytics can enhance the precision and efficiency of impact assessments. These tools can process large datasets, identify patterns, and provide real-time feedback, making assessments more dynamic and adaptive.
- **Enhanced stakeholder collaboration and co-creation:** Adopting participatory approaches that actively involve stakeholders in the assessment process ensures that their perspectives and values are incorporated, leading to more accurate and accepted outcomes. Building robust communication channels and trust with stakeholders can enhance their engagement and the quality of data collected.
- **Development of integrated assessment frameworks:** Creating integrated assessment frameworks that combine various methodologies, such as SROI with environmental impact assessments, provides a holistic view of the impacts. MCA can evaluate multiple, often conflicting criteria simultaneously, offering a more balanced assessment of complex projects.

3.8.3.4 Recommendations

Best practices for implementing effective impact assessments: Adopt a mixed-methods approach to capture both qualitative and quantitative data. Engage stakeholders early and throughout the process to ensure their perspectives are included. Leverage technology to enhance data collection, analysis, and reporting.
Cultural and Creative Industries & Museums: use participatory approaches to capture visitor experiences and integrate digital technologies to enhance engagement.
Fashion & Textile Industry: implement LCA to assess the environmental impact and use gamification to

engage consumers in sustainability initiatives.
Gaming industry: develop ethical guidelines for game development and use long-term studies to assess behavioural impacts.
Future directions for research and development: Focus on continuous innovation in assessment methods, integrating new technologies, and promoting cross-sectoral adaptation. Encourage collaboration between academia, industry, and policymakers to develop robust and comprehensive impact assessment frameworks.

3.8.4 Conclusion

This research on impact assessment methods for serious games within the cultural, creative, fashion, and textile sectors provides a comprehensive understanding of how these games can contribute to social, economic, and environmental goals. By evaluating current methodologies and exploring sector-specific trends, this study offers valuable insights for stakeholders involved in the development and assessment of serious games.
Key Findings

- **Methodologies**: traditional methods like Cost-Benefit Analysis (CBA), Social Impact Assessment (SIA), and Life Cycle Assessment (LCA) provide essential tools for evaluating serious games. Incorporating frameworks like Theory of Change (ToC) and Social Return on Investment (SROI) enhances these assessments by mapping activities to outcomes and quantifying social impacts.
- **Technological advancements**: advanced technologies such as AI, big data analytics, and geospatial tools significantly improve the precision and scope of impact assessments. These technologies facilitate real-time data collection, dynamic analysis, and comprehensive visualisation, making assessments more adaptable and effective.
- **Sector-specific insights**: in the cultural and creative industries, digital transformation and gamification enhance visitor engagement and educational outcomes. In the fashion and textile industry, sustainable practices, and consumer engagement through gamification balance economic and environmental goals. In the gaming industry, ethical design and innovations in user interaction are crucial for creating socially responsible and engaging games.
- **Challenges and opportunities**: common challenges in impact assessment include methodological limitations, data collection issues, and stakeholder engagement difficulties. Addressing these challenges requires leveraging technological advancements, fostering cross-sectoral learning, and developing integrated assessment frameworks. Opportunities for improvement lie in enhancing stakeholder collaboration, using advanced data analytics, and continuously innovating assessment methodologies.

Recommendations

- **Adopt integrated frameworks**: combining various assessment methodologies provides a wider impact assessment across four fields: cultural, social, economic, and sustainability/environmental.
- **Leverage technology**: use AI, big data, and geospatial tools to enhance data collection, analysis, and visualisation.
- **Enhance stakeholder engagement**: engage stakeholders throughout the assessment process to ensure their perspectives are incorporated and build trust for more accurate and accepted outcomes.
- **Foster Cross-sectoral learning**: encourage collaboration and knowledge exchange between sectors to develop robust and comprehensive assessment frameworks.

By implementing these recommendations, stakeholders can ensure that serious games effectively contribute to desired outcomes. This research underscores the importance of continuous innovation and adaptation in impact assessment methodologies to keep pace with technological advancements and evolving societal expectations. The ultimate goal is to enhance the overall impact and value of serious games, making them powerful tools for positive social, economic, and environmental change.

3.9 Financial support for serious games projects and game co-creation initiatives

In the rapidly changing landscape of the game industry and other sectors due to the adoption of advanced technologies, the issue of sustainability of the outcomes of initiatives as i-Game must be considered at very early stages and build-up along with the end product development. In this context, this section provides a

preliminary overview of the current context regarding potential pathways for financial support for initiatives targeting mainly social impact.

3.9.1 The Need and Importance of Financial Support for Non-Profit Game Co-Creation Communities

3.9.1.1 The Convergence of Textile Museums, Textile Industry, and Video Game Industry

In today's digital age, the convergence of traditional industries with innovative technologies opens up new avenues for education, preservation, and engagement. This is particularly true for the textile industry and museums, which have a rich heritage and a significant cultural impact. Textile museums play a crucial role in preserving the history and evolution of textile arts and industry, highlighting artefacts that embody centuries of craftsmanship and innovation. The textile industry, on the other hand, continues to be a dynamic sector with constant advancements in materials, techniques, and sustainability practices.

Integrating these domains with the video game industry through serious games can create immersive and interactive experiences that enhance public understanding and appreciation of textile heritage. Serious games, inspired by video games and the gaming world, are games mainly designed for educational purposes, combining learning with fun and engagement, making them powerful tools for learning through storytelling, communication, information, and other related learning activities. By connecting textile museums, the textile industry, and the video game industry, we aim to foster innovative collaborations that bring textile heritage to life in new and engaging ways.

3.9.1.2 The Role of Non-Profit Game Co-Creation Communities

Non-profit game co-creation communities are uniquely positioned to facilitate these interdisciplinary collaborations. These communities often comprise diverse stakeholders, including historians, designers, educators, technologists, and gamers, who work together to create meaningful and educational gaming experiences. Their non-profit nature ensures that the primary focus remains on cultural preservation, education, and public engagement rather than commercial gain.

However, the development of high-quality serious games that effectively bridge these industries requires significant resources. Financial support is essential to enable these non-profit communities to access the tools, expertise, and platforms necessary for game development. It allows them to:

- Develop Innovative Content: Creating immersive and educational content that accurately represents textile heritage and industry requires substantial investment in research, design, and technology.
- Facilitate Collaboration: Effective collaboration between museums, culture and industry experts, and game designers and developers necessitates funding for workshops, meetings, and collaborative platforms.
- Facilitate Inclusion and Ensure Accessibility and Reach: To maximize the learning impact of serious games, these need to be usable and accessible to a wide audience, which includes co-creation workshops, end-user testing, and investing in marketing, distribution, and user support.
- Sustain Long-Term Projects: Financial support ensures the sustainability of long-term projects, allowing for ongoing updates, improvements, and expansions of the games.

3.9.1.3 The Importance of Financial Support

The integration of serious games into the textile and museum sectors offers numerous benefits, but achieving these outcomes requires dedicated financial support. Here's why financial backing is critical:

- Innovation and Quality: Financial resources enable the adoption of cutting-edge technologies and high production values, resulting in engaging and effective educational games.
- Inclusive and Equitable Access: Funding can support initiatives to make these co-creation platforms and games usable and accessible to diverse audiences, including marginalized communities and people with disabilities, ensuring that the benefits of these innovations are widely shared.
- Capacity Building: Financial support helps build the capacity of non-profit game co-creation communities, allowing them to train new members, acquire necessary skills, and grow their impact.
- Cultural Preservation and Education: By financially supporting these initiatives, we contribute to the preservation of textile heritage and the dissemination of knowledge about the textile industry’s

history and evolution.

- Economic and Social Impact: Investing in serious games that connect these sectors can stimulate local economies, create job opportunities, and foster social cohesion through shared cultural experiences.

Financial support is a cornerstone for the success and sustainability of non-profit game co-creation communities that aim to connect textile museums, the textile industry, and the video game industry. By investing in these interdisciplinary collaborations, we can harness the power of serious games to preserve textile heritage, educate the public, and promote innovation across sectors. This, in turn, enhances cultural appreciation, supports the textile industry, and highlights the potential of the video game industry to contribute to societal good.

3.9.2 Research on existing EU funding schemes for both co-creation and game creation

For researching financial support available for serious game projects and game co-creation initiatives at both the EU and national levels, we have explored a mix of official government websites, research organization portals, and private institution reports. Here are the key sources used:

3.9.2.1 National Level

The main national resources from the i-Game pilot countries – Estonia, Italy, and Greece are:

3.9.2.1.1 Estonia

3.9.2.1.1.1 Government Websites

- **Estonian Ministry of Culture**[205]: The Ministry of Culture provides funding for various cultural projects, including digital and serious games.
- **Enterprise Estonia (EAS)**[206]: EAS supports entrepreneurship and innovation, offering grants and funding programs that can be utilized by serious game developers.
- **Estonian Research Council**[207].
- **Estonian Cultural Endowment**[208].

3.9.2.1.1.2 Research Organization Portals

- **Tallinn University**[209]: The university often collaborates on EU-funded research projects and initiatives related to serious games and digital learning.
- **Estonian Research Council**[210]: Offers various grants for research projects, including those that involve serious games and educational technology.
- **Tartu University**[211]**:** The university often collaborates on EU-funded research projects and initiatives related to serious games and digital learning.

3.9.2.1.1.3 Private Institution Reports

- **Gamedev Estonia**[212]: A network supporting the digital gaming industry in Estonia, providing information on funding opportunities and industry support.

3.9.2.1.2 Italy

3.9.2.1.2.1 Government Websites

- **Italian Ministry of Economic Development (MISE)**: Provides funding for innovation and development projects, including those in the gaming sector.
- **Creative Europe Desk Italy**[213]: Part of the EU Creative Europe program, this desk offers information and support for accessing EU funds for cultural and creative projects.

3.9.2.1.2.2 Research Organization Portals

- **National Research Council (CNR)**: Italy's largest public research institution, which often supports

[205] https://www.kul.ee/en
[206] https://eas.ee/en/
[207] https://etag.ee/en/
[208] https://www.kulka.ee/
[209] https://www.tlu.ee/en
[210] https://etag.ee/en/
[211] https://ut.ee/en
[212] https://gamedevestonia.ee
[213] https://www.europacreativa-media.it/

projects in digital education and serious games.
- **Politecnico di Milano**: Involved in numerous EU-funded projects related to serious games and digital innovation.

3.9.2.1.2.3 Private Institution Reports
- **Italian Interactive Digital Entertainment Association (IIDEA)**: Provides industry reports, funding opportunities, and support for the video game sector in Italy.
- **LVenture Group**[214]: A venture capital firm that invests in digital startups, including those in the gaming sector.

3.9.2.1.3 Greece

3.9.2.1.3.1 Government Websites
- **Hellenic Ministry of Culture and Sports**: Provides funding and support for cultural projects, including those involving serious games.
- **General Secretariat for Research and Technology (GSRT)**[215]: Offers funding for research and innovation projects, which can include serious game development.

3.9.2.1.3.2 Research Organization Portals
- **National and Kapodistrian University of Athens**: Participates in various EU-funded research projects related to educational technology and serious games.
- **Foundation for Research and Technology - Hellas (FORTH)**: Engages in extensive research in digital technologies, including serious games.

3.9.2.1.3.3 Private Institution Reports
- **Greek Game Developers Association (HGDA)**[216]: Provides information on industry support, funding opportunities, and networking for game developers in Greece.
- **Corallia**: An organization that supports clusters and innovation in Greece, including digital and gaming startups.

3.9.2.2 **National support schemes from other European main countries are:**
- Germany - Federal Ministry of Transport and Digital Infrastructure (BMVI): Funding programs for digital games and innovative projects.
- France - Centre National du Cinéma et de l'image animée (CNC): Grants and support for video game development.
- United Kingdom - UK Games Fund[217]: Provides grants to support early-stage video game development.
- Netherlands - Creative Industries Fund NL[218]: Grants for creative projects, including serious games.

3.9.3 European Union Level

3.9.3.1 Creative Europe Programmes

The Creative Europe[219] EU program provides funding for the cultural and creative sectors, including video games.

3.9.3.1.1 Culture Strand
- European cooperation projects and Pan-European Cultural Entities: **Creative Europe programme's Culture strand**.
- European Platforms for the promotion of emerging artists As part of the Creative Europe programme, the European Union co-financed 16 European platforms for the period 2021-2023.
- European networks: Below you will find the list of the 37 European Networks co-financed under the Creative Europe programme grouped by the following sectors: Architecture, Book and publishing, Cross-sectoral, Cultural heritage, Music, Performing arts

[214] https://lventuregroup.com/
[215] https://www.gsrt.gr/
[216] http://www.hgda.gr/
[217] https://ukgamesfund.com/
[218] https://www.stimuleringsfonds.nl/
[219] https://ec.europa.eu/programmes/creative-europe/

Culture Moves Europe, supporting cultural mobility in Europe and beyond. Here we can find questions and answers about the individual mobility scheme. Here

3.9.3.1.2 *Media Strand.*

3.9.3.1.2.1 Content cluster

- **Co-development**
- **Slate development**
- **Mini-slate development**
- **TV and online content**
- **Video games and immersive content development**
- Creative Europe MEDIA grants are awarded following competitive for proposals, published in **the Funding & Tender opportunities portal** of the European Commission.

3.9.3.1.2.2 Business cluster

- European media talents and skills.
- Markets and networking
- European film sales
- European Film Distribution
- Innovative tools and business models
- MEDIA 360

3.9.3.1.2.3 Audience Cluster

- Network of European cinemas
- European festivals
- European Video-on-Demand (VOD) networks and operators
- Films on the move
- Subtitling of cultural content
- Audience development & film education
- Networks of European Festivals

3.9.3.1.2.4 Policy Support Cluster

- Data intelligence.
- Policy exchanges and cooperation with Member States
- Communication, advocacy, and engagement with industry
- Audience outreach activities and awareness campaigns

3.9.3.2 Other Funding Programmes at EU level

- **Horizon Europe**: Horizon Europe: The EU's research and innovation framework program offers grants for innovative projects, including serious games.: **Funded Projects related to Serious Games**
- **European Commission -** Digital Single Market: Look for funding opportunities and policy documents related to the digital economy and serious games.
- **European Innovation Council (EIC)**: European Innovation Council: Provides funding and support for innovative startups and projects, including those in gaming and digital learning.
- **EICAcclerator**
- **EIC Pathfinder**
- **EIC Transition**

3.9.4 International and Private Institutions

- **World Bank**[220]: Look for funding opportunities and projects related to educational technologies and serious games.
- **Bill & Melinda Gates Foundation**[221]: Provides grants for innovative educational projects, including

[220] https://www.worldbank.org/en/topic/education/projects
[221] https://www.gatesfoundation.org/

digital learning tools.

- **Serious Games Association**[222]: Offers resources and information on funding opportunities for serious games.
- **Google for Startups**[223]: Look for funding and support programs specifically aimed at game developers and educational technologies.

3.9.5 State-of-the art in games and gamified experiences in European museums and potential funding sources for serious-game co-creation ecosystems

European museums have effectively embraced gamified experiences as an integral part of exhibition development and digital transformation. These initiatives are typically funded through a mix of Creative Europe, Horizon Europe, national cultural grants, and private sponsorships. This synthesis highlights the collaborative and innovative approaches museums use to enhance engagement, educate visitors, and integrate digital tools into cultural storytelling.

3.9.5.1 Integration with Exhibition Development

- The National Museum of Finland (Finland):
  - Gamified Experience: Developed an augmented reality (AR) game called The Secret of the Lost Manuscript, where visitors use their smartphones to solve historical mysteries while exploring the museum.
  - Funding: Supported by the Creative Europe Programme, as part of a cultural heritage innovation initiative.
  - Key Insight: Gamified experiences here are seamlessly woven into exhibitions, enriching visitor engagement with storytelling.
- Musée de la Romanité (France):
  - Gamified Experience: AR Odyssey, a mobile application that takes visitors on an interactive journey through Roman history with AR-enhanced features.
  - Funding: Funded by regional cultural grants and the French Ministry of Culture as part of a digital transformation agenda.
  - Key Insight: Games complement exhibitions, making ancient history immersive and accessible to younger audiences.

3.9.5.2 Focus on Enhancing Museum Services

- Rijksmuseum (Netherlands):
  - Gamified Experience: Operation Night Watch, an interactive online game that invites players to help conserve Rembrandt's famous painting through problem-solving and mini-games.
  - Funding: Supported by institutional funding and private sponsorship from ING, a Dutch multinational banking corporation.
  - Key Insight: Gamification extends beyond physical exhibits, enhancing digital engagement and reaching global audiences.
- The British Museum (United Kingdom):
  - Gamified Experience: The Museum Run, an online game where players collect artifacts while learning about their history in a fun and competitive format.
  - Funding: Financed by Horizon Europe grants aimed at fostering innovation in cultural education.
  - Key Insight: Digital gamified solutions allow museums to educate and engage with audiences far beyond their physical locations.

3.9.5.3 Diverse Partnerships for Development

- M9 Museum of the 20th Century (Italy):
  - Gamified Experience: Collaborated with a digital storytelling company to create interactive

[222] http://seriousgamesassociation.com/
[223] https://startup.google.com/

exhibits combining AR games and participatory activities focused on 20th-century history.
    - Funding: Co-financed by Creative Europe and private sponsorship from local businesses.
    - Key Insight: Partnerships with multi-disciplinary firms enable museums to craft innovative solutions tailored to visitor engagement.
- Museum of Broken Relationships (Croatia):
    - Gamified Experience: Visitors participate in a gamified digital archive by uploading and tagging their personal stories of heartbreak, creating an evolving digital museum.
    - Funding: Supported through national cultural funds and EU cultural cooperation grants.
    - Key Insight: Gamification encourages visitor participation and turns audiences into co-creators of museum content.

To provide a detailed overview of grants and funding sources available for serious game projects and game co-creation initiatives in the Museums & Culture and Fashion & Textile domains with a special focus on Estonia, Greece, and Italy, we can explore a variety of resources including government programs, research institutions, and private organizations. Below are specific references and links to potential funding opportunities in these countries.

3.9.5.4 Estonia

- **Tallinn Creative Hub (Kultuurikatel)[224]:** This creative centre fosters innovation in digital arts and culture, and frequently collaborates on projects that involve new media, including serious games and digital museum experiences.
- **Creative Estonia [225]**: An initiative that promotes the creative industries in Estonia. They provide information, networking opportunities, and support for businesses in the creative sector, including fashion and textiles.
- **Startup Estonia**: This organization supports startups in various fields, including creative industries. They offer programs, events, and funding opportunities that could be relevant to fashion and textiles.
- **Baltic Innovation Fund (BIF)**: Although not specifically focused on creative industries, BIF is a venture capital initiative that could provide funding for innovative businesses in sectors like fashion and textiles.
- **National Heritage Board of Estonia**: They oversee the protection and promotion of cultural heritage in Estonia. They offer support for projects that aim to preserve and promote heritage, including digital initiatives.
- **GameFounders[226]**: This is the first gaming startup accelerator in Europe, based in Estonia. They offer funding, mentorship, and networking opportunities specifically for game developers.
- **IGDA Estonia (International Game Developers Association Estonia)**: A community and networking platform for game developers in Estonia. They offer resources, events, and support for professionals in the game design industry.

3.9.5.5 Greece

- **Hellenic Ministry of Culture and Sports**: Offers grants for cultural projects, including serious games that enhance museum experiences and cultural heritage.
- **Greek National Tourism Organization (GNTO)[227]:** Supports projects that promote cultural heritage and tourism, including innovative digital experiences in museums.
- **Hellenic Foundation for Research and Innovation (HFRI):** Provides funding for research and innovation projects, including those related to serious games in cultural education.
- **Greek Fashion Council[228]:** Supports innovation in the fashion industry, including grants for projects that incorporate serious games and digital innovation.
- **Greek General Secretariat for Research and Technology (GSRT)[229]:** Provides funding for research and development projects, including those in the fashion and textile industries.

[224] https://kultuurikatel.ee/
[225] https://www.looveesti.ee/en/creative-estonia/
[226] https://www.gamefounders.com/
[227] https://www.visitgreece.gr/
[228] https://www.fashioncouncil.gr/
[229] https://www.gsrt.gr/

3.9.5.6 Italy

- **Italian Ministry of Culture (MiC)**[230]: Provides grants for cultural heritage projects, including digital and serious games that enhance museum experiences.
- **Fondazione Cariplo**: Offers funding for cultural innovation projects, including those that use serious games to promote cultural heritage.
- **Creative Europe Desk Italy**[231]**:** Supports cultural and creative projects with EU funding, including those in the digital and serious games sectors.
- **Italian Trade Agency (ITA):** Offers support for Italian businesses, including those in the fashion and textile sectors, promoting innovation and internationalization.
- **National Chamber of Italian Fashion (CNMI):** Provides funding and support for innovation in the Italian fashion industry, including digital and serious game projects.
- **Politecnico di Milano Fashion in Digital Era (FIDE) Program:** Supports innovation and research in fashion technology, including serious games and digital projects.

By leveraging this kind of resources, serious game projects and game co-creation initiatives in Estonia, Greece, and Italy can try to secure funding and achieve sustainability, particularly within the Museums & Culture and Fashion & Textile domains. It is essential to explore these opportunities thoroughly and consider forming strategic partnerships to maximize the impact and reach of their projects. However, it is important to note that funding opportunities are limited and that the submission and request processes are often competitive and often complex, requiring a certain level of expertise and skills.

To secure funding at European level and achieve sustainability for serious game co-creation ecosystems specifically within the Museums & Culture and Fashion & Textile domains, it is important to identify and leverage targeted funding opportunities, strategic partnerships, community networks and domain-specific initiatives. The following section provides an in-depth look at how these ecosystems can secure funding and ensure sustainability:

3.9.5.7 Museums & Culture Domain

3.9.5.7.1 Funding Opportunities

- **Creative Europe**[232]: This EU program supports the cultural and creative sectors, including projects that involve serious games for museums and cultural heritage. Projects can secure grants by aligning with the program's goals of cultural preservation, education, and digital innovation.
- **National Cultural Grants**: Many countries offer grants specifically for cultural projects. For example, the Italian Ministry of Culture offers funding for projects that enhance cultural heritage through innovative means, including serious games.
- **Local Museum Funds**: Many museums have their own grant programs or collaborate with foundations to support innovative projects. For example, the **Smithsonian Institution** offers grants for digital innovation projects.
- **Horizon Europe**[233]: This program funds research and innovation projects across Europe, including those that involve serious games for cultural education and heritage preservation.
- **The Getty Foundation** [234] : Supports innovative projects that improve the understanding and preservation of cultural heritage, including those using serious games.

3.9.5.7.2 Sustainability Strategies

- **Partnerships and Collaborations**: (i) Collaborate with educational institutions to create serious games that can be used in both museum settings and classrooms. (ii) Partner with technology companies to access cutting-edge tools and platforms, ensuring the serious games are technically advanced and engaging.
- **Revenue Generation Models**: (i) Develop paid versions of serious games for use by educational institutions. (ii) Create downloadable content (DLC) or expansion packs that can be sold to enhance the gaming experience. However, when looking at the current market, paid digital services are not a

[230] https://www.beniculturali.it/
[231] https://www.europacreativa-media.it/
[232] https://ec.europa.eu/programmes/creative-europe/
[233] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/home
[234] https://www.getty.edu/foundation/

very promising source of revenue for the heritage sector, either for general audiences or education sector. Monetization of digital heritage-based solutions is explored, but currently it remains a very occasional recommendation.

- **Community Engagement and Crowdsourcing:** (i) Engage the community through crowdfunding platforms like Indiegogo, Crowdcube, Seedrs, Ulule, Goteo, October, Verkami, Companisto or FundedByMe to raise funds for specific projects. (ii) Use crowdsourcing to gather ideas and feedback, ensuring the games are relevant and engaging for a wide audience.

3.9.5.8 Fashion & Textile Domain

3.9.5.8.1 Funding Opportunities

- **European Textile Platform (ETP)**[235]: Offers funding and support for innovation in the textile industry, including digital and serious games that promote sustainability and creativity.
- **Fashion Design and Textile Innovation Funds**: Various national and regional funds support innovation in fashion and textiles, focusing on sustainability, creativity, and education.
- **Creative Europe**: This program also supports the fashion and textile sectors under its cultural and creative industries funding, encouraging projects that combine fashion with digital innovation.
- **Horizon Europe**: Funds projects that combine technology with fashion and textiles, including those using serious games to promote sustainability and innovation in the industry.
- **The European Fashion Council**[236]: Provides funding and support for innovative projects in the fashion industry.

3.9.5.8.2 Sustainability Strategies

- **Partnerships with Fashion Brands and Retailers**: (i) Collaborate with fashion brands to create serious games that educate consumers on sustainable fashion practices. (ii) Partner with retailers to feature serious games in stores and online platforms, enhancing customer engagement and education.
- **Education and Training Programs**: (i) Develop serious games as educational tools for fashion and textile students, the general student population (as general knowledge acquisition) and the general public, experts and others interested in textile heritage, providing interactive learning experiences on topics such as sustainable practices and innovative design. (ii) Offer certifications for game-based learning modules, creating additional revenue streams.
- **Events and Competitions**: (i) Host fashion and textile innovation competitions that use serious games as a platform for highlighting new ideas and designs. (ii) Organize events and workshops where industry professionals, or other interested stakeholders, can experience and learn from the serious games, fostering a community of innovation.
- **Leveraging Digital Platforms**: (i) Utilize online platforms and social media to reach a wider audience, promoting the serious games and their educational benefits. (ii) Implement in-game purchases and virtual goods related to fashion and textiles, creating new revenue opportunities.

To secure funding and ensure sustainability for serious game co-creation ecosystems in the Museums & Culture and Fashion & Textile domains, it is essential to leverage a mix of government grants, industry-specific funds, research grants, and private sector support. Building strategic partnerships, engaging communities, and exploring innovative revenue models are key strategies to enhance sustainability and impact. By tapping into these diverse funding sources and adopting sustainable practices, serious games' projects can thrive and contribute significantly to their respective domains.

3.9.6 Analysis of studies, benchmarking white papers and literature related to sources and volume for the startup and videogame ecosystems

For conducting an analysis of different studies, benchmarking white papers, and literature related to the sources and volume of funding for startup and videogame ecosystems, we have gathered comprehensive information and performed a thorough analysis of the financial support mechanisms and ecosystem dynamics for serious game projects and startups.

[235] https://www.textile-platform.eu/
[236] http://www.europeanfashioncouncil.eu/

For the scientific research, the usual search engines have been used, including Google Scholar, Scopus, and Web of Science. The industry and market analysis reports included:

- **Newzoo**: Provides market reports on the global games, sports, and mobile markets, including funding and investment trends.
- **SuperData**: Offers insights and reports on the digital games and interactive media industry.
- **Statista**: Provides statistics and reports on the gaming industry and startup funding.
- PwC Outlook: Includes data on gaming industry revenues and trends.
- **Digi-Capital**: Provides analysis and market data on the games and interactive media sectors.

White papers and benchmarking studies from various sources were also considered, including:

- **Startup Genome**: Publishes comprehensive reports on the global startup ecosystem, including funding and performance benchmarks.
- **CB Insights**: Offers data-driven insights on venture capital, startups, and technology trends, including gaming.
- **Crunchbase**: Provides information on funding rounds, investments, and key players in the startup ecosystem.
- KPMG Report: Analyses global venture capital trends and startup ecosystems.
- **Ernst & Young (**EY) Report: Includes sections on gaming industry trends and funding.

Various sources for finding governmental and institutional reports were considered:

- **European Commission (EU) Reports**: Publications on digital economy, startups, and funding mechanisms within the EU.
- **National Endowment for Science, Technology, and the Arts** (**NESTA**): Reports on innovation, startups, and creative industries including gaming.
- **World Bank Reports**: Reports on educational technologies and digital innovation, which may include serious games.

Additional sources included industry associations and conferences, and other online resources:

- **Entertainment Software Association** (**ESA**): Publishes annual reports on the state of the video game industry in the U.S.
- **Game Developers Conference GDC**: Access to presentations, white papers, and benchmarking studies from industry experts.
- **International Game Developers Association IGDA**: Resources and reports on the game development industry.
- **Interactive Software Federation of Europe ISFE**: Publications and data on the European gaming market.
- **VentureBeat**: News and analysis on technology and gaming industry trends.
- **GamesIndustry.biz**: Provides news, analysis, and reports on the business aspects of the video game industry.
- **TechCrunch**: Reports on startups, funding rounds, and technology trends, including gaming.
- Bloomberg Technology: Insights and reports on the broader technology sector, including gaming and startups.

3.9.6.1 New and alternate funding opportunities

Various innovative and non-traditional funding mechanisms, which have emerged in recent years, were also explored. These include crowdfunding, blockchain-based funding, corporate accelerators, grants, and other unique financial models. Here are some detailed insights and examples:

Crowdfunding Platforms: Crowdfunding has become a popular alternative funding source for video game startups, allowing developers to raise money directly from fans and early adopters. Some EU based ones are listed in the previous section on sustainability strategies with interesting cases such as Shovel Knight raising over $300,000, Indivisible raising over $2 million and Psychonauts 2 raising over $3.8 million.

Blockchain and Cryptocurrency Funding: Blockchain technology offers decentralized and transparent funding opportunities, often through Initial Coin Offerings (ICOs) or Non-Fungible Tokens (NFTs).

- **ICO Funding**: Example: *GameCredits* is a blockchain platform specifically for gaming, enabling developers to launch ICOs to fund their projects.

- **NFTs**: Example: *Axie Infinity*, a game that uses NFTs to represent in-game assets, raised substantial funds through the sale of its tokens.

Corporate Accelerators and Venture Capital: Large tech companies and specialized venture capital firms have created accelerators and funds specifically targeting game developers.

- **Google for Startups Accelerator**: Offers mentorship, resources, and funding for tech startups, including gaming.
- **PlayStation's Indie Fund**: Provides financial support and resources to indie game developers.
- **Makers Fund**: A venture capital firm investing in interactive entertainment startups.

Government Grants and Subsidies: Many governments offer grants and subsidies to support the creative industries, including video game development.

- **Creative Europe MEDIA Programme**: Provides funding for European video game development projects.
- **UK Games Fund**
- Focus: Supports early-stage game development in the UK with grants and resources.
- **Canada Media Fund**: Offers funding to Canadian video game developers through various programs.

Revenue-based Financing: This model allows startups to receive funding in exchange for a percentage of future revenues, providing a flexible alternative to traditional equity financing.

- **Lighter Capital**: Provides revenue-based financing to tech startups, including game developers.
- **Clearbanc**: Offers revenue-based funding primarily to e-commerce and SaaS businesses but expanding to other sectors including gaming.
- Besides Uncapped, Wayflyer, Silvr, Karmen, Booste, re:cap, Levenue, and Viceversa, as additional existing options based in Europe.

Strategic Partnerships and Sponsorships: Forming strategic partnerships with established companies can provide both financial support and market access.

- **Epic Games' MegaGrants**: Provides funding to projects using Unreal Engine, including games, media, and other interactive projects.
- **Intel's Gaming Program**: Offers sponsorships and partnerships to game developers leveraging Intel technology.
- **Creative Europe Program**: supports cultural, creative, and audiovisual sectors, including game development, by providing funding to enhance innovation, competitiveness, and cross-border collaboration.

Equity Crowdfunding: Equity crowdfunding allows a large number of investors to fund startups in exchange for equity shares.

- **Seedrs**: Numerous startups, including game developers, have raised funds through equity crowdfunding on Seedrs.
- **Crowdcube**: Enables businesses to raise investment from the general public in exchange for equity.

Publisher Funding: Game publishers often fund game development in exchange for publishing rights.

- **Private Division**: Partners with independent developers to fund and publish their games.
- **Devolver Digital**: Known for supporting innovative indie games through funding and publishing.

3.9.7 Impact and identification of the opportunities

Funding policies play a crucial role in shaping the serious games industry, influencing its growth, sustainability, and the level of innovation and collaboration in game co-creation efforts. Here is an exploration of these impacts:

3.9.7.1 Growth of the Serious Games Industry

The European serious gaming market is likely to register a CAGR of 20.6% over the forecast period[237]. Globally, and from the Serious Games Market Insights of 2024[238]:

The global Serious Games market size was valued at USD 7581.95 million in 2021 and is expected to expand at a CAGR of 24.24% during the forecast period, reaching USD 27887.37 million by 2027. A serious game or applied game is a game designed for a primary purpose other than pure entertainment. The "serious"

[237] https://www.mordorintelligence.com/industry-reports/europe-serious-gaming-market
[238] https://www.linkedin.com/pulse/serious-games-market-analysis-present-future-growth-uqjif/

adjective is generally pretended to refer to video games used by industries like defence, education, scientific exploration, health care, emergency management, city planning, engineering, and politics. Serious games are a subgenre of serious storytelling, where storytelling is applied "outside the context of entertainment, where the narration progresses as a sequence of patterns impressive in quality ... and is part of a thoughtful progress".
The report also provides a list of the largest manufacturers of Serious Games worldwide:

- Nintendo Co., Ltd.
- BreakAway, Ltd.
- Intuition
- Designing Digitally, Inc.
- Promotion Software GmbH
- Learning Nexus Ltd
- IBM Corporation
- Tata Interactive Systems
- Revelian
- DIGINEXT

Positive Impacts:

- **Increased Production**: Funding policies, such as grants and subsidies, lower the financial barriers to entry, enabling more developers to create serious games. For example, the European Union's Horizon Europe program supports serious game projects focused on educational and training applications, thus boosting production.
- **Case Study**: The Horizon 2020 project "BEACONING" (Breaking Educational Barriers with Contextualized, Pervasive, and Gameful Learning) received substantial funding, which allowed it to develop innovative educational tools that integrate serious gaming with real-world contexts.
- **Case Study:** The "2024-2033 Global Serious Games Market Outlook" states that the serious games market is projected to grow from $9.71 billion in 2023 to $11.67 billion in 2024, with a compound annual growth rate (CAGR) of 20.3%. This growth is driven by factors such as the increasing use of virtual reality in training and development, educational initiatives, healthcare training or corporate skill enhancement.
- **Market Expansion**: By providing financial support, funding policies can help serious games reach wider markets. Programs like Creative Europe have enabled European developers to access international markets, thereby expanding their audience and revenue potential.
- **Case Study**: The game "Never Alone (Kisima Ingitchuna)," supported by the Cook Inlet Tribal Council and developed by E-Line Media, highlights how funding policies can aid in creating culturally significant games with a global impact, addressing both educational and societal themes.
- **Projects in Europe:** within the past five years, Games for Change (G4C) has expanded its initiatives in Europe. In 2024, G4C established the Games for Change Türkiye chapter to leverage the potential of games for inspiring positive social change across Türkiye and beyond. Additionally, the "Games 4 Change" project, led by the Centre for Bridging Communities, aims to enhance youth engagement from the EU and Western Balkans by connecting them through virtual exchanges. Another notable European initiative is the "Future Time Traveller" project, which focuses on career guidance for Generation Z. This project utilizes a game-based virtual world environment to help young people explore future job trends and the skills required for emerging professions. Implemented by experts across seven European countries, it exemplifies the application of serious games in education and career planning. These initiatives demonstrate G4C's commitment to fostering social impact through games within Europe in recent years.
- **Talent Development**: Funding for educational initiatives and game development courses increases the skill level within the industry. This investment in human capital translates to a more capable and innovative workforce.
- **Educational outcomes**: Investment in educational programs focused on game design and development significantly enhances the skill set of future developers, which is crucial for industry growth [117],

[118]. In fact, investing in educational programs focused on game design and development is crucial for enhancing the skill sets of future developers, thereby driving industry growth. In Europe, the video games sector is the fastest-growing cultural and creative industry, with an estimated market size of €23.3 billion in 2021. The European Parliament has recognized the significance of this sector, noting its potential for job creation, economic opportunities, innovation, and training in strategic areas. Furthermore, the European Video Games Society project has launched a comprehensive study on the video games sector within the EU, aiming to provide an overview of the industry and its various dimensions.

3.9.7.2 Economic sustainability of the Serious Games Industry

Positive Impacts:

- **Long-term Projects**: Sustained funding enables developers to work on long-term, impactful projects that require extensive research and development, such as healthcare and educational simulations.
- **Case Study**: The "Personal Investigator" game [119], funded by multiple grants over several years, allowed for the development of a comprehensive mental health intervention tool.
- **Stable Ecosystem**: Consistent funding policies create a stable ecosystem where developers can plan long-term and invest in substantial projects, enhancing industry resilience. Research [120] has emphasized the importance of a stable funding environment in fostering innovation and sustainability in the game industry.

3.9.7.3 Promoting Innovation

Positive Impacts:

- **Research and Development**: Funding policies that prioritize R&D, such as those seen in Horizon Europe, spur innovation by supporting experimental and cutting-edge projects.
- **Case Study**: The "REVEAL" project, funded by the EU, developed an innovative platform for augmented reality serious games, significantly advancing the field.
- **Cross-disciplinary Collaboration**: Grants that encourage collaboration between technologists, educators, and healthcare professionals foster interdisciplinary innovation. Programs like the US National Science Foundation's (NSF) funding for educational technology projects and events like Games for Health Europe, exemplify this.

Research highlights the benefits of interdisciplinary collaboration in developing serious games, noting that such partnerships can lead to more innovative and effective solutions [121], [122]. In fact, according to Pubmed and Frontiers In, interdisciplinary collaboration is essential in the development of serious games, as it integrates diverse expertise to create effective and engaging educational tools. The co.LAB project, funded by the Swiss National Science Foundation, emphasizes this by enhancing efficiency and relevance in serious game design through collaborative efforts. Additionally, the CIEMER project highlights that students recognize the benefits of interdisciplinary collaboration, noting its supportiveness and enhancement of competencies. These European initiatives underscore the value of interdisciplinary collaboration in advancing serious game development

3.9.7.4 Encouraging Collaboration in Game Co-Creation

Positive Impacts:

- **Networking Opportunities**: Funding programs often include provisions for networking and collaboration. For example, the EU's Creative Europe and Horizon Europe programs facilitate partnerships between organizations across member states.
- **Case Study**: The "JamToday" network, funded by the EU, brings together game developers, researchers, and educators to collaborate on serious game projects, fostering innovation and shared learning.
- **Shared Resources**: Funding policies that support co-working spaces, shared technology, and collaborative platforms enhance resource sharing and collective problem-solving.

Studies demonstrate the benefits of shared resources and collaborative environments in fostering innovation and efficiency in game development [123], [124]. More recent European studies ([125], [126]) state that simulation gaming and shared resources facilitate collaboration by engaging participants in virtual environments, improving communication, innovation, and efficiency. These approaches enhance productivity across scientific domains, including game development.

As a conclusion, funding policies have a profound impact on the growth, sustainability, and innovation within

the serious games industry. While they can drive production, expand markets, and foster interdisciplinary collaboration, there are challenges related to dependency, administrative burden, and potential risk aversion.

Effective funding policies should balance immediate project support with long-term sustainability, encourage high-risk innovation, and facilitate genuine collaboration across diverse sectors. This balanced approach will ensure the continued evolution and impact of the serious games industry.

Finally, to provide evidence that investing in non-profit game co-creation communities has a high return and good impact, we will draw on scientific studies and research from fields such as educational technology, cultural preservation, serious games, and non-profit collaboration.

While direct studies on the specific intersection of textile museums, the textile industry, and video games may be scarce, analogous research can help highlight the broader value of such investments.

Impact of Serious Games on Education and Learning Outcomes

Several studies have shown that serious games—games designed for purposes beyond entertainment, such as education, training, or social impact—offer powerful tools for enhancing learning outcomes. Research indicates that serious games can significantly increase engagement, retention, and deep understanding of complex topics. SGs improve learning by allowing players to experience simulations of real-world processes, enhancing cognitive engagement and making abstract concepts more accessible. This is especially relevant for textile museums, where understanding historical textile production processes, materials, and cultural contexts can be challenging to communicate through traditional methods.

A meta-analysis of 143 studies [127], finding that games used for learning showed moderate to large positive effects on student achievement, motivation, and engagement. This evidence supports the idea that non-profit co-creation communities developing serious games for textile museums could yield significant educational benefits, thereby maximizing social and cultural returns on investment. This is also highlighted in other articles, guidelines, and resources:

- Serious Games Guide: Everything You Need to Know in 2024 (by Chaos Theory Games). This guide highlights that serious games increase knowledge retention rates compared to conventional learning methods by engaging learners on multiple emotional, cognitive, and kinesthetics levels.
- Serious Games | Oxford Research Encyclopedia of Communication (by Oxford Research), an article that discusses how serious games in healthcare and medical training offer advantages such as increased engagement and enhanced knowledge retention.
- Serious Games as a Method for Enhancing Learning Engagement (Pubmed Central), a study that explores how serious games, as learner-centred approaches, allow students to control the learning process interactively, thereby enhancing engagement.
- Exploring the Impact of Serious Games on Learning and Training (Program Ace), a white paper discusses how serious games foster knowledge acquisition and retention, enhance employee engagement, and improve training outcomes.

Cultural Preservation through Digital Tools

Preserving cultural heritage through digital means has proven to be an effective method for enhancing public understanding, accessibility, and engagement. Games offer a dynamic and immersive way to explore and preserve cultural heritage.

- Anderson et al. (2010) emphasize the importance of digital tools in cultural preservation, noting that interactive media, such as games, allow users to experience historical and cultural content in ways that traditional methods cannot. Non-profit game communities, therefore, offer an innovative approach to preserving textile heritage by creating experiences that engage younger and digitally-native audiences.
- Smith & Trent (2014) demonstrated that virtual environments and games provide a new medium for cultural preservation. By simulating historical processes and environments, games offer experiential learning opportunities that can capture the intricacies of cultural traditions, such as textile craftsmanship, which might otherwise be lost in translation through static exhibits or text-based education.
- European projects such as Europeana (a digital platform that provides access to millions of digitized items from European cultural heritage institutions), which offers a vast collection of art, artifacts, books, videos, and sounds, making cultural heritage accessible to a global audience), 3D Digitization

of Cultural Heritage (focused on the 3D digitization and digital preservation of cultural heritage at risk, including under-digitized cultural assets), Digital Preservation of Cultural Heritage (on the digital preservation of cultural heritage, ensuring that cultural assets are maintained and accessible for future generations) and Digital Technologies in Cultural Heritage (an initiative that explores how digital technologies can improve public access to cultural assets and their reuse).

Economic and Social Impact of Cultural Game Co-Creation

Research suggests that investment in cultural game development, especially within non-profit frameworks, can have significant economic and social impacts, particularly by fostering local collaboration, job creation, and community engagement.

- Zheng et al. (2019) showed that cultural heritage-themed games can boost local economies through tourism and education. By investing in the creation of games that focus on the history and evolution of textile industries, stakeholders can promote local textile museums and increase visitor engagement, translating into economic benefits for surrounding communities.
- Delhaye & Van Meerkerk (2017) found that cultural collaborations between different sectors (such as museums, industries, and creative professionals) enhance social cohesion and contribute to local identity building. Non-profit game co-creation communities, which often emphasize inclusivity and diverse stakeholder involvement, can promote social capital by encouraging community participation and education in creative projects.
- Recent references include initiatives like the Social Entrepreneurship and Value Creation in the Cultural Sector (study that analyses the externalities of social enterprises driven by arts and culture, highlighting their role in fostering local collaboration, job creation, and community engagement), Co-Creation in Government (an article that discusses how co-creation efforts, involving multiple stakeholders, can lead to new practices that emerge from collaborative processes rather than traditional top-down approaches), the Gaming for Social Impact (a resource to explore how gaming is being used in the social sector to support individuals facing psychological challenges, build emotional connections, and develop meaningful relationships, thereby contributing to community well-being) and the Co-Creation With Non-profits for Social Innovation (a study to assess the effects of business-non-profit value co-creation on both organizational performance and social outcomes, emphasizing the importance of collaborative efforts in achieving social innovation).

Non-Profit Game Co-Creation and Public Engagement

Non-profit game development communities emphasize collaboration across diverse fields, enabling the pooling of knowledge, creativity, and resources to achieve common goals. Research supports the idea that such collaborative environments lead to high-impact projects that would not be possible through for-profit models alone.

- Vogel & Wagner (2018) argue that collaborative game development fosters innovation by integrating diverse perspectives, which enhances both the educational and entertainment value of serious games. This evidence highlights the potential of non-profit game co-creation communities to bring together experts in textile history, game design, and education to create rich, impactful experiences.
- Fuglsang & Pedersen (2020) found that non-profit collaboration networks contribute to social innovation and public engagement. These networks, particularly in cultural and creative industries, create value by promoting inclusivity, supporting marginalized groups, and offering free or low-cost access to cultural content. Financially supporting such networks ensures the continued development of high-impact projects that prioritize social good over profit.
- More recent initiatives in non-profit game co-creation have shown how collaboration across diverse fields can lead to impactful projects that would not be possible through for-profit models alone. One prominent example is the Global Game Jam (GGJ), an annual event where participants worldwide collaborate to develop games within a limited timeframe. GGJ fosters a collaborative, non-commercial environment that allows participants to experiment and innovate, often resulting in high-impact projects that reflect the collective creativity of the community. Urban Arts also plays a key role in this space, offering free game design programs to underserved populations. These programs teach skills in computer science, coding, animation, and storytelling, providing participants with both technical expertise and leadership opportunities. Additionally, Unity's Social Impact Programs collaborate with non-profits and educational institutions to provide free resources, enabling over 300,000 students

and educators each year to learn and create with Unity's game development tools

Financial Returns on Investment in Non-Profit Initiatives

Although non-profit ventures do not aim for commercial profit, the broader return on investment can be measured in terms of social, cultural, and educational impacts, which, in turn, generate economic and societal benefits.

- Moore & Eng (2014) explored the return on investment (ROI) of non-profit cultural initiatives, concluding that such projects often lead to long-term economic benefits by fostering creativity, preserving cultural assets, and increasing public engagement. The report highlights that, while the immediate financial return may not be as tangible as in for-profit ventures, the broader societal gains—such as enhanced cultural understanding, skills development, and community engagement—justify the investment.
- Steinkuehler & Duncan (2008) showed that educational games contribute to workforce development by building skills in critical thinking, collaboration, and problem-solving. Investment in non-profit game co-creation communities that produce serious games connected to the textile industry can contribute to skill development in both the creative and textile sectors, making the case for long-term economic benefits.
- Recent approaches include projects like MedUP!, which is led by Oxfam in partnership with Euclid Network, Diesis, and Impact Hub International. This project focuses on promoting social entrepreneurship in the Mediterranean region, aiming to enhance economic inclusiveness and employment. Besides that, the EU Programme for Employment and Social Innovation (EaSI) is another key initiative that supports non-profit ventures across Europe. Run by Euclid Network, the EaSI programme provides EU funding to promote sustainable employment, social protection, and the fight against exclusion and poverty. Another significant event is the Impact Week 2024, scheduled in Bilbao. This European forum brings together stakeholders from the social innovation sector, including social enterprises, investors, and policymakers to foster collaboration and share best practices, emphasizing the societal and economic returns generated by non-profit initiatives. In addition, Social Impact Bonds (SIBs) have gained traction in Europe as a mechanism for funding social programs. SIBs involve private investors financing social initiatives with the promise of returns based on the successful achievement of social outcomes.

3.9.8 **Conclusions**

The key conclusions as drawn from the analysis and review presented in section 3.9 are:

- The convergence of traditional industries like textiles with the video game industry opens new opportunities for education, preservation, and engagement.
- Textile museums and the textile industry have significant cultural and historical value and integrating them with the video game industry can enhance public understanding and appreciation.
- Serious games, designed for educational purposes, are powerful tools that combine learning with fun, making them ideal for preserving and communicating textile heritage.
- Non-profit game co-creation communities are key to facilitating interdisciplinary collaborations between textile museums, the textile industry, and video game developers. These prioritize cultural preservation, education, and public engagement rather than commercial gain.
- Financial support is essential for non-profit game co-creation communities to develop high-quality serious games that bridge industries like textiles and video games. It enables the development of innovative and immersive content that accurately represents textile heritage.
- Effective collaboration among museums, cultural experts, and game designers requires funding for workshops, meetings, and collaborative platforms.
- Long-term sustainability of serious game projects is dependent on consistent financial backing for ongoing updates, improvements, and expansions.
- Financial support facilitates the adoption of cutting-edge technologies and high production values, ensuring the quality of educational games.
- Investing in serious games that link textile heritage, and the video game industry can stimulate local economies and create job opportunities.

- Serious games can foster social cohesion by offering shared cultural experiences and enhancing public understanding of textile heritage.
- Researching EU funding schemes and other financial support opportunities is essential for securing resources for serious game and co-creation initiatives.
- Strategic partnerships, community networks, and domain-specific initiatives are key to enhancing the sustainability and impact of serious game projects.
- Innovative funding models such as crowdfunding, blockchain-based funding, and corporate accelerators are emerging as viable alternatives for serious game projects.
- Blockchain technology, through ICOs and NFTs, offers decentralized and transparent funding opportunities for video game projects.
- Corporate accelerators, venture capital, and publisher funding are valuable sources of financial support for game developers, providing both capital and market access.
- Financial support from programs like Horizon Europe and Creative Europe enables the development of innovative educational tools, such as serious games, which have the potential to revolutionize training and learning outcomes. These facilitate networking and partnerships, enabling developers to collaborate across borders and share resources for more effective game co-creation.
- Serious games funded for cultural preservation, such as those focused on textile heritage, help enhance public understanding and engagement, while also contributing to social good and educational outcomes.
- Investment in cultural game development within non-profit frameworks fosters local collaboration, job creation, and community engagement, generating significant economic and social impacts.
- Co-creation in non-profit contexts leads to social innovation, as seen in studies exploring the impact of gaming for social change, where collaboration supports psychological well-being and community development.
- Non-profit game development communities, through collaboration across diverse fields, create high-impact projects that for-profit models alone could not achieve, as demonstrated by initiatives like the GGJ.

The analysis and the summarized findings will place the ground for more focused market analysis and definition of economic sustainability paths for the i-Game platform and implemented demonstrators, which will be part of the exploitation plan developed in WP6.

3.10 **Desk research outcomes: stakeholders' context and needs**

This section focuses on defining the context of use and analysing the needs and requirements of the main stakeholders' groups (TG1-7) with direct interest in the games, co-creation platform and ecosystem that will be developed in the i-Game project. More specifically, it is expected that TG1, TG3 and TG7 will be among the first line of the i-Game co-creation platform users, thus potentially transitioning to TG6. Similarly, TG2 and TG4 are expected to be among the first game players (TG5) (testers and adopters) of the i-Game pilot demonstrators. However, TG6 expands behind the previously mentioned stakeholders, as it concerns a much wider and diverse representation of potential contributors to the serious games co-design in the context of the i-Game Project. While the context and needs of the remaining stakeholder groups (TG8-11) is also important in relation to the targeted i-Game outputs and impacts, it is not directly linked to the immediate technical developments in the project (e.g. the i-Game platform), thus the respective analysis will be performed Phase II of the research, and included in the 2nd version of the Research Report, due at M26.

3.10.1 **Museums and CCIs organizations and professionals (TG1)**

The stakeholders included in TG1, as outlined in section 2.2, are organizations and professionals who are actively involved in the promotion and provision of services in the context of cultural heritage preservation in the context of museums. While the term CCIs encompasses a wide range of sectors[239], in this case we only consider the organizations and experts closely related to museums.

[239] https://single-market-economy.ec.europa.eu/sectors/cultural-and-creative-industries_en

They need video games in order to:

- complement material exhibitions
- offer a richer and engaging experience to customers
- educate people about art and cultural heritage
- expand audience
- support monetization
- boost teamwork and community building
- reach audiences traditionally excluded, underrepresented or inaccessible
- foster empathy and deeper emotional connections with cultural content
- celebrate cultural diversity
- foster a sense of ownership over museum artifacts
- increase the usage of museum resources and services

How they feel about video games, digitization, and technology:

- video games are perceived as mostly educational tools
- video games are assumed to be too expensive to produce
- they are concerned about quick loss of relevance of the game for visitors
- fear that games in exhibitions are not particularly successful in achieving their goals

The requirements they have from serious games to be adopted/integrated in their business:

- compliance with motivation, goals, and activities of the museum
- embody a deep understanding of cultural heritage
- integration of pedagogical models into game design
- availability of digital collections
- making digital representations compelling within the game environment
- alignment between the collection life cycle (e.g. long-term) and the game resources (e.g. cost)

Main obstacles to integrate/adopt advanced technologies in museums:

- lack of skilled workforce to handle technical aspects related to game development and maintenance
- lack of cohesive digital strategies to support digital transformation
- lack of understanding and communication between museum staff and game developers
- lack of resources for the uptake of the advanced technologies
- social and economic sustainability of video games for museums has not been sufficiently demonstrated

Factors that facilitate/enable adoption and integration of advanced technologies in museums:

- enhanced digital maturity of museums
- fostering digital literate leadership
- hands-on experience of museum personnel with games
- addition of video game co-creation workshops to study curriculum (e.g. in schools or higher education)
- integrating field play-testing in the design and development process
- ensuring multi-disciplinary expert reviews
- emerging technologies, such as mixed reality and Metaverse

Motivators for museums participate in serious game co-creation:

- ensure that games are contextually accurate and culturally significant
- ensure that games are engaging and educational for visitors
- deeper connection and bridge the communication gap between visitors and museums
- benefit from fresh perspectives and creative ideas from overlooked demographic (e.g. teenagers)
- gamers bring technical skills in the co-creation process

Expertise/knowledge/stakeholders required by the museums in a game co-creation ecosystem:

- local communities
- heritage professionals
- representative sample of visitors (e.g. demographics, backgrounds)
- educational stakeholders
- game industry stakeholders (e.g. developers, designers, etc.)

Game co-design challenges identified by TG1 stakeholders:

- managing efficient and effective collaboration (e.g. time-schedule alignment, meaningful contributions)
- achieving tangible outputs
- accounting for diversity and individual differences among game players during the design process
- integration of pedagogical models into game design to ensure that educational objectives are met

3.10.2 **Museum visitors (TG2)**

They need video games for:

- enhanced experience and engagement with cultural heritage
- increased access to museums and culture (e.g. more inclusive museum services)
- developing skills and creativity
- explore new ideas, artifacts, and cultures
- gain knowledge and better understand historical contexts
- provide an alternate reality (e.g. different roles or worlds)

Needs and requirements from the serious games:

- effective and personalized learning experience
- facilitate social interaction (e.g. when visiting museum with family, friends, school groups)
- support both cooperative and competitive gameplay
- support immersion through realistic graphics, dynamic storytelling, engaging gameplay mechanics, etc.

They are motivated to play by:

- in-game rewards and incentives, such as museum gifts or discounts
- enjoyable and rewarding experience
- feeling of belonging (e.g. they find themselves in the virtual world)
- the challenge (e.g. mastering the knowledge/skills)

They are de-motivated to play by:

- cost limitation (e.g. high price of the museum ticket, if access to the game is linked to the physical visit)
- technical limitations and accessibility issues (e.g. inaccessible game design)
- lack of personal connection to the narrative
- learning curve (e.g. complex interfaces or overly challenging levels)
- time limitation (e.g. lengthy games or quests)
- cultural or social perceptions (e.g. game may be perceived as unproductive or juvenile)

3.10.3 **Textile and fashion industry and professionals (TG3)**

They need games, gamification, and advanced digital technologies in order to:

- enhance design and production processes
- enhance consumer interaction
- increase customer trust and satisfaction
- increase sales
- protect brand reputation
- ensure traceability and authenticity of textile products
- promote sustainable and responsible practices
- boost customer confidence when buying products
- provide refined and personalized shopping experience
- forecast visual popularity of new garment designs
- enhance cultural heritage preservation
- provide creative and educational environments
- expand access to craft learning
- provide captivating cultural experiences
- help preserve traditional crafts on the long-term

- familiarize players with the fashion value chain
- encourage critical thinking, debating, and understanding of lifestyle choices and opportunities
- engage with younger, tech-savvy audiences
- provide a new platform for marketing
- educate consumers on ethical standards

How they feel about video games, digitization, and technology:

- video games are perceived as an opportunity for expanding audiences and increase accessibility
- they are concerned that it might alter/dilute their brand's luxury image or exclusivity
- they feel worried about the technical skills required to design games (e.g. mastering 3D modelling)

The requirements they have from serious games to adopt/integrate them in their business:

- use of VR and AR to deliver immersive experiences (e.g. enable users to try on garments virtually)
- use of immersive storytelling to enhance user experience
- use of authentic and accurate virtual fashion items
- incentivize players to adopt responsible behaviours (e.g. upcycling, wardrobe sharing, mindful fashion consumption, sustainable laundry habits)
- help players explore how clothing practices can be improved
- support multiple languages
- address people of different ages
- help players manage their own wardrobe (e.g. what they own, try new combinations)
- help designers make ecologically responsible fashion choices
- incorporate ethical fashion principles
- support social interaction
- support in-game creative activities (e.g. user-created clothing or scenes)
- support branded gaming
- support customizable characters
- support community engagement
- track users' activities to provide feedback to the fashion industry (e.g. shape trends)
- incorporate brand ratings in relation to sustainability practices
- award system that scores environmentally friendly actions
- the games should not be too complex
- support communication between fashion industry and potential customers
- deliver interactive visual and playful content
- consider different motivational factors for diverse audience
- ensure an enjoyable gamified experience for a variety of users

Main obstacles to integrate/adopt advanced technologies in the fashion and textile industry sectors:

- bridging the gap between game design, technology, entrepreneurship, and sustainable fashion

Factors that facilitate/enable adoption and integration of advanced technologies in the fashion and textile industry sectors:

- the possibility to realistically simulate garments for virtual try-ons with VR
- the possibility to try-on garments with AR in shops, without physically trying them
- the increased access of fashion customers to emerging technologies, such as VR, AR, MR
- the positive user acceptance of VR technology use in fashion
- the potential to create innovative marketing strategies

Motivators for fashion and textile industry to participate in serious game co-creation:

- enhance user experience
- build brand loyalty
- create new revenue opportunities
- foster community engagement
- foster partnerships between fashion brands and technology companies

Expertise/knowledge/stakeholders required by the fashion and textile industry in a game co-creation eco-system:

- artists
- fashion designers
- game designers
- consumers
- clothing brands
- recycling companies
- researchers

3.10.4 Textile and fashion customers (TG4)

They need the video games for:

- socialize with people with similar interests when it comes to fashion
- learn skills and change behaviours
- express creatively and achieve social validation (e.g. likes on styling apps)

They are motivated to play by:

- in-game rewards and incentives, such as discount coupons
- enjoyable and rewarding experience
- feeling of belonging
- achieving personal milestones (e.g. tracking fitness goals in smart clothing apps, reaching a sustainable shopping target)
- curiosity-driven shopping (e.g. virtual try-ons)
- access to exclusive content
- immersive experiences
- storytelling

They are de-motivated to play by:

- technical limitations and access issues
- learning curve (e.g. complex interfaces)
- overly intricate gamified system (e.g. which needs lots of patience)
- privacy concerns (e.g. when personal data is required)

3.10.5 Game players (TG5)

In i-Game, the individuals characterized as “game players” are citizens which are eventually museum visitors or fashion customers, and are at the same time, or may become in the future players of the serious games developed in the project. Given this overlap, basically the context of use, motivation and obstacles or de-motivating factors detailed in sections 3.10.2 for TG2 and 3.10.4 for TG4, are applicable to TG5. In addition, based on the more generic theories and concept of blending entertainment with leaning:

They need the serious games and gamification for:

- learn new skills or knowledge through more effective methods than traditional ones (e.g. staying engaged)
- enjoy mundane tasks, while achieving real-life goals
- understand complex concepts/problems from different perspectives
- making serious topics approachable and engaging for game-savvy audiences
- foster collaboration (e.g. shared goals, building relationships, community engagement)
- understanding technology and complex systems (e.g. AI, sustainability, digital citizenship)

They are motivated to play by:

- challenges that go beyond entertainment
- gamification impact on personal well-being (e.g. fitness routine)

They are de-motivated to play by:

- dull or overly task-focused games
- accessibility issues (e.g. for players with disabilities or from other underserved communities)
- significant time required to achieve meaningful outcomes
- technical and performance issues (e.g. bugs, lag, crash) that disrupt the learning process
- misalignment of objectives (e.g. game not aligned to personal motivations)
- cultural and context barriers (e.g. finding the content irrelevant, confusing, or unrelatable)
- unrealistic expectations (e.g. serious games on limited budget do not have the same quality of graphics, audio, or storytelling with commercial games)

3.10.6 **Game co-creators (TG6)**

In i-Game, the stakeholder group of game co-creators is a very heterogeneous group of professionals and end users, coming from diverse domains (e.g. museums, cultural institutions, fashion, and textile industry, etc.) and background (e.g. game players with diverse abilities, skills, and culture). Their needs and context of use mainly concern the i-Game platform, and not the games, as they are the ones contributing to the design of the game.

What they need from the co-creation platform:

- Collaborative tools, which allow multiple users to work simultaneously (e.g. in real-time) on the various aspects of the game (e.g. designing levels, scripting events, creating assets)
- Version control to track changes (e.g. revert earlier versions, resolve conflicts between edits)
- Feedback mechanisms (e.g. to comment or make suggestions on other's work)
- Cross-platform compatibility (e.g. accessible from various devices or operating systems)
- Intuitive interfaces for creators with varying levels of technical expertise
- Possibility to store and share assets and projects in the cloud
- Repositories and libraries (e.g. pre-made assets, sounds, animations, scripts)
- Tools to create custom assets without requiring advanced coding knowledge
- Import/export options for assets (e.g. compatibility with popular design tools)
- Space and tools for community building (e.g. network, exchange ideas, find collaborators)
- Templates and tutorials to support learning and guidance during the co-creation process
- Tools and templates for licensing and IP management
- Access control (e.g. role-based rights to create, edit, view projects)
- Tools for analytics and reporting (e.g. game's performance, playtesting feedback, data-based reports)

What motivates them to participate in co-creation:

- Professional goals and interests (e.g. museums, fashion industry)
- Creative expression (e.g. desire to express themselves beside the workspace)
- Development of games for a cause (e.g. they belong to are interested to develop games for a specific group of people)
- Altruistic personality (e.g. they want to contribute with knowledge and expertise for a cause)
- Recognition and visibility (e.g. the co-creation platform can be a promotion tool)
- Learning and portfolio creation (e.g. learn new skills)

Obstacles and factors that negatively impact on participation in co-creation:

- Lack of clarity in regard to objectives and roles
- Language and cultural barriers
- Conflict of interests (e.g. competing goals)
- Difficulties to align schedules (e.g. time zone differences and varying schedules)
- Resource constraints (e.g. time, financial, skills)
- Lack of incentives (e.g. feeling that their contribution is not well received, no rewards)
- Bureaucracy and lengthy approval processes (e.g. to use digital assets from a museum)
- Disputes over IP rights or contribution ownership
- Fear of rejection (e.g. of negative feedback or ridicule)
- Length or intensity of the project (e.g. exhausting participants)

- High expectations (e.g. from other domain stakeholders)

3.10.7 **Game industry (TG7)**

The game industry stakeholders in i-Game project are seen as one of the groups contributing to the co-creation process during the design of the games and consequently taking over the game design document to do the actual implementation. Thus, when it comes to the co-creation platform, their needs, motivation, and barriers are aligned to those of TG6. In addition, the following motivating factors have been identified:

What they need from the co-creation platform and ecosystem:

- Discovery of skilled individuals (connect with artists, programmers, designers, and other creative stakeholders engaged in game design and development).
- Access to showcases of new work.
- Tools and frameworks to facilitate collaboration contracts, intellectual property management, etc.
- Access to industry-standard tools and integrations with existing engines, including accessibility resources to create more accessible games (i.e. checklists, design guidelines and tutorials), and tools that allow for the creation of diverse characters.
- Access to libraries of pre-made art, sounds, music, and other game assets.
- Access to collaboration tools for real-time co-editing, conducting tests with diverse groups, gathering player feedback and ways for measuring the success of co-created games.
- Access to a diverse community.

What motivates them to participate in co-creation:

- Professional goals and interests (networking, visibility, portfolio enhancement)
- Prospects of enhanced creativity and broadening perspectives (e.g. fresh ideas from other domains)
- Market alignment (e.g. engage with players, alignment to trends)
- Identify and resolve issues early in the development cycle
- Shared workload, allowing them to focus on what they like to do most
- Learning for future projects (e.g. what works and what not)

Obstacles and factors that negatively impact on participation in co-creation:

- IP concerns, the complexity of agreements.
- Difficulty in aligning with their overall vision and quality standards.
- Challenges with integrating a variety of player-created content, compatibility issues, with the game engine and other systems.
- Dealing with potential community issues, i.e. toxicity or inappropriate content, difficulties effectively filtering and moderating to maintain quality and safety.
- Overall concerns about data privacy and security of the platform, policies, procedures, and decision-making processes.

4 FIELD RESEARCH

4.1 Introduction

This chapter focuses on the bottom-up approach applied in T2.2 Context and needs analysis to elicit user requirements through field research, by directly engaging with individuals from the main target groups (TG1, TG3, TG6 and TG7) that are envisaged as the main platform users, with interest in creating games for their customers (e.g. TG1 and TG3) or being involved in the design and implementation of the games. The field research activities were conducted in coordination with T3.2 User Personas and co-creation definition, in order to take advantage of the participant selection and engagement at the same time, as further explained in section 4.2.

The process of eliciting user requirements is usually an integral part of the design of any interactive system, with user- and human-centred design being considered as the best design approach that aligns with end users' needs, wishes and context [128]. However, eliciting user requirements represents in most of the cases a challenging task, in particular when dealing with complex organizational situations (e.g. multitude of stakeholders with diverse needs), as is the case in the i-Game project. The process becomes even more difficult when the end users involved in the process have no preliminary knowledge about how the designed system will look like and how it will work, and what they want the system to do for them, as they have little or not at all experience in using similar tools and platforms. The fact that most users are usually reflecting the current system/or processes that they know or have been using, rather than being innovative, or they think along traditional lines, may also negatively impact on the user requirements analysis process. Furthermore, end-user organizations often do not consider research toward new services/systems as their main business, and thus may be reluctant to engage in such activities [128]. These limitations, and many more, are linked to the sample bias [129], and although involving the end-users is important in order to develop more inclusive, fair and valuable systems, it should be adequately planned and complemented by other approaches.

A multitude of methods and approaches have been proposed and used in the past to elicit user requirements, each having its advantages and disadvantages [130]. Given the complexities of the i-Game platform and the multidisciplinary nature of the developed games (e.g. combining entertainment with education, targeting social impact on various dimensions, targeting to be inclusive, etc.), it is important to select appropriate methods to support the process of generating and validating user requirements, by taking into account the various contextual characteristics of the project (e.g. targeted application domains, type of end users and stakeholders, time frame and limitations, experience and expertise of the moderators/facilitators, etc.) and the expected outcomes of the process [131]. A short overview of the most used and relevant methods for user needs identification, including their main benefits and disadvantages, is presented in appendix 8.4.

Depending on the available resources, one method or a combination of most relevant methods are employed to establish the user requirements in an appropriate manner. In i-Game project, a multi-step and multi-approach process has been adopted. This process started with the Information gathering through desk research during the first period of T2.2 Context and needs analysis and reported in section 3. The comprehensive state-of-the art analysis and research helped to establish a solid theoretical foundation and establish the most common patterns in regard to context of use and needs and requirements (see section 3.10). In the second step, the potential user groups of the i-Game platform have been engaged in a variety of activities employing some of the methods described above (e.g. surveys/questionnaires, focus groups and interviewing) and the methodology and outcomes of this step are further detailed in this chapter. In the next step, in T3.3 Co-creation workshops and Concept Prototypes definition, the relevant stakeholders will be involved in co-design workshops and testing of mock-ups and prototypes, in order to refine the platform design in an iterative process.

4.2 Methodology

4.2.1 Research Approach

The main research questions relevant for the definition of the users' need and requirements in i-Game project have been defined in T2.1 Design of the research framework during the definition of the Research Framework and are presented in Table 1. In particular, the field research was focused on a subset of the questions related to the Innovative practices and on all questions related to Stakeholder engagement, as follows:

(1) What are the purposes of setting up gamified or game-based online experiences versus the onsite ones for cultural and fashion sectors?
(2) What are museums' and fashion industry's experiences with digital tools and technology, and how they feel about?
(3) What specific needs, expectations, and experiences do stakeholders have regarding the development and societal impact of games?
(4) What are stakeholders' motivations to use games, in particular serious games?

These questions guided the formulation of the actual questions that were used during the Interviews or Focus Group discussions and are further detailed in section 4.2.2.

4.2.2 Methods

The main methods selected to implement the field research in T2.2 Context and needs analysis included Interviews, Focus Groups and Online Surveys. The Interviews were considered as a more direct and comprehensive method to engage with the museum and fashion industry stakeholders primarily; in order to gather more detailed information in regard to the context of use and needs they have in regard to the games and the process to design and implement them. Focus Groups were employed to discuss with stakeholders from TG6 and TG7, targeting to gather more technical details, and discuss potential challenges, limitations and concerns they have in regard to the multi-disciplinary and application-driven (e.g. aligned to the vision and needs of TG1 and TG3) co-creation of serious games.

The Online Survey was primarily used as a tool to collect the socio-demographic information (Socio-demographic Questionnaire) from all participants (e.g. all target groups engaged in the field research in Phase I of the research activities).

However, in particular cases, when the invited participants were not able to meet online (e.g. attend the scheduled group online meetings, or the time zone imposed difficulties to schedule a meeting), Interviews (e.g. for TG6 and TG7 stakeholders) or Online Surveys (for all groups) were employed as alternative tools to engage will all participants that responded positively to our call. Further details are provided in the following sections.

For all employed tools the questions, and where the case the predefined answers, were drafted by RtF and consequently discussed and finalized together with all project partners involved in the field research activities. While a much larger number of questions was initially considered, some of these were removed as: (1) in regard to socio-demographic information the reason was to gather only sensitive data which contributes significantly to the further analysis and interpretation (e.g. it was agreed that the targeted samples are not sufficiently large to allow for example analysis of the requirements per type of disability) and to keep it as short as possible (e.g. to be answered in ~10 minutes); (2) in regard to interviews and focus group questions, it was agreed that the number of questions must be restricted, such that the interview duration is less than 1 hour, while the target group meeting duration is less than 1 hour and 30 minutes. It was agreed that longer durations would represent a barrier for invited stakeholders to participate in the research activities. Test sessions were conducted internally in the consortium (e.g. 1-to-1 interview and a focus group with 1 moderator and 4 participants) in order to make sure that the final selected set of questions per tool complies with these requirements.

For all employed tools, the questions were first finalized in English, and subsequently these were translated to the local languages by the responsible partners (e.g. KEPA/CERTH - Greek, TMP - Italian, ENM - Estonian, MSS - Dutch, CB - Spanish).

The Interview and Focus Group questions presented in sections 4.2.2.2 and 4.2.2.3 only concern the activities relevant for T2.2 Context and needs analysis, while the remaining questions included in the framework of these tools, relevant for T3.2 User Personas and co-creation definition, are presented in *D3.2 Final user's analysis*.

4.2.2.1 **Socio-demographic questionnaire**

The questionnaire that was used to gather socio-demographic information from all participants of Phase I of the field research included questions related to the following aspects (where the case, the predefined answers are included):

- **Age**
- **Gender** (Male | Female | Diverse | No answer)
- **Cultural background**, namely belong to any minority group, such as ethnic, religious, linguistic, migrants, etc (YES | NO | No answer, if YES optional details)
- **Education level** (Primary/Middle School | High School | bachelor's degree | Master Degree | Doctorate Degree | Other, if Other optional details)
- **Current occupation** (Student | Full-time Employment | Part-time Employment | Self-Employed | Unemployed | Retired | Other, if Other optional details)
- **Country of residence** (Belgium | Canada | Estonia | Germany | Greece | Luxembourg| Italy | Netherlands | Spain | United Kingdom | United States of America | Other Country, if Other optional specification)
- **Residence location** (Large city/Metropolitan area | Town | Rural area | City suburbs | Other, if Other optional details)
- **Main area of expertise** (minimum 3 free text keywords)
- **Years of experience**
- **Current/most recent job** (free text description)
- **Organization type** (Museum | Cultural Organization or Association | Creative Industry | Gaming Industry | Textile Industry | Fashion SME | Research Organization | Educational Institution | Non-profit Organization | Start-up | Social Enterprise | Other, if Other optional details)
- **Organization size** (<10 employees | 10-50 employees | 51-250 employees | >250 employees)
- **Organization location** (same options as country of residence)
- **Digital skills self-assessment** (Very Good | Good | Limited | Poor | Very Poor | Not sure | No answer)
    - If (Very Good | Good), **Type of education** (Formal education | Life-long learning | Vocational training | Self-taught | Other)
- **Interest to acquire new skills** (YES | NO | No answer, if YES optional details)
- **Daily use of technology** (YES | NO | No answer, if YES optional details)
- **Digital accessibility preferences** (The computer mouse | The keyboard | The screen reader | Dictation tools | The magnifying tool | High colour contrast | Other Tools for Accessibility, if Other optional details)
- **Use of specific technologies** (YES | NO | No answer, if YES optional details)
- **Serious games/gamification knowledge** (Never heard of it | I know very well what it means | I have heard, but not sure what it means)
- **Domain specific serious games** (free text description - examples, positive/negative experiences)
- **Ethics and law (IT, IP, copyright) knowledge** in relation to games (Very Good | Good | Limited | Not sure | Not aware | No answer)
- **AI ethics and legal frameworks knowledge** (Very Good | Good | Limited | Not sure | Not aware | No answer)

4.2.2.2 **Interview questions**

The interview framework was designed in a semi-structured format, in order to accommodate for the potential difference in expertise and knowledge of the participants, given the multi-disciplinary scope of the research (e.g. even within a certain domain, experts from various fields have interests in the i-Game project outcomes). Thus, we established a framework indicating the main aspects and respective questions to be discussed with the participants, however, it was agreed that it is not mandatory for the participants to answer

all questions in a predefined order. The facilitators, based on their experience and knowledge about the participants, would decide which questions to include in each individual interview. Furthermore, the facilitators had the freedom to expand (e.g. asking for clarifications) on the questions they assessed as most relevant in relation to the expertise of the participant.
The interview questions were grouped into 2 main categories, as follows:

1. Capacity Building Needs and Preferences:

- Did you participate in any training activities during the last 3-5 years? (Yes, very often (e.g. at least 2 times each year) | Yes, a few times | Rarely (e.g. 1-2 times in the last 5 years) | Not at all | No answer).
  - Please describe some of the training activities, in particular those that involved serious games or gamification elements.
  - Please indicate the main reasons for not participating more often in training activities (e.g. personal time and/or resources limitations, cost, no relevant opportunities, not interested).
- Are you interested in participating in training activities to advance your game co-creation skills? (YES | NO | No answer)
- Please describe the type and format of learning that you prefer (i.e. In-person vs online, traditional read-test vs gamified, video/audio tutorials vs text-based, etc., guided courses vs self-paced, quick learning modules vs comprehensive and detailed courses, etc.).
- Did your company organize any training activities for the workforce? (Yes, very often (e.g. at least 2 times each year) | Yes, a few times | Rarely (e.g. 1-2 times in the last 5 years) | Not at all | No answer)
  - Did any of the training courses or learning events involved gamification or gamified elements?
  - How would you describe the experience? What was most efficient and what did not work for your team/co-workers?

2. Needs and Context of Use of Games:

- Why and how could serious games or gamification be exploited in your practice (workplace/domain/business)? What games would you need?
- Which consumers, groups or communities should be targeted when using serious games to create novel products/services? Who would benefit most from online/mobile serious games in your practice?
- Based on your experience, please give some examples of successful serious games for culture and museums or for the fashion or textile industry, with high impact for people and/or society (e.g. improving skills or well-being, Increasing cultural participation/ knowledge about sustainability for vulnerable/ marginalized/ under-represented people).
- Are there any groups or communities that currently do not have access or their needs are not sufficiently considered when creating new digital products in your organization? Share your organization's commitment to social inclusion, diversity, and digital accessibility (both at workforce and business level).
- What could facilitate the use and adoption of serious games in your practice/domain?
- What do you think are barriers/obstacles to using serious games to create novel products/services for your practice/customers?
- Do you believe that the law (Intellectual Property law, AI legal framework, ethics, etc.) play a role in how you / your company creates/works and, if so, how?
- Do you use Artificial Intelligence tools in your practice, and if yes which ones and how? Do you disclose such a use, and if yes how?

The second set of questions, regarding needs and context of use of games, was considered as being applicable to all participants, while the first one, concerning capacity building needs and preferences was considered as being mostly relevant for TG3 stakeholders, as the pilot related to this TG may be focused on capacity building of these stakeholders.

4.2.2.3 **Focus Groups questions**

The Focus Group activities were targeted at engaging mainly with TG6 and TG7 stakeholders, who are expected to contribute to the co-creation process, and are not necessarily going to use the games, by themselves. However, it is expected that they may be interested in the social inclusion of certain groups or communities (e.g. vulnerable or marginalized). As such, most of the questions considered for the focus group

discussions are relevant for the work and targeted outcomes of *T3.2 User Personas and co-creation definition* (see *D3.2 Final user's analysis*), and only a limited number of questions may drive the elicitation of needs and context of use of games, as follows:

- For which domain and for which business/application/scope you find it interesting to co-create games, and in particular serious games (e.g. What type of games do you want to build? For whom? What requirements do you have from such games?)?
- Who should be the driving force beyond game co-creation projects targeting to facilitate social inclusion and enhance innovation in culture/museum or fashion/textile sectors?
- Describe any game co-creation projects you know that are related to the iGame sectors (e.g. culture/museums or fashion/textile), including details on the funding strategy for these projects.

The Focus Group moderators had the freedom to include additional questions or ask for clarifications. No predefined order was indicated for the questions during the focus group discussion, and it was not mandatory to ask all questions.

4.2.3 **Implementation Details**

The activities related to the implementation of the field research activities are common for *T2.2 Context and needs analysis* and *T3.2 User Personas and co-creation definition*, in order to engage once with each participant, in order to optimize the resources both at project consortium level and in regard to the time the participants spend on the project activities, given the fact that their involvement was based on a volunteer basis (e.g. no financial compensation or incentives were given).

4.2.3.1 **Moderator/Facilitator Guide**

The leading partner of *T2.2 Context and needs analysis*, RtF, prepared a detailed guide for moderators and facilitators of the Interviews and Focus Groups, in order to establish a common and standardized approach for the implementation of the field research. The document included guidance in regard to:

- Targeted stakeholders and relevant inclusion criteria, including recommendations regarding the selection of participants to ensure diversity in regard to expertise, abilities, and skills.
- Participants need assessment in regard to venue (e.g. physical accessibility needs for in-person activities), technology (e.g. audio recording, online meeting tools), and materials (e.g. project flyer, Informed Consent Form).
- A check-list with activities to be performed one week before the scheduled interview or focus group meetings (e.g. preparing translations, printing, confirming participation, sending the informed consent form by e-mail, inviting the participants to fill in the Socio-demographic questionnaire, etc.)
- A list of activities to be performed one day before the interview/focus group (collecting all informed consent forms, checking that the questionnaire has been filled in, etc.).
- Guidelines for the actual activity to ensure that all participants have the opportunity to express their opinion in the case of the focus groups, and to make sure that the data collected is clear in regard to content.
- Guidance for the activities to be performed after the interview/focus group in order to share data securely and privately between the data controller and the partner responsible for the processing of the data.

4.2.3.2 **Informed Consent**

An English template for the Informed Consent Form was prepared by RtF in collaboration with KUL (see appendix 8.2), which provided the invited participants details in regard to:

- Project description, scope, and partners
- GDPR compliance
- Purpose and procedure of data collection and processing
- Type of data collected and processed
- Responsible partner of the research activity
- Consequences of participation and provision of data
- Data processing privacy and security

- Data retention
- Participant Rights
- Explicit consent to participate in the current research activities
- Explicit consent to be informed in the future about the project
- Additional contact information

The template was translated to local languages by the partners responsible for the field research, and it was sent to the participants with sufficient time in advance (e.g. at least 1 week) to ensure they have time to read and understand it and ask for clarifications. Each data collector was responsible to collect and safely store the signed forms and ensure that the personal contact information of the participants is not shared to any other third parties.

4.2.3.3 **Data collection**

The primary data collection method during the interviews and focus group activities was audio recording, as the meetings took place using online meeting tools (e.g. Zoom, Teams). In addition, as an alternative or complementary way to collect data, in particular from TG1 participants, the Interview and Focus Group questions were implemented in the form of extended online surveys of the Socio-demographic Questionnaire, e.g. Long Interview online survey for TG1 and TG2, and Long Focus Group online survey for TG6 and TG7, and this way we ended up with 3 online surveys. The Socio-Demographic Questionnaire and the Long Interview survey were implemented also as translated versions to Greek, Italian, Estonian, Spanish, and Dutch. It was not considered necessary to translate the Long Focus Group survey, as it was foreseen that it will only be used in English. The EU Survey Platform was used to implement all online surveys.

In order to facilitate privacy and protection of personal contact and sensitive information, a unique Participant Identifier was created by all project partners involved in the field research activities. The 6-digit identifier was created in such a way to facilitate tracking identification of the project partner who issued it, and the target group to which the participant belongs, namely:

- The first two digits correspond to the project partner number, e.g. CERTH - 01, KEPA - 02, etc.
- The next two digits correspond to the Focus Group, e.g. TG1 - 01, TG3 - 03, TG6 - 06 and TG7 - 07
- The last two digits correspond to an increasing unique number assigned by each partner to the invited participants, e.g. 01, 02, etc.

The Participant Identifier facilitated also the intermediary necessary control steps, for example to confirm that all participants that were engaged in the field activities by a certain partner have filled in the Socio-Demographic Questionnaire, and to identify those pending to fill in the information. This also made possible for the participants to fill in the data in multiple sessions, by saving the link to their contribution and accessing as many times as it was needed. This was important in particular for those filling in the long versions of the survey, as instead of spending more than 30 minutes continuously they could split it in a few smaller sessions, to fit their other schedule and availability.

A file naming convention was also established, in order to manage the collected data:

Data Identification Example	iGame_GR_KEPA_TG01_INTV_ORG_RES_020101_AU	
Project acronym	iGame	
Country (of the data controller)	[ISO 3166-1 alpha-2 country code]	
Data Controller	[Project partner acronym]	
Target Group	TGx	
Data Collection tool	INTV | FG |SUR	Interview | Focus Group | Survey
Processing level	ORG | PROC | AGR	Original| Processed | Aggregated
Sensitivity level	PUB | PINT | CONF | RES	Public | Project internal use | Confidential | Restricted
Participant identifier	[Participant identifier assigned by the data controller]	
Data type	VD | AU | TXT | IMG | TRS | XLS | ICF	Video | Audio | Text | Image | Audio File Transcription | Excel | Informed Consent Form

4.2.4 Data processing and analysis

The first preparatory step in the data processing pipeline was the transcription of the recorded audio files, in order to obtain the text version of the discussions. Each partner that conducted the field research was responsible for the transcription step.
Translation of the transcript to English was necessary for a large number of interview and focus group data files, as the data was originally collected in Greek, Italian, Estonian, Dutch and Spanish. The translated data was shared by the data controller with the partner responsible for the processing (RtF) in most of the cases without any preliminary processing. Two of the partners, KEPA and ENM, due to internal rules in regard to research data sharing, processed the data to create aggregated texts per question.
In qualitative research, as the research performed in T2.2 Context and needs analysis, different methods can be employed to analyse the collected data, among which content analysis is extremely well-suited to analysis multifaceted phenomena [132]. The purpose of content analysis is to organize the collected data and to elicit meaning by identifying and grouping data into categories, in order to make valid inferences [133], [134]. In particular, the manifest analysis, looking at the surface structure (e.g. «What has been said?"), has been adopted in our study. A deductive coding system, using an unconstrained matrix of analysis, has been used. The categorization matrix has been instantiated based on the outcomes of the desk research (see section 3.10) in order to establish the main categories.

4.2.5 Participants selection and samples

In qualitative studies there are no standardized or well established requirements in regard to the number of participants, being common that the study can involve from 1 to 30 individuals [133]. In most of the cases, the sample size depends on the available resources, the most important aspect being that the research question can be answered with sufficient confidence. Our initial target was to engage with at least 20 individuals from each target group, in order to have a sufficiently significant sample in each unit of analysis. However, the actual samples per target group depended on the resources of the involved partners and on the responsiveness of the invited participants. The effort of the project partners in regard to reaching out to a wide and diverse audience were significant, and, as a result the initial target set per target group was exceeded (see Table 20), in some cases significantly (e.g. TG6).

Table 20. Field Research reach out statistics

	TG1	TG3	TG6	TG7	TOTAL
Invited	74	65	104	140	**383**
No Answer	15	29	34	77	**155**
Negative Answer	9	0	1	9	**19**
Positive Answer	50	36	69	54	**209**
Dropped out	9	9	16	17	**51**
Completed	**41**	**27**	**53**	**37**	**158**

4.2.5.1 Inclusion Considerations

The activities planned for Phase I of the field research aimed at eliciting ideas and concepts in order to analyse the user requirements and the context of use for the games (T2.2) and for the platform (T3.2), by engaging with diverse stakeholders. The selection of the participants was based on inclusion criteria, by contemplating potential profile variations such as genders, preferences, capabilities, and technological skills. However, it was important to understand at first which are the inclusion factors to consider and how to guide the participant selection process.
In order to understand which diversity factors to consider and what under-representation means, our approach was to first identify edges, by considering the following questions:

- Who is under-represented in the game industry?
- Who cannot use/access digital platforms (e.g. for game co-creation)?
- Who has more to offer (e.g. different culture/values) and must be part of the co-creation ecosystem?

- Which diverse skills and abilities are needed in the game co-creation process?
- Which diverse knowledge, expertise and experience are needed?
- Who cannot play/experience digital games or serious games?
- Who is vulnerable/ marginalized when it comes to culture and social inclusion, and could benefit from the games?

When it comes to facilitating access and experience for gamers with diverse abilities, skills and backgrounds, the desk research analysis presented in section 3.6 already provides the ground to identify the main end-users groups with potential accessibility problems: people with disabilities, older adults, people with low digital skills, people with language accessibility issues (e.g. minorities, immigrants), etc.

Participation in cultural activities enhances civic engagement, democracy, and social cohesion, as citizens who participate in cultural activities are more likely to engage in democratic and civic aspects of daily life[240]. Thus, it is important to support the sustainability of the cultural sector in order to promote an inclusive and engaged society.

When it comes to culture and social inclusion, the EU Culture Statistics[241] show that there is a big difference among the EU Member States, with the western and Nordic countries recording high levels of cultural participation, while eastern countries (e.g. Romania, Bulgaria) recording very low participation. Participation in cultural activities decreases with age, and overall, a decreasing trend is seen for all age groups in 2022 compared to 2015.

Based on a more thorough analysis of these reports and findings, we have created a matrix of potential vulnerability factors and groups/communities that are vulnerable or are at risk to be marginalized when it comes to culture participation and digital accessibility of games (see Table 21).

Table 21. Vulnerability factors/criteria and vulnerable or marginalized groups

Vulnerability Criteria/ Vulnerable Group	*Youth/Younger Adults (16-30 years old)*	*Older Adults (>60)*	*Women*	*Deprived People (Socio-economically)*	*People with disabilities*	Unemployed/Part-time workers	Minority* people
Age		x				x	
Gender			x				
Education	x			x	x	x	x
Digital Skills		x	x		x	x	
Employment Status	x	x			x	x	
Temporary vulnerability (e.g. Pregnancy, sick leave)		x	x			x	
Demanding family context			x			x	
Living conditions	x			x			x
Financial Situation				x			x
Physical/cognitive limitations					x		
Residence area				x			x
Language					x		x

** ethnic, religious, immigrant or other minorities (e.g. sexuality related)*

These vulnerability criteria are relevant also when considering the potential involvement of the game end-users in the co-creation process, as the inclusion and digital accessibility factors described in the Table 21 remain valid.

Similarly, these criteria remain relevant when it comes to digital accessibility of stakeholders from TG1 and TG3 in relation to their participation in the game co-creation activities. For example, older workers, unemployed people, women, and minority people usually have lower digital skills, thus facing an inclusion problem when it comes to using an online platform.

Under-representation in the game industry is an issue under debate, with the sector claiming to have taken positive steps, but the under-representation to remain visible in the outcomes (e.g. games remain gendered artifacts) [135]. Despite the sector's efforts towards achieving gender balance, women are commonly found

[240] https://op.europa.eu/en/publication-detail/-/publication/07370fba-110d-11ee-b12e-01aa75ed71a1/language-en
[241] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Culture_statistics

in administration, economy, public relations and human resources management in game companies, while female game developers work as freelancers (e.g. labour reserve) and with much lower income as compared to male game developers [77], [136]. Similarly, under-representation of minority groups is a fact [137]. Deprived people have less access to higher education, thus not meeting the labour market requirements of the gaming industry [138].

In addition to the vulnerability aspects, taking into account the multi-disciplinarity aspects of the project and of the targeted ecosystem, and the potential needs of the co-creation process, it is important in particular for all TGs to engage with: (i) stakeholders who have diverse knowledge and expertise within a certain domain, and (ii) stakeholders who have different levels of experience, e.g. novices and young professionals who potentially have a higher technology acceptance level and knowledge on innovative technologies, but also professionals who have deep knowledge of their domain (e.g. more than 15 years of experience).

The outcomes of this analysis were conceptualized in the form of inclusion recommendation in regard to engaging the various vulnerable groups in the field research activities (see Table 22 and Table 23). It was assessed that TG7 had some differences, in particular in regard to middle-aged workforce (e.g. workers 40-60 years old), female participation (e.g. the recommendation was lowered to 30%) and self-employment (e.g. this sector has overall high level of self-employed workforce).

Table 22. Inclusion recommendations for TG1, TG3 and TG6

Vulnerability and diversity aspects	Selection criteria	Recommended distribution
Age	>60 years old	10%
Gender/Sexuality	Female	40-45%
	Diverse	10%
Education	Primary/Middle/High School	10%
	Master/Doctorate Degree	20%
Experience	<5 years	10%
	>15 years	20%
Expertise	no. of different areas	at least 5
Employment status	unemployed/ part-time workers/ retired	20%
	self-employed	20%
Cultural background	belonging to minority groups	20%
Digital skills	limited	20%
Digital accessibility needs	people with disabilities (e.g. deaf, low vision)	20%
Language accessibility	immigrant, ethnic minority	20%
Residence location	City suburbs/ Rural area	10%

Table 23. Inclusion recommendations for TG7

Vulnerability and diversity aspects	Selection criteria	Recommended distribution
Age	>60 years old	10%
	40-60 years old	20%
Gender/Sexuality	Female	>30%
	Diverse	10%
Education	Primary/Middle/High School	5%
	Master/Doctorate Degree	20%
Experience	<5 years	10%
	>15 years	20%
Expertise	no. of different areas	at least 5
Employment status	unemployed/ part-time workers/ retired	10%
	self-employed	30%
Cultural background	belonging to minority groups	20%

Digital accessibility needs	people with disabilities (e.g. deaf, low vision)	20%
Language accessibility	immigrant, ethnic minority	20%
Residence location	City suburbs/ Rural area	10%

While these recommendations are important for the inclusive character of the project, we were aware of certain limitations and the potential not to reach or not to be able to understand the exact distributions: (i) the collected socio-demographic information that was agreed by the partner, may not give the possibility to estimate the exact statistics; (ii) for certain aspects it was not possible to intervene during the invitation stage, as they are of a sensitive nature (e.g. diverse gender, belonging to minority groups, having a disability); (iii) similarly, such sensitive aspects, may have not been reported accurately (they may have selected "No answer") by the participants despite our effort to anonymize the collection and access to this type of information; (iv) the capacity of the consortium to reach certain groups was limited by the actual representation of such individuals in the workforce (e.g. it is extremely rare for museum workers to have a low education level). Thus, after internal discussion with the consortium partners, the bottom-line recommendation was that each involved partner should focus on the top 3 vulnerability criteria that are achievable on their side. This strategic decision was considered beneficial for the field research, as it would motivate engagement with a larger number of participants, rather than limiting the total number just to meet the inclusion statistics recommendations.

4.2.5.2 TG1 Sample

The total number of TG1 stakeholders engaged in the Interviews organized by 5 project partners (RtF, MSS, TMP, UNIS and ENM) was 41. Among them, 13 were male and 28 were female. One person indicated that it belongs to a minority group, and one person opted not to answer this question. The distribution of the participants per age group is shown in **Σφάλμα! Το αρχείο προέλευσης της αναφοράς δεν βρέθηκε.**.

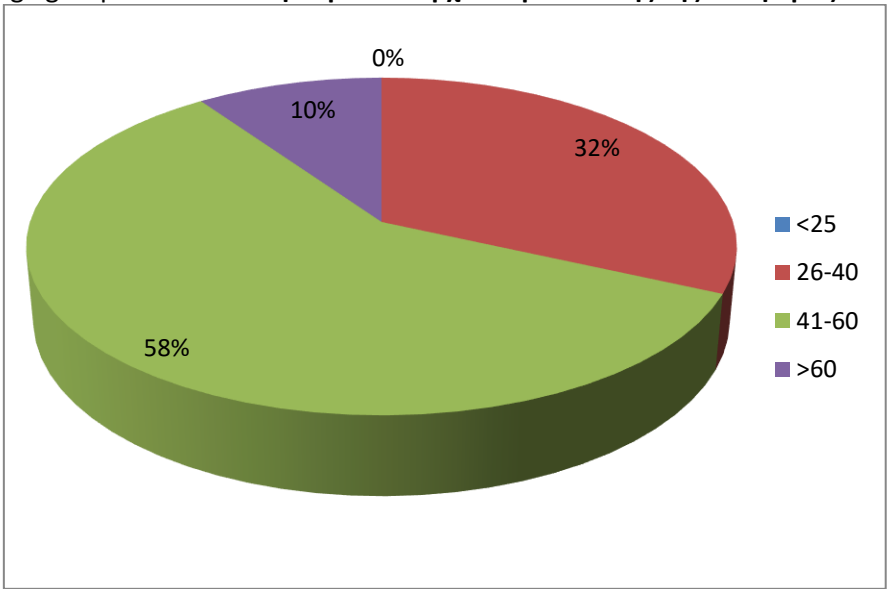

Figure 5. Distribution of TG1 stakeholders per age group.

The distribution of TG1 participants in relation to their education level is presented in Figure 6. The distribution of the participants in relation to the type of employment is presented in Figure 7.

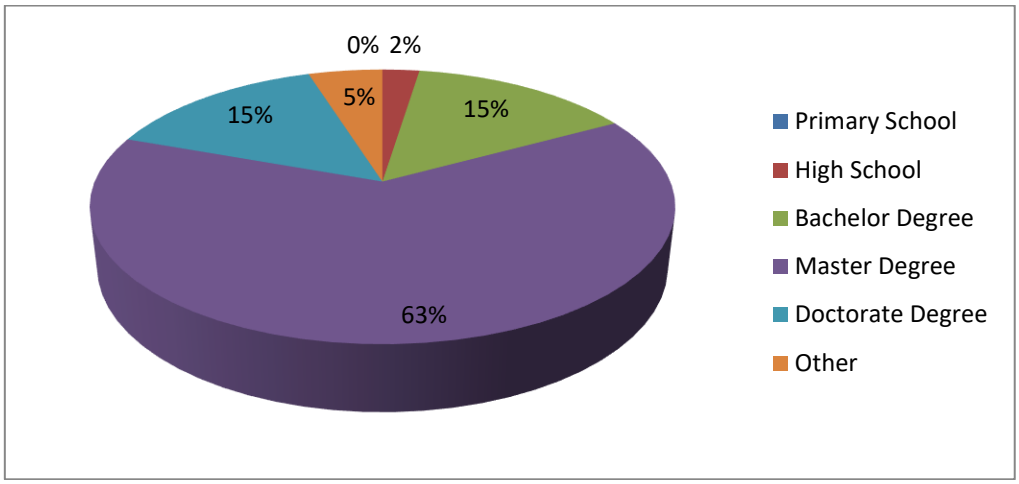

Figure 6. Distribution of TG1 stakeholders in relation to their education level.

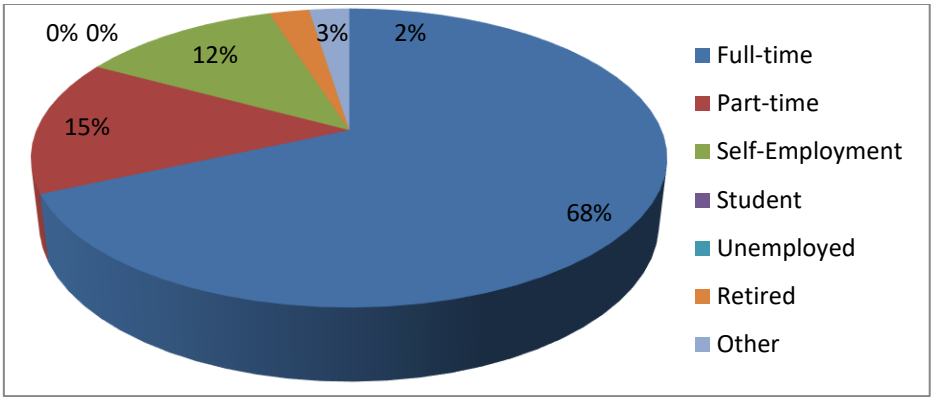

Figure 7. Distribution of TG1 participants per type of employment.

Three project partners, TMP, UNIS and ENM, conducted the field research at local level, respectively with 12 participants from Italy, 8 participants from Greece and 10 participants from Estonia. MSS and RtF engaged participants from other EU countries (e.g. Belgium - 2, Germany - 1, France -1, Finland - 2) and some other countries (UK - 1, Switzerland -2, Canada -1, Australia -1).
The distribution of the participants in relation to their residence area is presented in Figure 8.

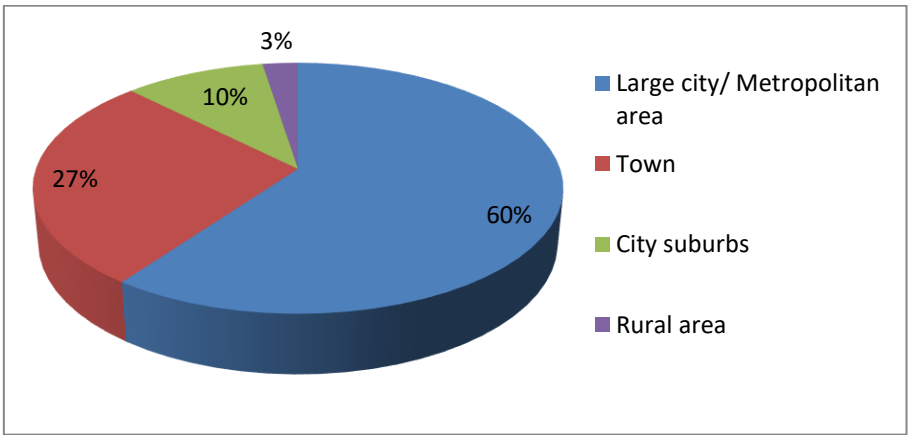

Figure 8. Distribution of TG1 participants in relation to their residence area.

The distribution of the participants per area of expertise is presented in Figure 9, and their level of experience (e.g. years they have been working in these areas) is shown in Figure 10.

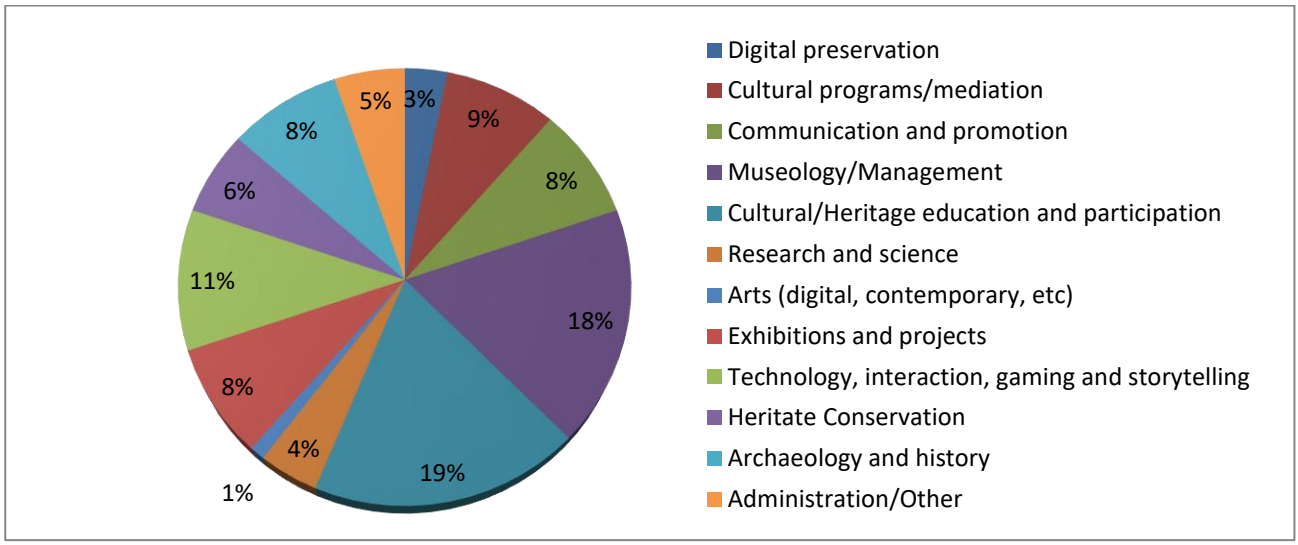

Figure 9. Distribution of TG1 participants per area of expertise.

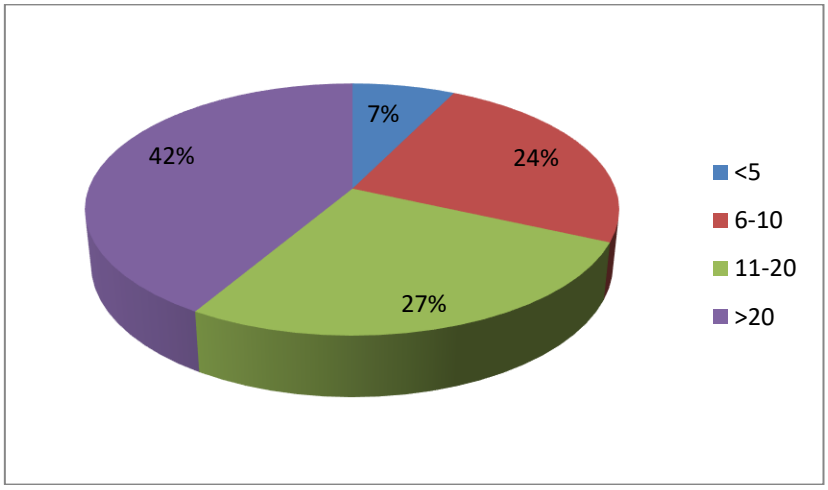

Figure 10. Distribution of TG1 participants in relation to their level of experience.

As expected, most of the participants are working in Museums or Cultural organizations (29 and 5 respectively), while a few of the engaged participants were working in the Creative Industry (including Start-ups), Educational Institutions, and Non-profit Organizations. The distribution of the participants in relation to the size of their organization is presented in Figure 11.

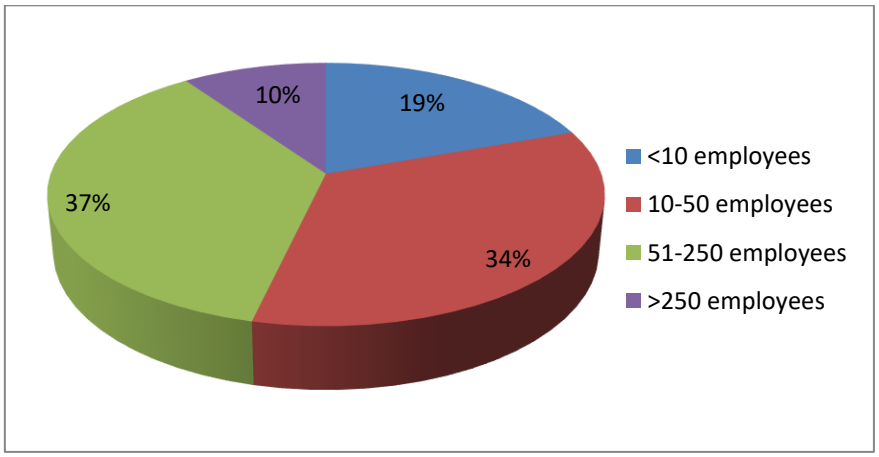

Figure 11. Distribution of TG1 participants in relation to the size of their organization.

When it comes to technology use, all participants indicated that they are using computers, laptops, or mobile

devices on a daily basis, both for work and leisure. However, a large percentage of the participants, namely 20%, self-assessed their digital skills as limited (see Figure 12).

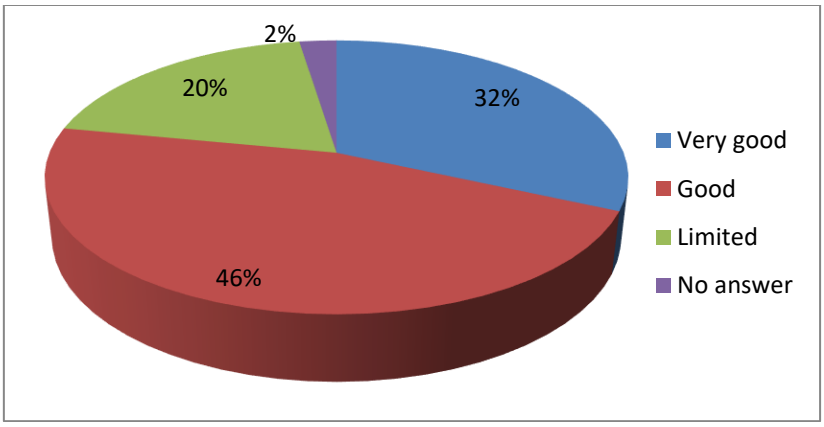

Figure 12. Distribution of TG1 participants in relation to the self-assessed level of their digital skills.

When it comes to accessibility needs, only 2 of the participants indicated that they are visually impaired and they are using a screen reader, dictation tools, the magnifying tool and high colour contrast. A large number of participants, namely 18, indicated that they are using language translation tools due to the fact that English is not their native language.

Half of the participants, namely 21 participants, have very good knowledge of the terms and technologies related to serious games and gamification, while most of the remaining (18 participants) indicated to have limited knowledge and 2 have no knowledge on these aspects.

The knowledge of the participants in regard to IT/IP laws and AI ethical requirements is very limited, as only 1 participant indicated to have very good and 14 good knowledge on the IP/IT laws, and 11 participants indicated to have good knowledge on the AI ethical requirements.

4.2.5.3 TG3 Sample

The total number of TG3 stakeholders engaged in the Interviews organized by 2 project partners (KEPA and TMP) was 27. Among them, 10 were male and 17 were female. Two persons indicated that they belong to minority group. The distribution of the participants per age group is shown in **Σφάλμα! Το αρχείο προέλευσης της αναφοράς δεν βρέθηκε.**.

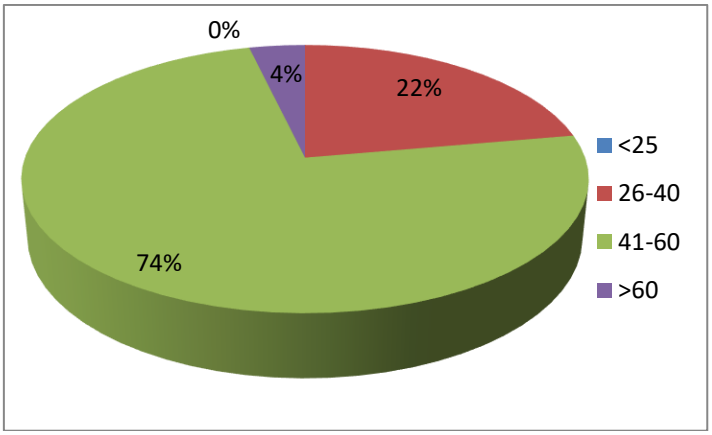

Figure 13. Distribution of TG3 stakeholders per age group.

The distribution of the TG3 participants in relation to their education level is presented in Figure 14. The distribution of the participants in relation to the type of employment is presented in Figure 15.

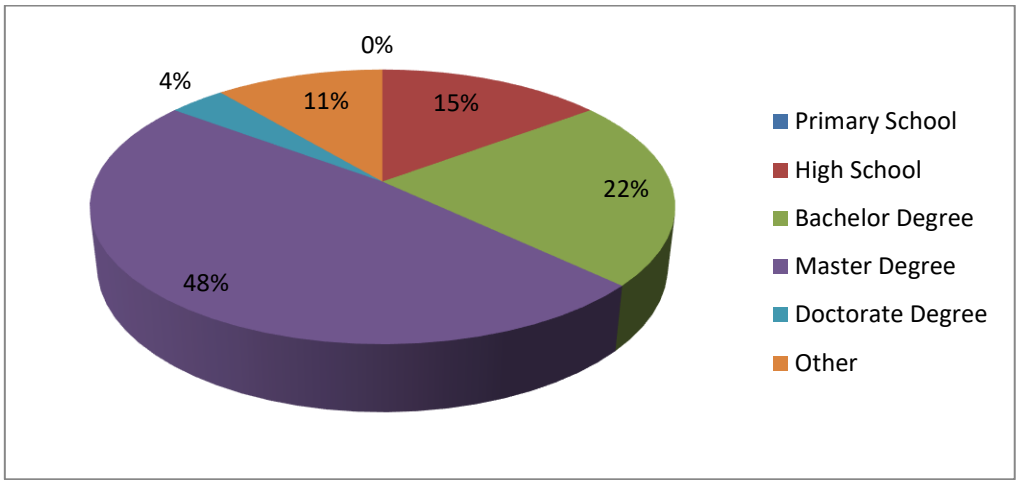

Figure 14. Distribution of TG3 stakeholders in relation to their education level.

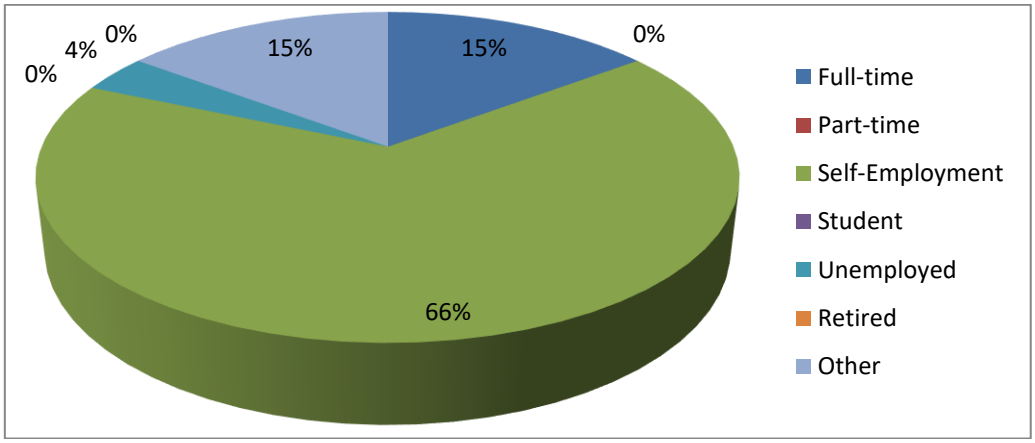

Figure 15. Distribution of TG3 participants per type of employment.

The field research conducted by KEPA and TMP took place at local level, with 17 participants from Greece and 10 participants from Italy. The distribution of the participants in relation to their residence area is presented in Figure 16.

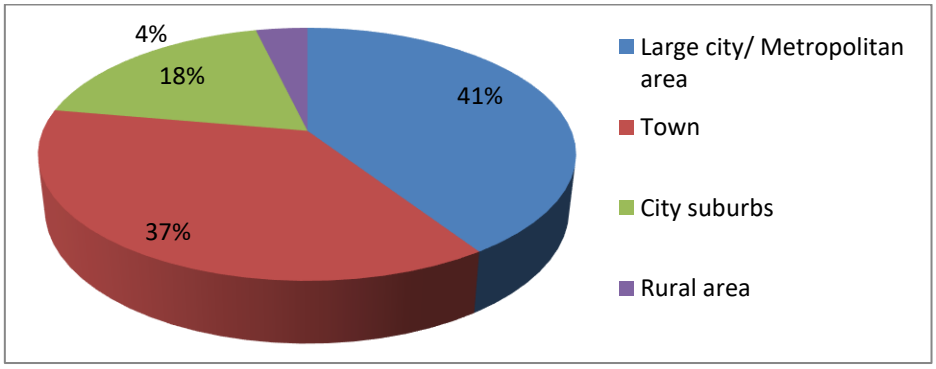

Figure 16. Distribution of TG3 participants in relation to their residence area.

The distribution of the participants per area of expertise is presented in Figure 17, and their level of experience (e.g. years they have been working in these areas) is shown in Figure 18.

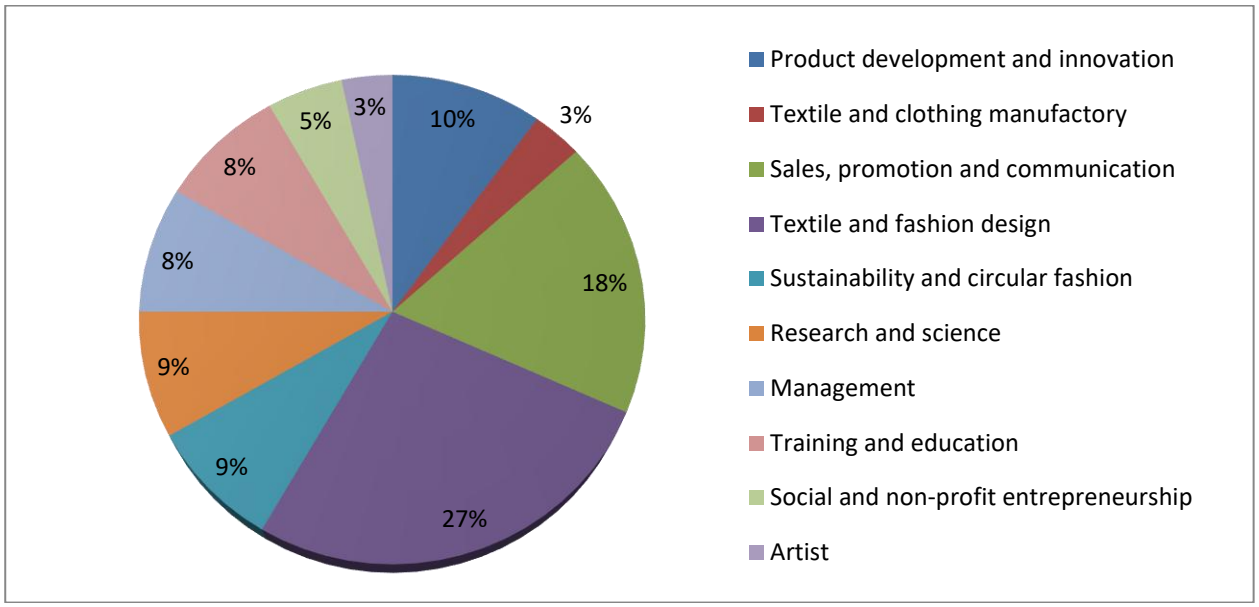

Figure 17. Distribution of TG3 participants per area of expertise.

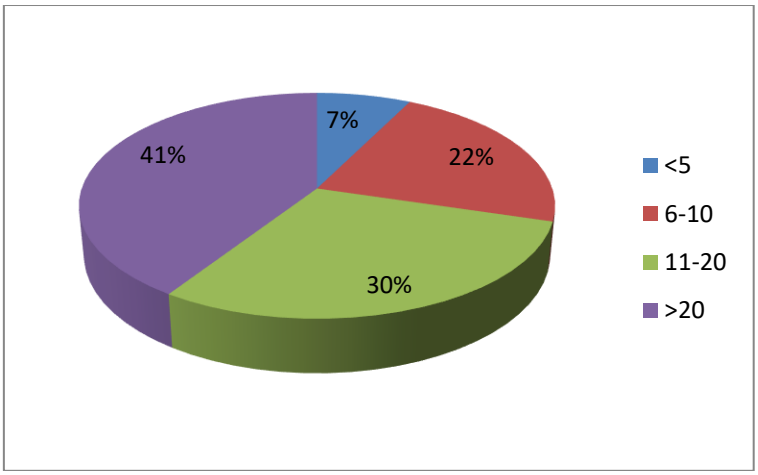

Figure 18. Distribution of TG3 participants in relation to their level of experience.

Among the TG3 participants, 4 are working in the Creative Industry, 6 in the Textile Industry, 7 in Fashion SMEs, 4 in Educational Institutions, 2 in Non-Profit Organisations, and 4 in other type of organizations. The distribution of the participants in relation to the size of their organization is presented in Figure 19.

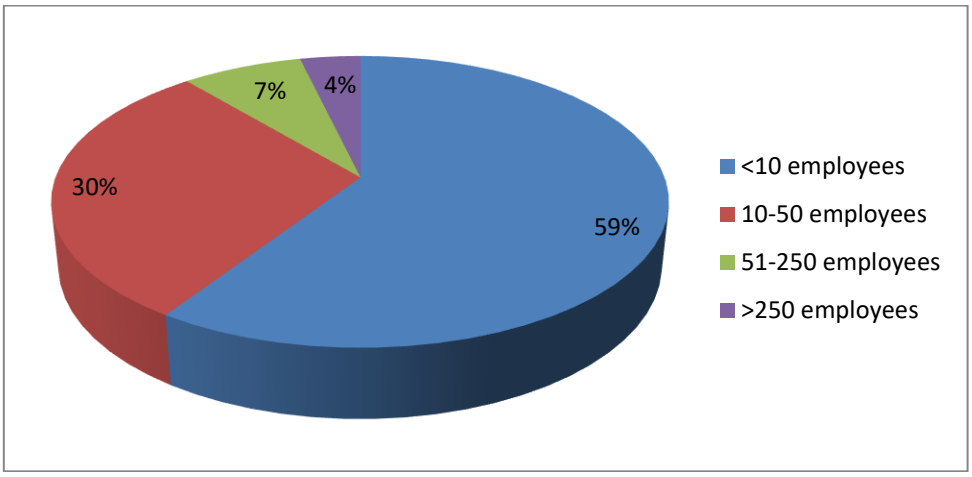

Figure 19. Distribution of TG3 participants in relation to the size of their organization.

When it comes to technology use, all participants indicated that they are using some sort of device (computer, laptop, or smart mobile) on a daily basis, either for work or leisure. However, 18% of the participants self-assessed their digital skills as being rather limited (see Figure 20), and 4% opted not to answer to this question.

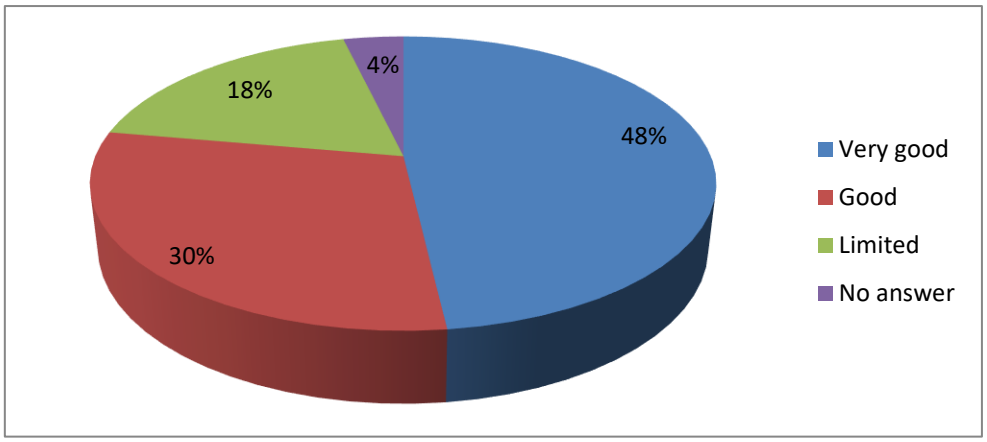

Figure 20. Distribution of TG3 participants in relation to the self-assessed level of their digital skills.

When it comes to accessibility needs, 4 participants indicated that they are visually impaired and they are using a screen reader, dictation tool, the magnifying tool or high colour contrast, and 3 participants indicated that they are using language simplification tools. A large number of the participants, namely 15, indicated that they are using language translation tools due to the fact that English is not their native language.
When it comes to serious games and gamification, only 9 participants (1/3) have very good knowledge of the terms and relevant technologies, while the remaining 2/3 of the participants either have very limited knowledge (15 participants) or no knowledge at all (3 participants) on these aspects.
The knowledge of the TG3 participants in regard to the IT/IP laws and AI ethical requirements is overall limited, as only 4 participants indicated to have very good and 10 good knowledge on the IP/IT laws, and 11 participants in total indicated to have very good or good knowledge on the AI ethical requirements.

4.2.5.4 **TG6 Sample**

The total number of TG6 stakeholders that participated in the Focus Group or Interview activities organized by 6 project partners (CB, RtF, TMP, MSS, ENM and KEPA) and successfully completed the socio-demographics survey was 53. Although the total number of engaged in Focus Groups was slightly higher, those that did not fill in the survey were considered as dropout cases and not considered in the following analysis. Among the participants, 35 were male, and 18 were female. A high number of participants belonged to minority groups, namely 13, and 5 persons opted not to answer this question. The distribution of the participants per age group is presented in Figure 21, showing that 30% of the participants were aged below

25 years old, 40% between 26-40 years old, 28% between 41-60 years old and 2% were older than 60.

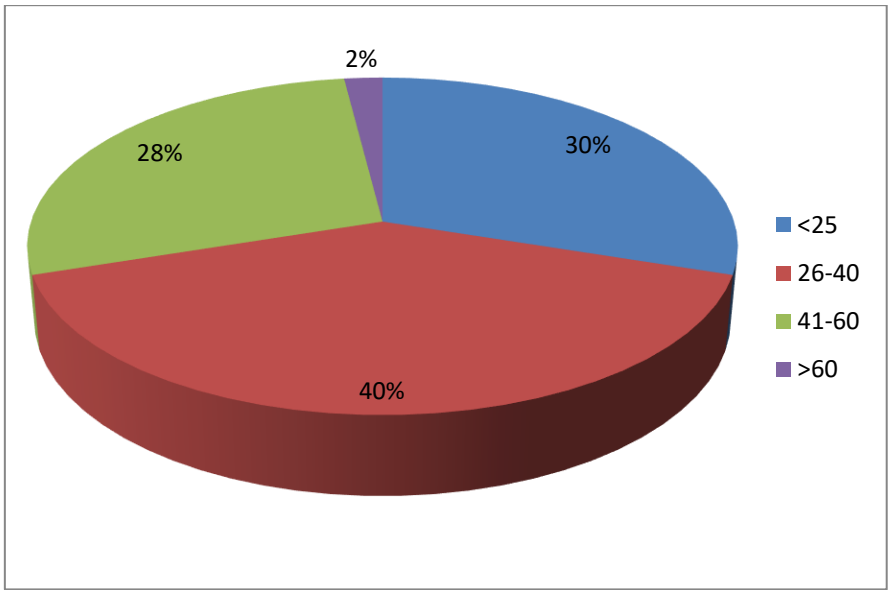

Figure 21. Distribution of TG6 participants per age group.

The distribution of TG6 participants in relation to their education level is presented in Figure 22. The distribution of the participants in relation to the type of employment is presented in Figure 23.

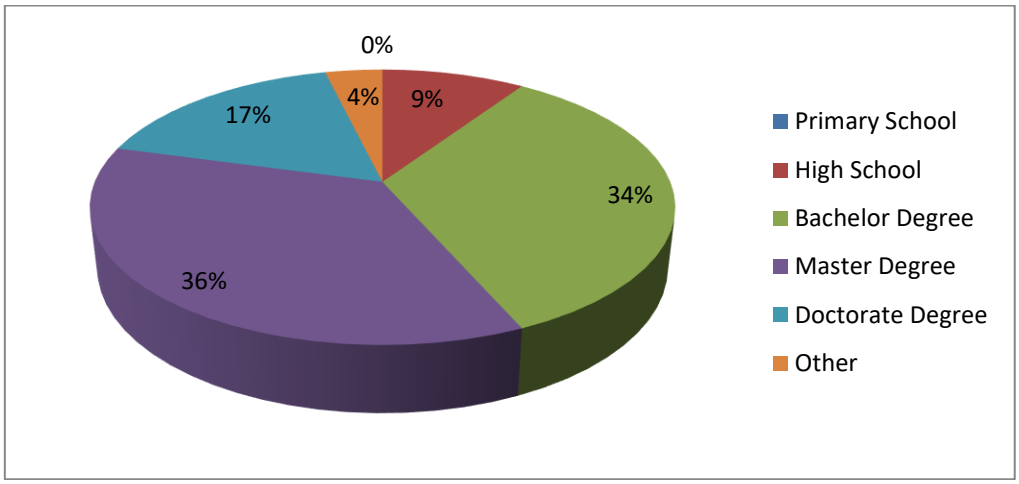

Figure 22. Distribution of TG6 participants in relation to their education level.

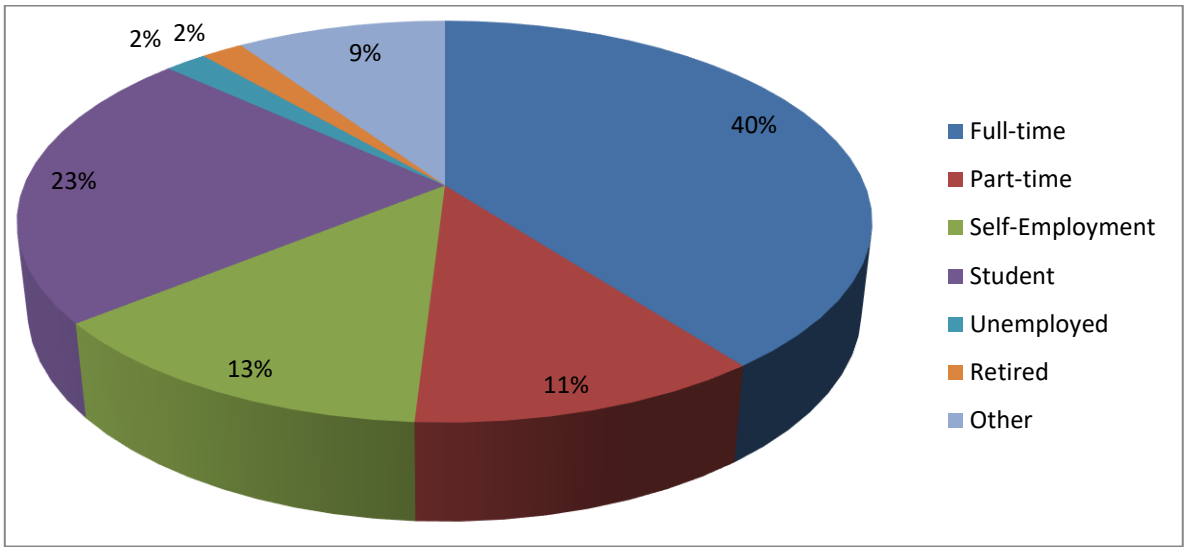

Figure 23. Distribution of TG6 participants per type of employment.

Some of the project partners, in particular TMP, CB and the ENM, conducted the research at local level (e.g. 11 participants from Italy, 19 participants from Spain, 4 participants from Estonia), while the rest of the participants were from other countries: Germany, Greece, Nederland, Finland, France, India, Australia, Denmark, United Kingdom, USA, Ireland, and Belgium.
The distribution of the participants in regard to the area of their residence is presented in Figure 24.

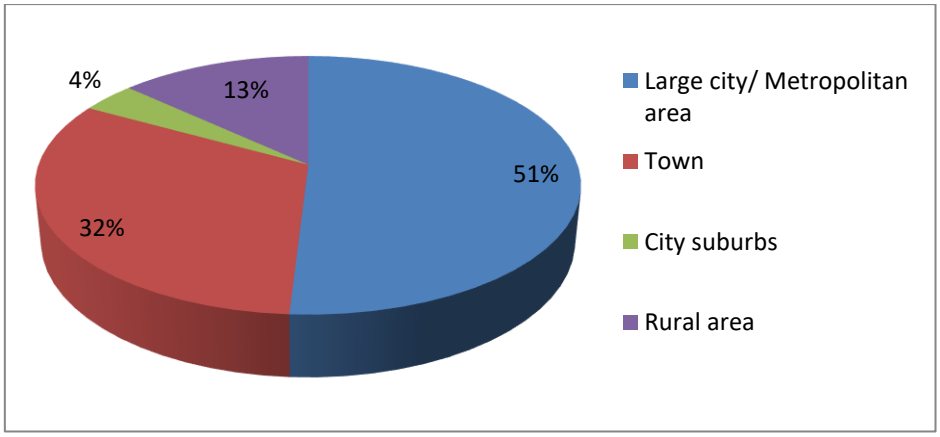

Figure 24. Distribution of TG6 participants in relation to their residence area.

The distribution of the participants per area of expertise is presented in Figure 25, and their level of experience (e.g. years they have been working in these areas) is shown in Figure 26. Distribution of TG6 participants in relation to their level of experience..

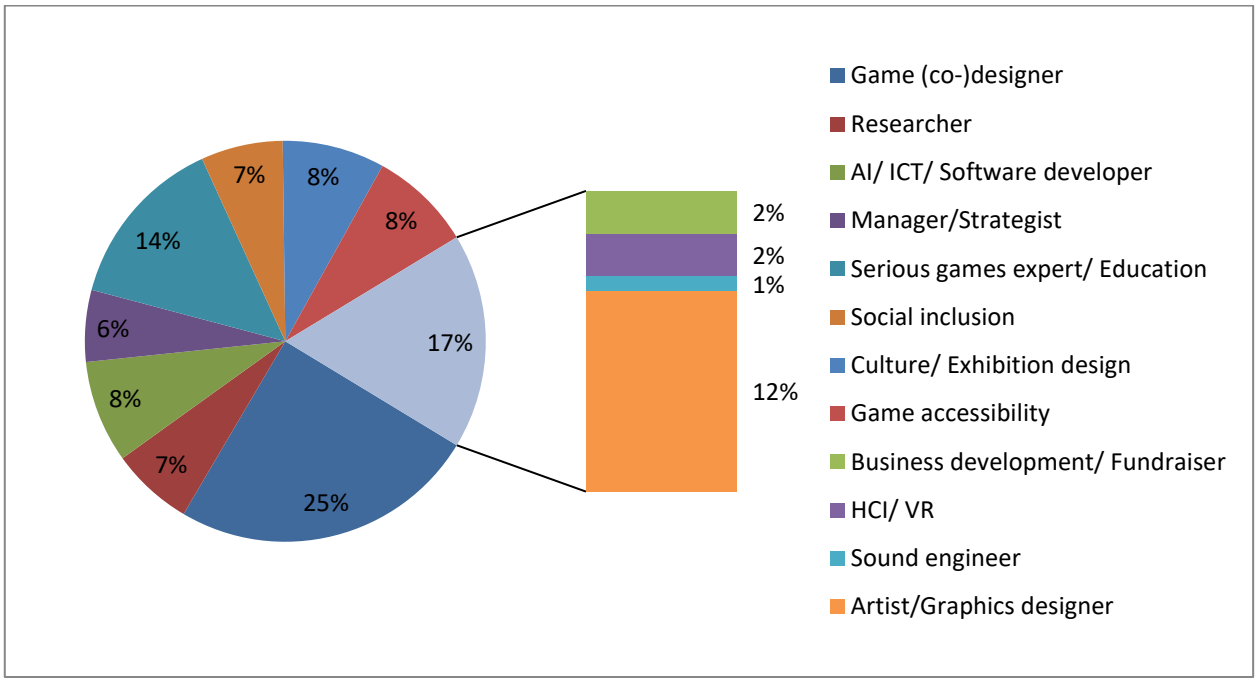

Figure 25. Distribution of TG6 participants per area of expertise.

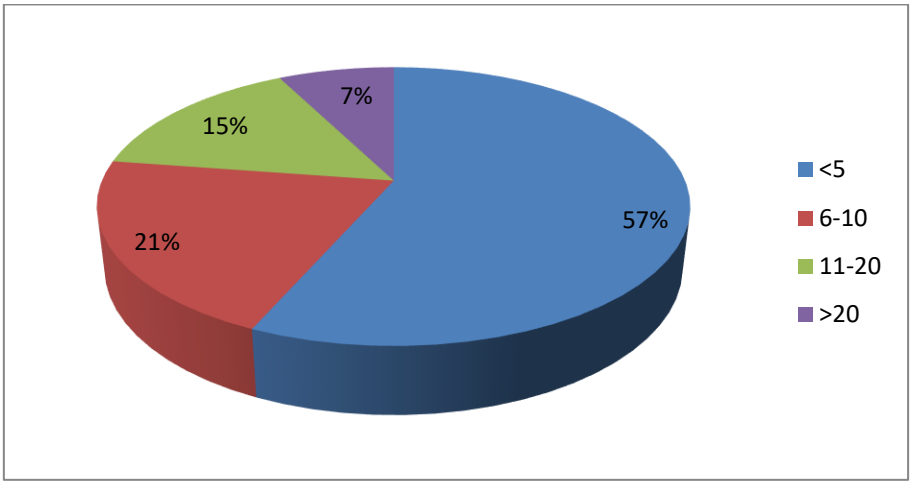

Figure 26. Distribution of TG6 participants in relation to their level of experience.

The participants are widely distributed in relation to their organization type, including 3 participants from Museums, 7 from the Creative Industry, 7 from the Gaming Industry, 15 from Educational Institutions, 2 from Research Organizations, 4 from Non-profit Organization, 4 from Start-ups and 6 who are self-employed or work for other type of organization (e.g. government, policy). The distribution of the participants in relation to their organization size is presented in Figure 27.

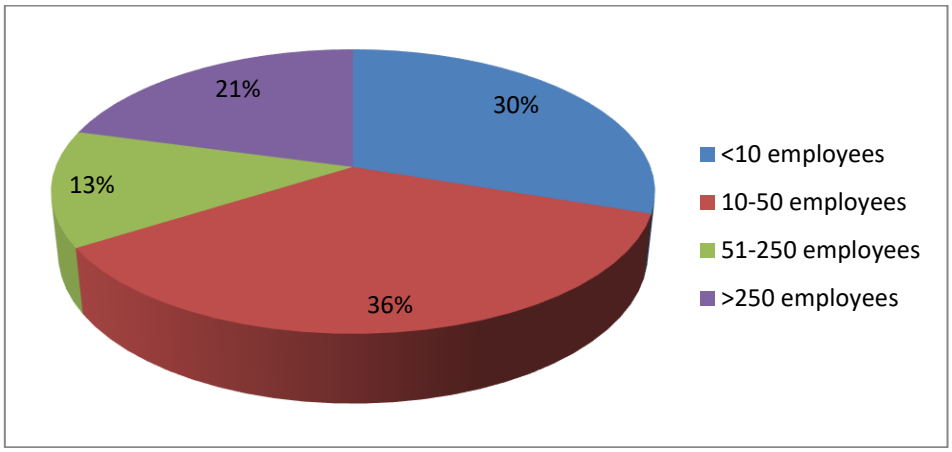

Figure 27. Distribution of TG6 participants in relation to the size of their organization.

When it comes to technology use, all participants are using computers, laptops or mobile devices on a daily basis, both for work and leisure, with only 4% of the participants assessing their level of digital skills as being limited (see Figure 28).

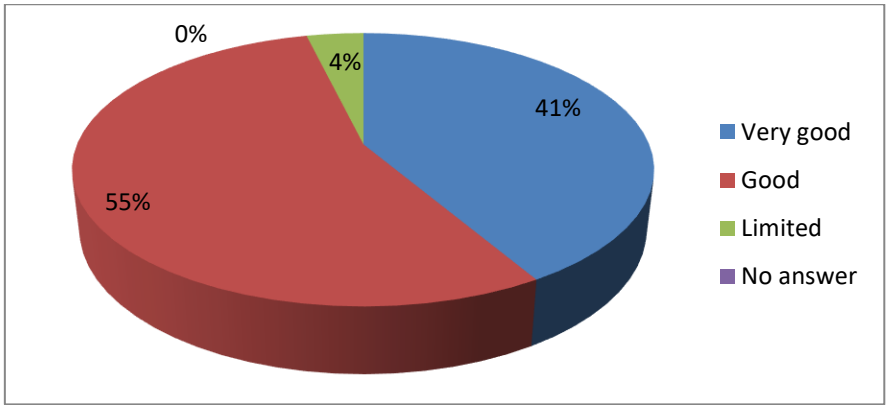

Figure 28. Distribution of TG6 participants in relation to the self-assessed level of their digital skills.

When it comes to accessibility needs, 6 of the participants indicated that they are visually impaired and are using a screen reader, dictation tools, high colour contrast and/or the magnifying tool. A large number of participants indicated that they are using language translation (19 participants), but in most of the cases it is due to the fact that English is not their mother tongue/ first language. Other accessibility tools used by 5 participants include digital keyboard, trackball mouse, mouth-operated mouse, tools to recognize and describe images, short-cut keys, etc. Further details are provided in Figure 29.

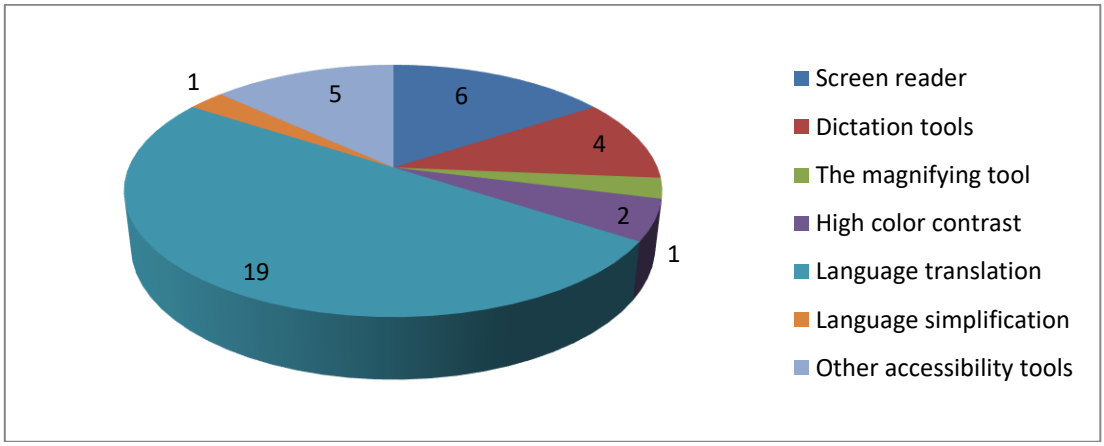

Figure 29. Accessibility needs of TG6 participants.

4.2.5.5 TG7 Sample

The total number of TG7 stakeholders engaged in the Focus Group or Interview activities organized by 4 project partners (CERTH, RtF, CB and TMP) was 37. Among them, 23 were male, 13 were female and 1 participant opted not to answer this question. One person indicated that it belongs to a minority group and 3 persons opted not to answer this question. The distribution of the participants per age group is shown in **Σφάλμα! Το αρχείο προέλευσης της αναφοράς δεν βρέθηκε.**, showing that 56 % of the participants were aged between 41-60 years old, 38% between 26-40 years old and 6% were older than 60.

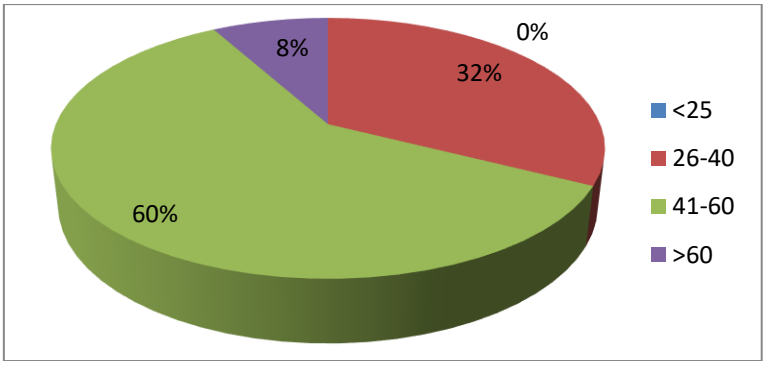

Figure 30. Distribution of TG7 participants per age group.

The distribution of TG7 participants in relation to their education level is presented in Figure 31. The distribution of the participants in relation to the type of employment is presented in Figure 32.

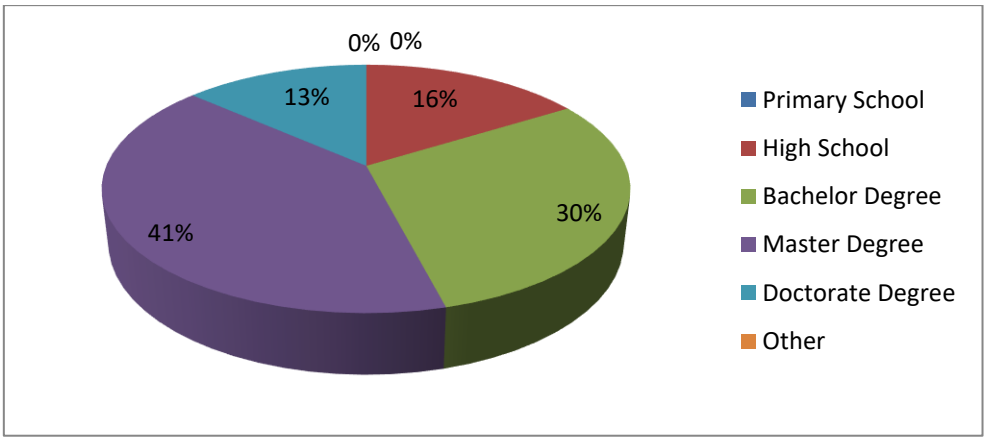

Figure 31. Distribution of TG7 participants in relation to their education level.

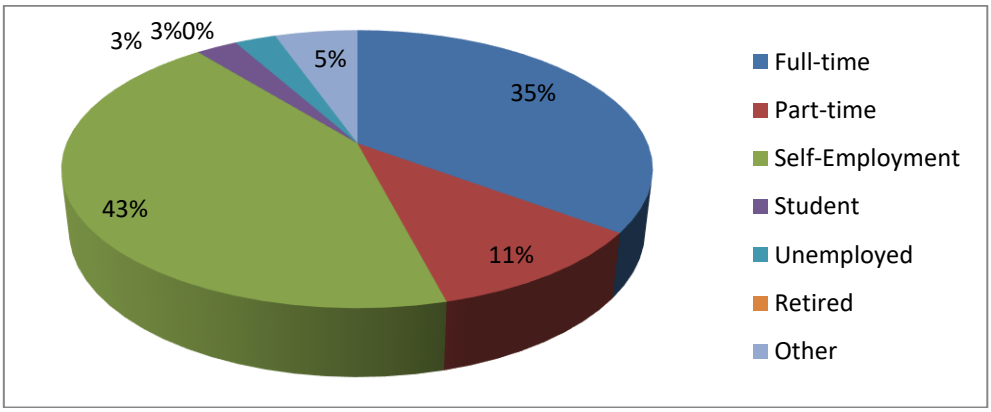

Figure 32. Distribution of TG7 participants per type of employment.

Three of the project partners, CERTH, TMP and CB, conducted the research at local level, respectively with

10 participants from Greece, 9 from Italy and 9 from Spain. The research in other EU countries and at international level was conducted by RtF, with the following distribution per country: Germany - 1, Sweden - 2, Denmark - 1, Australia - 2 , USA - 2, Canada -1.
The distribution of the participants in regard to the area of their residence is presented in Figure 33.

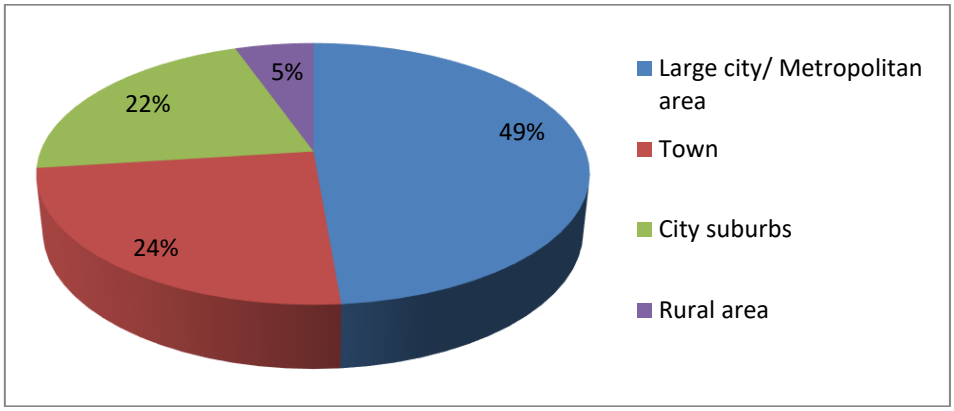

Figure 33. Distribution of TG7 participants in relation to their residence area.

The distribution of the participants per area of expertise is presented in Figure 34, and their level of experience (e.g. years they have been working in these areas) is shown in Figure 35.

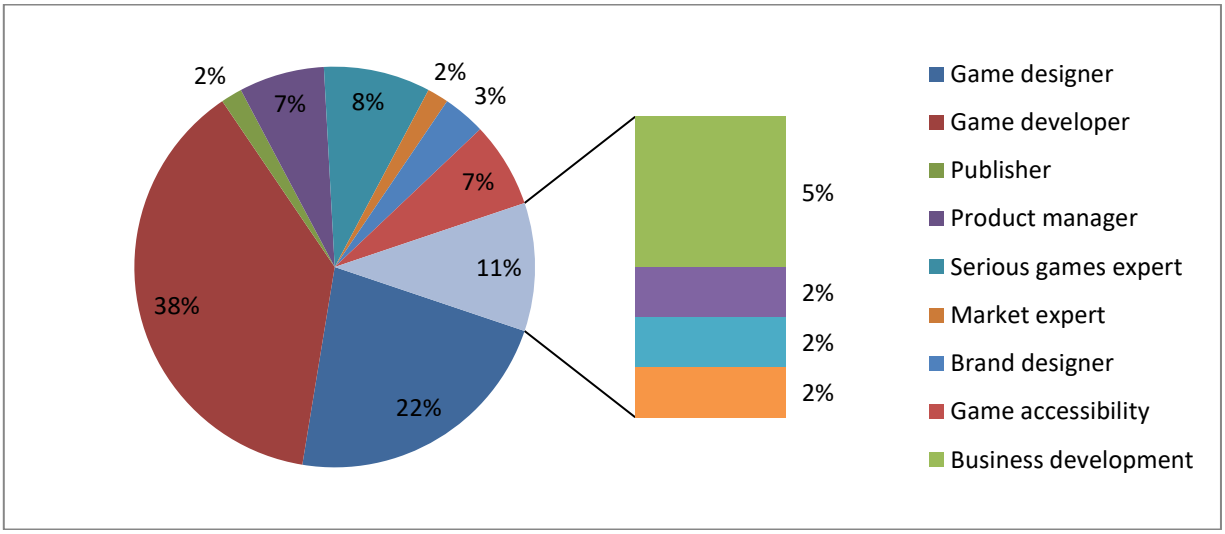

Figure 34. Distribution of TG7 participants per area of expertise.

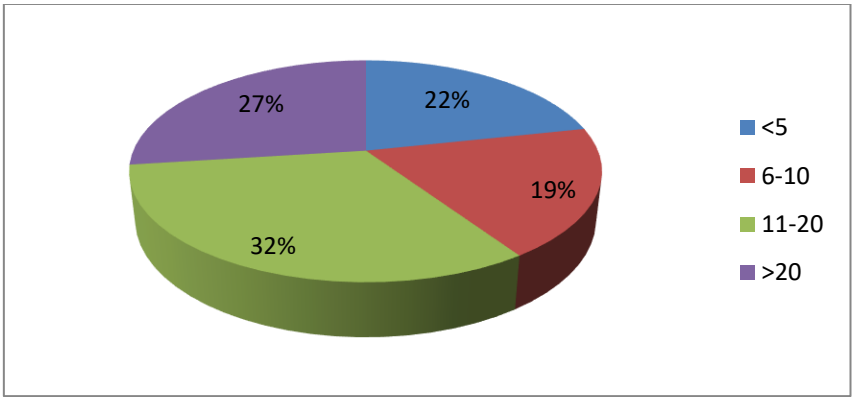

Figure 35. Distribution of TG7 participants in relation to their level of experience.

As expected, most of the participants, namely 25, are working in the Gaming Industry. The remaining are

distributed among Creative Industry, Educational Institutions and Cultural Organizations. Most of the participants are from small (<10 employees) to medium (10-50 employees) organizations, but there was significant representation of participants working for large organizations, including 19% of the participants from organizations with more than 250 employees (see Figure 36).

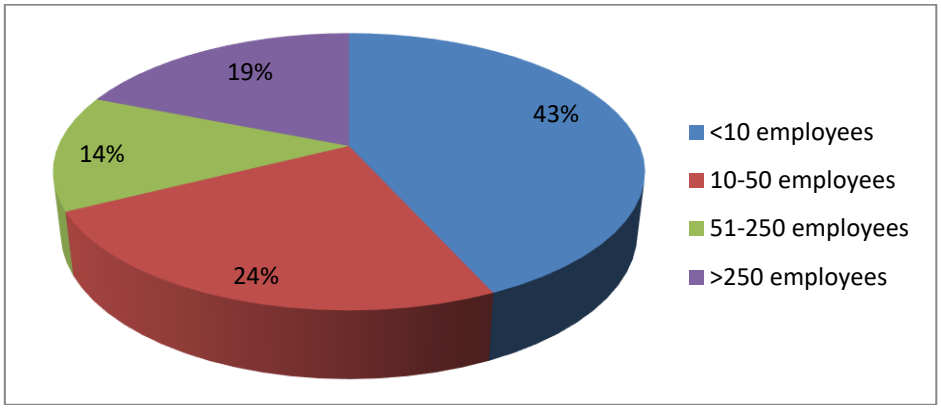

Figure 36. Distribution of TG7 participants in relation to the size of their organization.

When it comes to technology use, all participants are using computers, laptops, or mobile devices on a daily basis, both for work and leisure. However, 8% of the participants assessed their level of digital skills as being limited (see Figure 37).

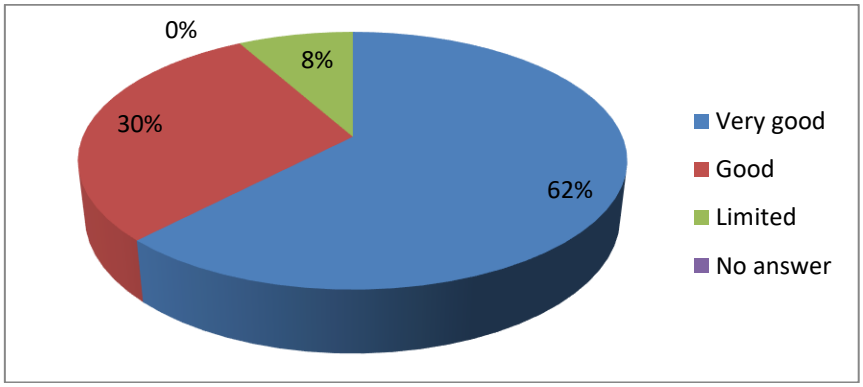

Figure 37. Distribution of TG7 participants in relation to the self-assessed level of their digital skills.

When it comes to accessibility needs, 4 of the participants indicated that they are visually impaired and are using a screen reader, dictation tools, high colour contrast and the magnifying tool. A large number of participants indicated that they are using language translation, but in most of the cases is due to the fact that English is not their mother tongue/ first language. Further details are provided in Figure 38.

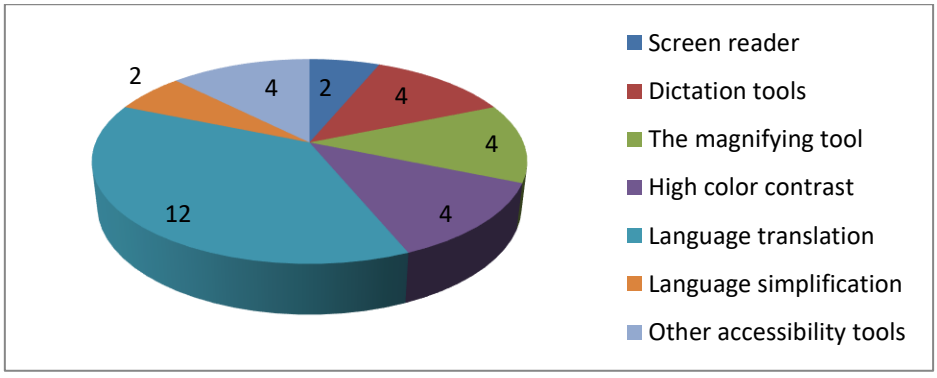

Figure 38. Accessibility needs of TG7 participants.

Most of the participants, namely 28 participants, have very good knowledge of the terms and technologies

related to serious games and gamification, 8 indicated to have limited knowledge and only 1 participants has no knowledge on these aspects.
When it comes to legislation and ethical frameworks, 16 and respectively 15 participants indicated to have very limited knowledge in regard to IT/IP laws and AI ethical requirements. Only 7 and respectively 5 participants indicated to have very good knowledge on these aspects.

4.3 Field Research Outcomes

The following sections are presenting the outcomes of the field research results per target group of stakeholders. The main findings focus on: why each TG in interested in videogames and gamification, how to they feel about such technologies and their sector readiness to adopt them (including facilitators and obstacles), which are their requirements from the games, for which target groups they want to build them, which groups/communities should be considered more when creating new digital products, and which are the best practices in their domain.
The extracted opinions are grouped per category, and it is indicated if this opinion was expressed by "Few" (e.g. less than 10%), "Many" (between 10% and 50%), the "Majority" (up to 80%) or almost "All" (>80%) of the participants engaged from the respective TG. As expected, the outcomes of the analysis show that the data collected from TG1 and TG3 provide a comprehensive view on the context of use of serious games and gamification for museums/culture and the fashion industry. The data collected form TG6 and TG7, provides a comprehensive view on the needs and context of use of the i-Game co-creation platform (see deliverable D3.2), while only few opinions in regard to the context of use of games are mentioned (see sections 4.3.3 and 4.3.4).

4.3.1 TG1: Museums and similar CCIs institutions and professionals

They need games, gamification, and advanced digital technologies in order to:

Create engaging applications for diverse audiences (e.g. magical experiences)	**Many**
Present cultural information in a playful manner	**Many**
Educate the public through participatory and engaging processes	**Many**
Showcase the cultural heritage (e.g. games are part of the toolbox)	**Many**
Showcase scientific information (e.g. the discovery process)	Few
Transfer knowledge on history/culture topics interactively (e.g. to school pupils, families)	**Many**
Develop critical thinking of gamers	**Many**
Making exhibitions more interactive	**Many**
Opening the black box around how digital technologies work	Few
Teach unbiased history	Few
To bring young people closer to culture (e.g. games are a low threshold tool)	**Many**
Increase human interaction (e.g. social dialogue, human connection), and interaction between people and culture/museum collection	**Many**
Optimize social and economic returns	Few
To initiate discussions on taboo topics	Few
Develop alternative ways of perceiving and appreciating the museum collections	Few
Enhance creative and mental stimulation (e.g. become more reflective)	Few
Enhance the valorisation of cultural heritage.	Few
Increase audience of cultural spaces	Few
Support green transition (e.g. through education)	Few
Connect the art with the viewer.	Few

Connect different generations	Few
Showcase textile history	Few
Help visitors understand the process of making objects	Few
Convey exhibition content through different/alternative media	**Many**

How they feel about the sector/industry:

The museum staff is open to new educational methods	Few
The museums should be open to experimentation as a main key for discovering new fields and learn.	Few
There is a lot of hesitation to build connections with the gaming community or local game designers.	Few
Worldwide, many museums have started to acquire games as part of collections and educational tools.	Few
Museums are open to involving different target groups in the game development process (e.g. to ensure accessibility of digital solutions/services, to meet the needs of diverse audiences).	**Many**
Museums lack a clear vision and digital strategy that includes the use of games	**Many**
Older generation museum workers are more conservative and not willing to experiment with digital technologies	Few

How they feel about video games, digitization, and technology:

Fear of copyright infringement (e.g. museum digital assets are used without authorization) in particular in online platforms	Few
Concerned about the time-consuming process versus limited outcomes in regard to impact (e.g. little increase in audience, the investment does not pay off)	Few
Concerned about having to start from scratch in an unknown area.	Few
Fear that may create a clash between the curators, mediation team and the artist.	Few
They do not like using the term "serious games" as it may lead to specific perceptions (e.g. not fun)	Few
Gaming should be considered more in the entire museum tasks and actions (e.g. internally).	Few
Senior leadership teams, while excited by the prospect of bringing games in the museums, do not understand what is needed at organization (e.g. infrastructure, strategy) and workforce levels.	Few
They believe it is challenging to balance digital innovation with the museum's core values.	Few
Fear and feeling overload of digitalisation.	Few
Older experts (>60 years old) see themselves more as content creators rather than developers of that content into a game.	Few
Potential historical distortion that may be introduced in digital games is considered highly dangerous, and museums should not engage in or allow such practices, as it directly impacts the institution's trustworthiness and credibility.	Few
Games may have a negative environmental impact.	Few
Concerns about how data from museum digital databases will be used by the game players, as the public data literacy to use heritage databases is low.	Few
Big budget exhibitions could have a budget to include games tailored for that use.	Few
Many times, games are included in the exhibition just to make it more attractive to young people.	Few

Requirements they have from games:

Small game-like activities could be designed especially for children	Few

Gamification could include rewards for out-of-game activities (e.g. recycling devices)	Few
Games targeting pre-adolescents should include learning elements related to responsible use of technology	Few
Games must be connected to the museum collection/content (e.g. develop from the exhibition)	**Many**
The games should represent the museum values, global narrative, and strategy	Few
Digital experiences should be aligned with visitors' skills.	Few
Games must align to the exhibition overarching goal defined by the curator (e.g. should not be small independent narratives)	**Many**
AI can assist tailoring gameplay to individual users based on preferences or player behaviour in real time.	Few
Games should facilitate users to provide feedback.	Few
Standard game solutions should be provided, which are easily adaptable and help save time and resources.	Few
Games should be short, as lengthy role-playing games are not typically played in a museum setting.	Few
Games should be played in the context of the museum (e.g. as part of the exhibition), as afterwards activities (e.g. taking games along, later downloading) has not proven to be popular.	Few
Games should cater to teams and families who come together at the museum (e.g. even in the case of an individual VR game others should at least be able to see what is happening in real time).	Few
Games should have both competitive and collaborative elements. In the museum setting games could be more focused on collaboration, making choices and exploring the consequences of these choices.	Few
Ensuring in-game data accuracy is important for the museum (e.g. factual accuracy).	Few

For which target audiences they want to build games:

all age groups	**Many**
young people (e.g. <30 years old)	**Many**
children	**Many**
older adults (e.g. >65 years old)	**Many**
families	**Many**
educators/teachers	Few
school groups	Few
people/students with disabilities	**Many**
audiences for human rights storytelling	Few
teenagers (e.g. the hardest target to reach by the museums)	**Many**
neuro-diverse visitors	Few
socially-oriented organizations	Few
museum systems	Few
life-long learners	Few
adult gamers	Few
higher education students	Few
children with learning disabilities	Few
groups who are otherwise not very interested in what is happening in the museum world	Few
museum visitors seeking a more interactive experience	**Many**

people with lower education levels	Few
people who does not have physical access to the museum (e.g. hospitalized, living in rural areas or other countries)	Few

Main obstacles to integrate/adopt advanced technologies and games in their practice:

Lack of financial and human resources	**Many**
Lack of awareness among the domain professionals	Few
Lack of understanding of potential/value (e.g. mindset/perception of some professionals that games are childish/toys, or platforms for sexist/harmful/harassment behaviours)	**Many**
Lack of technological infrastructure	**Many**
Lack of knowledge and training on game design and development	**Many**
Decision makers are not convinced/aware of the game market size and usefulness	Few
Bureaucracy, complex processes, and issues with interpretation of IP law in order to obtain permission to use photographic, 3D, video, and other forms of digital materials	Few
Competing against commercial games (e.g. high standards)	**Many**
Low level of digital skills or relevant knowledge of the workforce (e.g. internal digital competence)	**Many**
High production costs, in terms of budget, time and team size	**Many**
Low level of adoption of games/gamification in the domain	Few
Need for specialized knowledge/expertise (e.g. developers)	Few
Wrong selection of targeted demographics (e.g. targeting visitors who do not wish to engage with games)	Few
Difficulty to reach vision/education objectives/ relevance level (e.g. risk of creating something that is not culturally centred, does not provide the correct cultural context)	**Many**
Existence of a large number of useless products	Few
Games require too much learning and/or are perceived as difficult	Few
Technology adoption barriers at workforce level (e.g. fear of new and unknown)	Few
Complexity of technical management of the digital assets (e.g. requiring updates, VR/3D require maintenance)	**Many**
Lack of structured collaboration between multidisciplinary teams (e.g. challenges in finding suitable partners and efficiently collaborating with them)	**Many**
Work organization difficulties	Few
Games might lose relevance in time, may quickly become outdated in terms of technology and design, losing their appeal.	**Many**
The digital space is confusing, and continuously evolving and changing, raising sustainability concerns.	**Many**
Difficulty to balance between the needs and requirements of different audiences.	Few
Low tolerance in the digital world (e.g. everyone expects a fully functional tool)	Few
Most museum current audiences do not know much about games.	Few
Workforce limited resources to enhance digital skills and knowledge (e.g. they work at their full capacity on the job tasks)	Few
Missing clear vision and strategy at leadership level.	**Many**
Difficulty to balance between standardized and unique solutions (e.g. standardized games are cheaper, but not museum specific)	**Many**
Ageing workforce (e.g. technology acceptance, low digital skills, etc)	**Many**

Concerns about the potential of the game to contribute to conveying the strongly physical experience of a museum (e.g. how does the game support the emotional experience of it?)	Few

Factors that facilitate/enable adoption and integration of advanced technologies and games in their practices:

Awareness, promotion, and widespread practices around games/gamification	**Many**
Training and familiarization with games/gamification use in the cultural context	**Many**
Increased support and recognition of value from the policy makers	Few
Digitization of heritage and art assets	Few
Appealing game storytelling to engage people	**Many**
Improved communication strategies in regard to value and benefits	**Many**
Existence of a diverse and multi-disciplinary pool of experts that facilitate innovative collaboration	Few
Integration of games/gamification into organizational operations	Few
Organizational attitude towards games/gamification and new technologies	Few
Engaging various audience groups in the process	Few
Availability of knowledge and attractive/convincing best practices	**Many**
Increased number of practitioners	**Many**
Availability of resources (human, financial)	**Many**
Enhanced multi-disciplinary communication and networking	Few
Promotion/approval by policy makers	Few
Lower production cost (e.g. important in particular for smaller museums)	Few
Financing opportunities	Few
Selective process and use when truly needed and meaningful	Few
Technical awareness of the sector stakeholders	Few
Potential to stimulate business innovation, creativity, and inclusion	**Many**
Attracting/engaging with new audiences (e.g. teenagers, different ethnic groups)	Few
Making museum collections more inclusive (e.g. often seen as "unattainable" or difficult to understand)	Few
Game jams in the museum space (e.g. involving the museum staff, focusing on the collections)	Few
Younger sector professionals can help build the bridge between museums and the new digital world.	Few
Adaptability of developed games (e.g. ulterior small changes may be costly or impossible)	Few
Dependence on 3rd party infrastructure (e.g. changing terms of use, licence costs)	Few
Trustworthiness of data from 3rd party providers	Few

Groups/communities that should be considered more when creating new digital products:

Older adults/elderly (e.g. difficulty interactive exhibits)	**Many**
People with disabilities (visual, hearing, mobility, cognitive, etc.)	**Many**
Individual on the autism spectrum	**Many**
Immigrants	Few

Individuals affected by the digital divide (e.g. children and young people with low education level, economic poverty)	**Many**
Young people	**Many**
Teenagers/adolescents	Few
Children/ School pupils (e.g. museum content difficult to understand)	**Many**
Families	**Many**
Women	Few
People from diverse backgrounds (e.g. people of colour, Indigenous communities)	Few
People from minority groups (e.g. LGBTQ+, linguistic minorities)	Few
People with barriers to physically visit the museum	Few

Organizational efforts towards inclusion:

Unclear/unknown policy	Few
Following European guidelines for digital platform accessibility	**Many**
Simplified (easy-to-read) version of online information	Few
Tactile exhibits and audio-guided applications for the visually impaired people	Few
Physical and collection (e.g. translations, audio guide, descriptive translations) accessibility for visitors/customers	**Many**
Provide content and services that are open and free to everyone	Few
Dedicated hiring program for people with disabilities	Few
Accessible digital materials and platform for educational activities with employees	Few
Universal accessibility: diversity, equity and inclusion are integrated in all facets of the work, both at workforce and business level.	**Many**
Inclusive and diverse workforce (e.g. gender equality policies, museum ethics framework)	**Many**
Recognition of minority voices	Few
Hybrid and flexible work set-up (e.g. remote work across multiple sites or from home)	Few
Digital accessibility is not fully implemented.	Few
Diversity and social inclusion considered for educational programs for visitors/customers	Few
Social inclusion is a key factor in their activities	**Many**
Follow general principles of inclusion, as evidenced by the recognized need to collect feedback from visitors.	**Many**

Examples of game/apps/platforms that could are considered best practices:

Assassin's Creed Odyssey	Few
Chronos App	Few
Rembrand Reality App	Few
Duolingo	Few
https://melodisseia.gr/	Few
Escape room training on the dangers of hackers and the mindful use of technology and the internet	Few
https://museotek.net/	Few
Museum of Cycladic Art Guide App (on Apple Store and Google Play)	Few

https://archaeologicalmuseums.gr/el	Few
Clio Muse app	Few
https://www.hellenic-cosmos.gr/feidias-vr	Few
Minecraft (education edition)	**Many**
Father and Son (Museo Archeologico di Napoli)	**Many**
Escape rooms	Few
AquaMANN	Few
Museum in your pocket App	Few
Past for Future	Few
A Life in Music	Few
Rally driving simulator	Few
Newspaper creation game (e.g. suitable for families, collaborative creation, and discovery)	Few
Horse anatomy (e.g. engaging for both adults and children)	Few
Biodiversity game (e.g. impact of mowing a lawn in terms of species affected/lost)	Few

4.3.2 TG3: Textile and fashion industry and professionals

They need games, gamification, and advanced digital technologies in order to:

Promote sustainable fashion, including zero waste, use of natural materials, reuse of materials, awareness on the energy footprint, and the concept of eco fashion.	**Majority**
Promote digitalization of fashion	**Majority**
Educate customers on the concepts related to sustainable fashion	**Majority**
Support slow fashion movement	**Many**
Educate staff (e.g. machine and tools, maintenance activities, highlight problems)	**Many**
Developing new products	Few
Stimulate recycling	Few
Engage users in creative activities for fabric design	Few

How they feel about the sector/industry:

Concerned about the trend of non-professionals "becoming fashion designers"	Few
Protecting IP rights (e.g. of designs) is too complex and costly process	**Majority**
The professionals in the domain only have minimal entrepreneurial knowledge	**Many**
There is a shortage of young professionals specializing in repair and small jobs (e.g. patterns)	**Many**
The willingness of the sector professionals to participate in volunteer activities is reduced	**Many**
Professionals in the sector need business advice and consultation services, as there is a lack of consistency, planning, target setting, audience selection and producer/supplier selection.	**Many**
Entrepreneurship knowledge and skills are highly important in the fashion industry (e.g. company organization and management, promoting a fashion brand, developing sales)	**Majority**
At a business level, the concept of inclusivity is not a priority for fashion designers	**Majority**

Requirements they have from games:

Ensure that multi-disciplinary designed games (e.g. game developers working together with fashion designers) convey ethically correct messages.	**Many**
Games could be used to promote understaffed jobs of the sector (e.g. repairs)	**Many**
Main end-user groups to be targeted when designing games: new generations (16-30 years old), women aged 50-65 with middle-to-high education and medium-to-high income; vulnerable groups (e.g. women trying to reintegrate in society)	Few
Hybrid games (e.g. mixing digital activities with paper/pen ones)	Few

For which target audiences they want to build games:

Customers	Few
New/ Novice employees	**Many**
Employers	Few
Young people	**Many**
Students in the domain	Few
People with language accessibility barriers (e.g. immigrants)	Few
Fashion brands	Few
Programmers and communication designers	Few

Main obstacles to integrate/adopt advanced technologies and games in the fashion and textile industry sectors:

The majority of fashion designers prefer and still use analogue design methods (pencil and paper)	**Majority**
Technology tools are not used in an optimal manner (e.g. sending files via photo or using a scanner)	**Majority**
Age factors, as older designers/workers (e.g. over 55) have limited knowledge of domain-specific and general digital tools (e.g. struggle even with email)	**Majority**
Limited knowledge/experience/awareness in the use of serious games and gamification elements in sector-specific educational activities	**Many**
Limited knowledge on storytelling and its use in the context of business development	Few
Lack of work resources (e.g. time) to test/experiment	Few
Bureaucracy and legislation issues	Few
Little diffusion and misinformation	Few

Factors that facilitate/enable adoption and integration of advanced technologies and games in the fashion and textile industry sectors:

Professionals are willing to learn to use some digital tools	**Majority**
Professionals understand the importance of storytelling for business development (e.g. branding, marketing)	Few
AI tools (text-to-text, text-to-image, transcription) can be useful to generate content for marketing activities and campaigns, or for inspiration	Few
Existence of educational opportunities in this field	**Many**
Existence of young personnel in the company/organization	Few
Increased digitization at organization level	Few

Groups/communities that should be considered more when creating new digital products:

Minority groups	**Many**
Ethnic groups	Few
Immigrants	Few
People who face difficulties on the job market	Few

Organizational efforts towards inclusion:

Certified for gender equality and inclusion	Few
Inclusion and accessibility considered for all activities organized	Few
Inclusion at workforce level	Few
Language accessibility	Few

Best practices - Themes for narratives for business or product promotion, or education:

Elements of nature	Few
History	Few
Art	Few
The life cycle of a garment	Few
The history of materials - fabrics	Few
Bringing meaning to users' lives so that the fabric has positive impact on their health and economic status	Few

Best practices - Examples of games:

Design Home app	Few
Aurora dressup games	Few
Animation Gucci & Hermes	Few
Mindcraft	Few
Covet	Few
Clone Evolution	Few
Fashion Guru, figure plan	Few
Duolingo	Few
Kahoot!	Few
Junker App	Few

Best practices - Other examples:

Digital twin of the fabrics archive	Few

4.3.3 TG6: Game co-creators

Games they are interested to create:

Advergaming type, which emulate certain risks and consuming them can save lives, raise awareness, and educate the user.	Few
Gamification for social construction and community discussion.	Few

Games targeting to train soft skills, in particular to empathize or communicate with people with different cultural background (e.g. different traditions).	Few
These games could be a perfect tool for teachers in high school to create a complete syllabus with the freshness and fun of game playing.	Few
Serious games for parents, which could help them with their children' studies.	Few
Games that would bridge museum and entertainment to bring culture to people who face physical or mental barriers.	Few
Games that target conservation and preservation of history.	Few
Multi-lingual games	Few
Games that are bridging the inter-generational gap.	Few
Games that teach digital accessibility	Few
Games that build social bridges between people with disabilities and the rest of the society.	Few
Games that explain and describe museum/fashion assets in a plain language (e.g. not using too technical terms).	Few
Games that can be distributed and played on diverse platforms (Steam, Itch.io, iOS, Android, Xbox, Nintendo Switch).	Few
Gamify educational content for university students (e.g. sociology modules)	Few
Games that convey exhibition materials in an interactive and immersive way	**Many**
Games that promote simple yet clever solutions to drive attention to the exhibit (e.g. making it fun for children, will also draw attention of parents/adults)	**Many**

Concerns they have and obstacles they see in regard to adoption of games by museums and cultural organizations:

Games always come with context, where budgets, workloads, etc. are enormous for large games.	**Many**
Questioning the extent to which museums need to develop and create games along with their exhibitions.	Few
Games are complex developments, many of which fail.	**Many**
Museums should not focus much on making games, but rather focus on the stories they have (e.g. the whole spatial experience)	Few
Competition with commercial games is hard, thus being difficult for museum games to be attractive outside the museum environment.	**Many**
Games need continuous updates and are difficult to be maintained for long time (e.g. to maintain novelty).	Few
Museum customers may be disappointed/frustrated by low budget and poor-quality serious games.	Few
The purpose of the game should be clear (e.g. educational or just an entertaining activity)	**Many**
Mismatch between the technical requirements of a game and the available museum infrastructure, e.g. along with the game, the technical specifications/documentation should also be provided.	**Many**

Requirements regarding the game design and development:

Creation of in-game community and communication	Few
Options to personalize in-game settings	Few
Support of in-game language translation	Few
Games should have a clear educational objective	Few

The game should be an inclusive space, where people with diverse abilities and backgrounds find themselves (e.g. diverse NPCs).	Few

***For* which target audiences they want to build games:**

Children/ School pupils	**Many**
Young people	**Many**
Parents	Few
People who face physical or mental barriers	Few
Older adults	Few
Lonely individuals	Few
People who have locational restrictions or are living in remote places (e.g. difficult physical access to museums, agoraphobia)	Few
People who have vision impairment (e.g. not being able to visualize physical objects in an exhibition or patterns of a fabric)	Few

4.3.4 TG7: Game industry

Games they are interested to create:

Providing gamified environments and interactive features to museums.	Few
Serious games for adults to play, as they have lost interest in playing and having fun (e.g. they do not play neither with board games, nor with video games)	Few
Building games for educational environments.	**Many**
Games that have social impact, raising awareness on issues such as mental health and various social problems.	Few
Games for language learning.	Few
Games for the health environment, targeting to improve certain medical-health related aspects.	**Many**
Games for business tasks.	Few
Games for preserving history and heritage.	Few
Games for training soft skills.	Few
Games that simulate real-world cultural artefacts	Few
Games that have health/well-being impact (e.g. promote change of behaviour)	Few

Requirements regarding the game design and development:

The appropriate rules and design should be used when targeting a group with some form of disability	**Many**
Target a wider audience, and incorporate elements to include some specific groups, this way more people can play without losing the overall game appeal.	**Many**
Provide motivation to players to identify with the game (e.g. Points, rewards, museum gifts)	Few
Facilitate game community creation linked to potential attraction to museum/culture	Few
Provide means to make players feel they have power (e.g. Impact, influence) in the game (e.g. Their in-game actions may change the game course for following visitors)	Few
Make players feel more capable and smarter	Few

Provide means for the player to identify with the game hero	Few
Make players feel they belong to the game's world	Few
Cater for different player types (e.g. competitive vs cooperation)	Few
In order to be inclusive, the game must be playable without many instructions	Few
Design a personalized in-game experience capable of generating journeys based on the user's own narrative.	Few
The games should have a clear and simple loop: challenge and reward.	Few
By definition, the game must be fun, independent of the learning or education dimension.	Few
Make clear what the game is "selling" (promoting) in relation to the cultural dimension.	Few
Trigger curiosity mechanisms to lead to exploration and learning.	**Many**

5 GAMES: CONTEXT OF USE AND USER NEEDS

This section focuses on aggregating the main outcomes of the desk and field research for the two main i-Game groups of stakeholders, TG1 and TG3, which are interested in exploiting the platform and co-creation processes to create innovative products and services for their customers.

5.1 Context of use and needs from games for TG1

5.1.1 Needs and objectives for using video games and digital technologies

Purpose and Goals:

- Enhance cultural exhibitions by making them more interactive and engaging.
- Educate visitors about art, culture, and history through participatory processes.
- Expand audience reach, including traditionally excluded or underrepresented groups.
- Complement material exhibitions with playful, engaging tools.
- Convey scientific and cultural information interactively, fostering critical thinking.
- Promote empathy and deeper emotional connections with cultural content.
- Increase human interaction and dialogue around museum collections.
- Showcase cultural heritage through alternative media and storytelling.
- Optimize social, economic, and environmental returns.
- Initiate discussions on taboo topics and foster understanding across generations.

Applications in Practice:

- Develop alternative perspectives on museum artifacts.
- Engage audiences by connecting art with viewers in meaningful ways.
- Address diverse learning needs through adaptable and inclusive games.

5.1.2 Perceptions and attitudes toward video games and technology

Positive Perceptions:

- Video games are recognized as powerful educational tools.
- Growing openness in museums to experiment with digital technologies and games.
- Games can bridge gaps between museum collections and visitors.
- Increasing acknowledgment of the importance of engaging diverse target groups.

Concerns and Hesitations:

- Fear of high costs and quick obsolescence of digital tools.
- Concerns about copyright infringement and historical inaccuracies in games.
- Resistance among older staff toward adopting new technologies.
- Challenges in balancing digital innovation with core museum values.
- Perceived lack of relevance or limited impact on audience growth.
- Worries about the environmental footprint of digital tools.

5.1.3 Requirements for games and gamification in museums

Game Design and Content Integration:

- Games should align with museum goals, narratives, and collections.
- Ensure contextual and cultural accuracy, avoiding historical distortion.
- Facilitate educational and emotional experiences tied to exhibitions.
- Incorporate elements that support collaboration and inclusivity.

Technical and Functional Aspects:

- Games must be short and designed for museum contexts (e.g., onsite use).
- AI-driven personalization to cater to diverse audience preferences should be considered.
- Developing standardized, adaptable solutions to save time and resources was highlighted.
- There is a need to align digital experiences with visitors' skills and expectations.
- Facilitating user feedback mechanisms at various steps is seen as important.

Target Groups:

- Cater to diverse audiences, including children, teenagers, older adults, families, and educators.
- Design for individuals with disabilities, neurodiverse populations, and underserved communities.

5.1.4 Challenges and Obstacles in Adopting Technologies

Key Barriers:

- Lack of financial, human, and technical resources.
- Low digital literacy and resistance to new technologies among staff.
- Complex IP laws and bureaucratic hurdles in accessing digital assets.
- High production costs and competing with commercial games.
- Difficulty balancing diverse audience needs and game relevance.
- Concerns about technology’s sustainability and maintenance requirements.

Workforce Challenges:

- Limited expertise and training in game development.
- Aging workforce with low adaptability to digital tools.
- Workforce operating at full capacity, leaving little room for skill enhancement.

5.1.5 Enabling Factors for Adoption and Integration

Strategies for Success:

- Enhance digital maturity and literacy within museums.
- Promote training and familiarization with games in cultural contexts.
- Establish multidisciplinary collaboration and expert reviews.
- Engage diverse audiences in game co-creation processes.
- Secure policy support and funding opportunities.
- Encourage inclusion of digital tools in organizational strategies and operations.
- Use game jams and workshops to involve staff and stakeholders in the development process.

5.1.6 Target Audiences and Inclusivity Considerations

Diverse Target Groups:

- All age groups, from children to older adults.
- Families, educators, and lifelong learners.
- Neurodiverse individuals, people with disabilities, and marginalized communities.
- People are unable to physically access museums (e.g., rural areas, hospitalized individuals).

Inclusion Efforts:

- Ensure universal accessibility of content and platforms.
- Develop tactile exhibits and audio guides for visually impaired individuals.
- Create simplified content for those with lower education levels.
- Employ diverse and inclusive hiring practices.
- Follow global standards for digital accessibility and inclusion.

5.1.7 Examples and Best Practices

Successful Implementations:

- **Games and Apps:** Assassin's Creed Odyssey, Minecraft Education Edition, Father, and Son.
- **Interactive Platforms:** Museum of Cycladic Art Guide App, Clio Muse, AquaMANN.
- **Engaging Activities:** Escape room scenarios for cybersecurity training, biodiversity games, and newspaper creation games.

Key Takeaways:

- Focus on storytelling and user engagement to enhance learning.
- Use collaborative and competitive elements to foster deeper connections with museum content.
- An easy way-around is adapting successful commercial games for educational and cultural use.

5.2 Context of use and needs from games for TG3

5.2.1 Needs for Games, Gamification, and Advanced Digital Technologies

- **Common Goals**:
  - Promote sustainability (e.g., eco-fashion, zero waste, responsible consumption).
  - Enhance consumer interaction and education on sustainable fashion.
  - Support the digitalization of fashion processes and access.
  - Boost creativity, education, and community engagement.
  - Provide immersive and personalized experiences (e.g., VR/AR try-ons).
  - Address traceability and authenticity challenges.
  - Foster innovative marketing strategies.

5.2.2 Perceptions and Concerns

- **Positive Aspects**:
  - Games as tools for audience expansion, accessibility, and brand engagement.
  - Potential for enhanced user experience and new revenue streams.
- **Challenges**:
  - Risk of diluting luxury image or exclusivity.
  - Limited technical skills in game and digital design.
  - Resistance to technology due to age and preference for traditional methods.

5.2.3 Requirements for Effective Integration

- **Game Design**:
  - Multidisciplinary collaboration for ethical and sector-relevant games.
  - Inclusivity for diverse audiences, including younger generations and vulnerable groups.
  - Support creative and interactive activities (e.g., fabric design, user-generated content).
  - Promote ethical and sustainable practices through gamified actions.
  - Ensure accessibility (language, motivational factors) and usability for all age groups.
- **Technology Integration**:
  - Provide tools for real-time simulation (e.g., virtual try-ons).
  - Offer hybrid options combining digital and traditional methods.
  - Build a feedback loop for the industry using user activity data.

5.2.4 Obstacles to Adoption

- Preference for analogue methods and limited digital awareness.
- Age-related challenges with technology adoption.
- Resource constraints (time, knowledge, workforce).
- Bureaucracy and misinformation about advanced technologies.

5.2.5 Enablers for Adoption

- Positive user acceptance of VR/AR.
- Growing digitization and interest in storytelling for branding.
- Availability of AI tools for content creation and inspiration.
- Support for educational initiatives in the field.

5.2.6 Key Stakeholders for Co-Creation

- Artists, fashion designers, game designers, and tech developers.
- Consumers, recycling companies, and researchers.
- Ethnic and minority groups, and those facing job market difficulties.

5.2.7 Target Audiences for Games

- Customers and new employees.
- Young people and students in the domain.
- Vulnerable populations and fashion brands.

5.2.8 Best Practices and Examples

- Narratives that resonate: Nature, history, fabric life cycles, and user impact stories.
- Successful game examples: Covet, Kahoot!, Duolingo, Junker App.
- Innovation examples: Digital twin archives and animation projects.

5.3 Conclusion

The aggregation and synthesis in this chapter highlights major aspects which are shared across both research actions (desk and field research).

Museums aim to use video games and digital technologies to make exhibitions interactive, educate audiences, and broaden access. They focus on fostering empathy, critical thinking, and dialogue, while

optimizing social and economic impacts. While games are recognized as effective educational tools, there are hesitations around costs, obsolescence, historical accuracy, and digital adoption, especially among older staff. Games must align with museum narratives, facilitate collaboration, and cater to diverse audiences. They should be short, engaging, and adaptable to visitors' preferences, ensuring cultural and contextual accuracy. Key obstacles include limited resources, low digital literacy, high production costs, and complex IP laws. Resistance to new technologies and difficulties balancing diverse audience needs are also significant barriers. Success relies on enhanced digital literacy, multidisciplinary collaboration, policy support, and inclusive co-creation processes. Workshops and game jams are effective for engaging stakeholders.

The fashion and textile industry seeks to use games, gamification, and advanced technologies to promote sustainability, improve customer interaction, enhance digitalization, and foster creativity. Games, gamification combined with tools like VR/AR, are seen as opportunities for audience engagement and innovation, as they can enable immersive, personalized, and educational experiences for their customers. However, concerns about maintaining brand exclusivity and limited technical expertise remain prevalent. Adoption is hindered by analogue preferences, digital illiteracy among older workers, resource constraints, and bureaucracy.

6 CONCLUSIONS

The research performed in the first year of the project in T2.2 Context and needs analysis and described in this document, was guided by the Research Framework established in T2.1 Design of the research framework and presented in Chapter 2. The Research Framework is a foundational blueprint for understanding stakeholder needs and context of use of the i-Game platform and demonstrators. The framework adopts a dual approach:

- **Desk Research**: Systematic review of existing literature, policy documents, and case studies to identify trends, opportunities, and gaps in gaming, culture, and creative sectors.
- **Field Research**: Direct engagement with stakeholders via interviews, focus groups, and surveys to capture real-world insights and address specific needs.

The objectives of the research include analysing gaming technologies, methodologies, and accessibility solutions; understanding stakeholder contexts and needs; and analysing and synthesizing information to inform other work packages. Ethical and legal considerations are paramount, ensuring data privacy and compliance with GDPR. Chapter 2 also provides a timeline, ensuring structured research progression and adaptability to emerging insights.

Chapter 3 presents findings of a comprehensive analysis of the gaming landscape. Each section explores a different research area, as identified in the Research Framework. The analysis showed that video games are positioned as transformative tools for enhancing visitor engagement in museums and cultural institutions. Challenges include funding constraints, digitization complexities, and the need for collaboration between museums and game developers. Successful integration relies on creating cost-effective, educational, and historically accurate games. The textile and fashion sectors can leverage gamification and digital tools to promote sustainability, creativity, and efficiency. Games and virtual experiences are being used to enhance consumer awareness of ethical practices, while technology integration drives innovation in design and production. Gamification and co-creation are seen as state-of-the art methods to foster creativity and inclusion. In particular, game development benefits from collaborative tools and platforms that enhance creativity and streamline processes. Frameworks for team collaboration, task management, and user feedback play a critical role in ensuring inclusive and efficient co-creation. The game co-creation must account for factors that enhance player engagement, including storytelling, interface design, and psychological motivators. Both, positive impacts of gaming on skill development, emotional well-being, and social behaviour, and risk factors and negative impacts on daily life (e.g. infinite play, economic spending, sedentarism, addiction, etc.) must be considered in the videogame design process. The importance of legal and ethical considerations in game co-design is highlighted, including intellectual property rights, data privacy, and the implications of AI-generated content. Also, it is important to identify and select the appropriate methodologies to measure the societal and economic impacts of serious games, and the mechanisms that can facilitate the sustainability of i-Game like initiatives. The outcomes of this analysis are summarized in the last section of the chapter, which analyses the needs, challenges, and contexts of the main stakeholder groups involved in the i-Game project. It provides a detailed understanding of how stakeholders can benefit from game co-creation and use while identifying barriers and facilitators. Museum professionals seek tools and frameworks that promote audience engagement, cultural preservation, and educational outreach, but are facing challenges related to limited funding, lack of technical expertise and difficulties in digitizing cultural resources. The collaboration with game developers could support them towards leveraging innovative technologies (e.g. AR/VR, SGs, AI) to create engaging visitor experiences. Museum visitors need interactive and immersive experiences that make cultural content more engaging and accessible, but the main challenges are bridging the gap between traditional museum-goers and gamers and addressing diverse digital literacy levels. Textile and fashion industry professionals need gamified solutions to enhance design creativity, promote sustainable practices, and improve customer engagement. These can be facilitated by cross-industry collaboration and the promotion of ethical and sustainable practices through gamification. The main challenges are resistance to technological adoption in traditional workflows and cost barriers. Textile and fashion customers could benefit from games that raise awareness about sustainable fashion and offer personalized, interactive experiences. However, the adoption is hindered by the difficulties in

overcoming generational and cultural gaps. The main need of game players is to have access to games that are engaging and cater to diverse interests and abilities. The game co-creators need collaborative platforms that support inclusive game design, enable creativity, and incorporate feedback from diverse stakeholders (e.g. ensuring diverse representation). A major challenge for them is balancing creative freedom with cultural and ethical considerations. The game industry professionals, while interested to contribute and help co-create games in collaboration with the museums and the fashion industry, their main concerns are related to the communication difficulties (e.g. unrealistic expectations of end users) due to missing domain knowledge on both sides. Navigating regulatory and ethical frameworks also represents a challenge for them. All groups emphasize the importance of collaboration in order to maximize impact, once the main barriers (e.g. high costs, limited digital skills in the cultural/fashion domains, institutional resistance to adopting new technologies) are overcome.

The Field Research presented in Chapter 4, complements Desk Research by capturing real-world perspectives. It aims to validate theoretical findings and provide granular insights into stakeholder needs, motivations, and challenges. The research employs qualitative and quantitative methods, including structured and semi-structured interviews, focus groups, and surveys. Stakeholder selection criteria are outlined to ensure diverse and representative participation. Data collection emphasizes ethical standards, including informed consent and data anonymization. Similar to the desk research outcomes, collaboration across domains emerges as a critical factor for success, as interdisciplinary partnerships can address resources and skill gaps while fostering innovation. Also, the main challenges in adoption of games and advanced technologies are related to the financial constraints, resistance to change and lack of technical expertise. This creates an opportunity for the i-Game platform and ecosystem to support partnerships between museums, fashion professionals and the gaming industry to foster mutual growth and social inclusion.

In conclusion, the research highlights the transformative potential of the i-Game platform in promoting co-creation and inclusivity of videogames in the cultural context, and sustainability and circular economy for the fashion industry. Stakeholders value games for their ability to engage, educate, and innovate. However, accessibility and ethical considerations are critical for broad adoption, and collaboration between sectors is essential for addressing challenges and maximizing impact.

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8 APPENDIXES

8.1 Appendix A1: Innovative technologies, games, and good practices in museums

8.1.1 Estonian National Museum (ENM) - Findings

#	TITLE	LINK	Relevance Section / Impact-Outcome area
1	Designing for Play and Appropriation in Museum Experiences involving Tangible Interactions and Digital Technologies	https://dl.acm.org/doi/10.1145/3383668.3419957	A 1/7
	Following a research-through-design method, the focus of this study is to explore how to design experiences that facilitate play and appropriation in the GLAM space and provide insights into ways that this appropriation can be used to redesign the experience.		
2	Digital games in the museum: perspectives and priorities in video game design	https://www.zotero.org/groups/5436521/igame/collections/5G4RCFN2/items/YRGWPTL3/attachment/JLT82VNI/reader	A, E 1/5/7
	Digital games are seen as ways of recreating historic worlds, affording empathetic and affective engagement, and increasing interest in and understanding of historical periods or processes, working in complementarity with material exhibitions and artefacts on display. Stakeholders engaged in the development of digital games, however, may have different views of what constitutes significant knowledge and priorities.		
3	Games as tools for dialogic teaching and learning	https://www.zotero.org/groups/5436521/igame/collections/5G4RCFN2/items/I3BBH9D3/attachment/XYUJG9LS/reader	A, F, 1, 5
	The chapter introduces a pedagogical model for researching and designing how games can become tools for teaching and learning.		
4	Serious Games in Cultural Heritage: A review of Practices and Considerations	https://www.zotero.org/groups/5436521/igame/collections/5G4RCFN2/items/RNKQ7A4P/attachment/JHLI2HXY/reader	A, 1/2/5
	This work aimed to identify design practices and considerations in the design of location-based games. This work is intended for educators, researchers, instructional designers, game developers, and those in the CH field interested in exploring creative ways to embody a deeper understanding of and appreciation for CH.		
5	A model of heritage content to support the design and analysis of video games for history education	https://link.springer.com/article/10.1007/s40692-018-0120-2	A, 1,
	The article presents a model that defines how historical information can be embedded in video games. This model relies heavily on collaboration between heritage experts, game designers, and educators to ensure that the content is both accurate and engaging. Collaborative efforts between game developers and cultural institutions can enhance the authenticity and educational value of serious games for heritage applications. By incorporating input from cultural organizations and museums, game developers can ensure that the historical information presented in games is accurate, engaging, and aligned with educational objectives. The article introduces a novel methodology based on activity theory to guide the design of serious games with pre-defined heritage instructional content		
6	Co-Designing the User Experience of Location-Based Games for a Network of Museums: Involving Cultural Heritage Professionals and Local Communities	https://www.mdpi.com/2414-4088/6/5/36	D, 3/6
	The design of location-based games (LBGs) for cultural heritage should ensure the active participation and contribution of local communities and heritage professionals to achieve contextual relevance, importance, and content validity. This paper presents an approach and methods of the participatory and co-design of LBGs that promote awareness and learning about the intangible cultural heritage of craftsmanship and artisanal technology throughout a long-term project from sensitization to implementation		

7	Gaming for affect: museum online games and the embrace of empathy	https://www.zotero.org/groups/5436521/igame/collections/5G4RCFN2/items/26QW3D85/attachment/366FBZJ6/reader	E, 1
	What kinds of narrative worlds should museums seek to construct? What kinds of experiences do visitors expect – and crave – within these encounters? Finally, what is the relationship between the games, users' experiences of them, and the larger narratives museums construct across multiple sites and media?		
8	Do Game Designers' Decisions Related to Visual Activities Affect Knowledge Acquisition in Cultural Heritage Games? An Evaluation From a Human Cognitive Processing Perspective	https://dl.acm.org/doi/10.1145/3292057	E, 6
	There is evidence that individual differences in the inherent way people search, process, analyse, comprehend, store, and retrieve visual information in their surrounding environment are reflected in their performance, experience, effectiveness, and efficiency in such environments. Even though cultural heritage game designers favour learning experiences in such contexts, current design and evaluation practices of cultural heritage games barely consider the gamers' individual differences in visual information processing.		
9	Enhanced Inclusion through Advanced Immersion in Cultural Heritage: A Holistic Framework in Virtual Museology	https://www.mdpi.com/2079-9292/13/7/1396	E, 6
	The digital representations of artifacts, paintings, books, and collections, as well as buildings or archaeological sites, has led to the transfer of cultural organizations to the digital space. This digital transition should expand its impact on most of the population. This article aims to cover the lack of structured methodology in the design and development of inclusive virtual spaces in cultural heritage. It introduces a holistic framework for even more inclusive and immersive user experiences in digital cultural heritage, through the interconnection of extended reality, the creative industry of computer games, and emerging technologies of haptics and olfactory, in alignment with the requirements of virtual museology		
10	Digital Learning and Education in Museums. Innovative approaches and insights	https://www.ne-mo.org/news-events/article/nemo-report-on-digital-learning-and-education-in-museums	A, C, F, 1
	The report emerged from the NEMO working group LEM (The Learning Museum). It highlights various formats of digital engagement and innovative approaches to digital learning and education, as well as insights and recommendations from museum professionals and experts from the tech sector.		
11	Museums and Technology: Being inclusive helps accessibility for all	Curator, Vol 56, 3, 2013	A, E, F - 3,6,7
	The authors are people with different disabilities, and they describe personal experiences, giving a sense of the various barriers and benefits that are involved. The aim of this paper is to provide museums with a disabled person's point of view, which could help in inspiring improvements for the future.		
12	The Digital transformation agenda and GLAMs	https://digipathways.co.uk/resources/the-digital-transformation-agenda-and-glams/	B, 2
	Study on UK GLAM sector's readiness or digital transformation, focusing on concepts, such as digital transformation, digital maturity, digital literacy, digital skills and addresses capacity-building within the organizations. The digital divide is an issue for the public and society globally, but it also exists within GLAMs and matters to the people working inside them. The digital divide is about digital understanding as well as access.		
13	Game-based design for Inclusive and Accessible digital exhibits	https://futures.clir.org/game-based-design/	D, 1

	The article explores applying gaming for digital exhibits in the libraries and discusses how game-based exhibits facilitate reaching the audiences that have been excluded from library exhibits and those who may be included through gaming. Video games, though popular, have since their inception embedded issues of diversity. The article addresses practices, interactions, expertise and learning that should be generated around digital exhibitions. It offers an overview of the many ways that gaming can be used to make more-inclusive digital exhibits for people with diverse backgrounds (e.g., disabled, Lesbian, Gay, Bisexual, Trans, Queer, Intersex, Asexual or Ally (LGBTQIA+), Black, Indigenous, and other minoritized groups).		
14	Learning cultural heritage by serious games	https://www.sciencedirect.com/science/article/abs/pii/S1296207413001349	A, 1
	Serious games – videogames designed for educational objectives – appear as a new tool to learn cultural content in an engaging way. In this paper, we will provide an extensive portrait of the current proposition of serious games in the cultural sector, highlighting the educational objectives of games in this domain and analysing the complex relations between genre, context of use, technological solutions and learning effectiveness. We finally identify and discuss the most significant challenges in the design and adoption of educational games in cultural heritage.		
15	Play in museums: a scoping review	https://www.zotero.org/groups/5436521/igame/collections/5G4RCFN2/items/8I46LXE6/attachment/IEPM7MG4/reader	A, 1/3
	Not addressing video games, but relevant. This article presents a quantitative scoping review of play in museums, focusing on when, where, and how play has been applied and researched. The main objective of this study is to take a first step in terms of mapping play in museums by conducting a scoping review (Arksey and O'Malley 2005) that systematically identifies where, when, and how play has been applied and researched in museums. The aim is to provide a comprehensive overview of the existing research literature. Specifically, the focus on the concept of play itself, excluding games or edutainment unless they are defined or described as play.		
16	The Use of Serious Games in Museum Visits and Exhibitions: A Systematic Mapping Study	https://ieeexplore.ieee.org/document/7590371	A, E, 1/6
	This paper aims to present a systematic mapping study on modern museum gaming technologies and applications. More specifically, focus is given on the use of Serious Games (SGs) by the visitors during exhibition navigation and exploration of the museum's cultural and educational content. Major analysis criteria and review findings include game goals, purpose of use, scope, user acceptance and educational effectiveness.		
17	Videogames and the Public Museum	https://www.zotero.org/groups/5436521/igame/collections/5G4RCFN2/items/XNF2A8A2/attachment/G4NM4RXS/reader	A, D, 1/3/5/7
	PhD thesis based on ethnographic study about designing video games in a museum setting (Victoria and Albert) exploring how video games complicate the work of museums.		
18	When museums meet videogames handbook	https://www.zotero.org/groups/5436521/igame/collections/5G4RCFN2/items/E6Z8MQDL/attachment/6ZXFNEI7/reader	A, 1/2
	Overview of the state of the art, challenges. Intro material for the museums regarding the video games sector. The potential of video games for museums is limitless. However, the relationship between the creative and the cultural sectors is still full of pitfalls. Museums often digitize their collections without considering how they appear in digital native environments, while production studios do not pay enough attention to the historical and scientific context that museums provide. Museums also struggle to pass on a sense of ownership and leadership to their audiences. Thus, it is clear that the relationship between museums and video game studios remains complex and requires further examination.		

	Audience participation in museums: Game Design as Learning Activity	https://www.researchgate.net/publication/236901140_Audience_participation_in_museums_Game_Design_as_Learning_Activity/link/02e7e51b1a7af6cdf9000000/download?_tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6InB1YmxpY2F0aW9uIiwicGFnZSI6InB1YmxpY2F0aW9uIn19	C, 1,5,6
19	Article discusses game design as an example of museum audience participatory activity and identifies its learning dimensions. In particular, it elaborates on the role of technology in providing a scaffold that can help museum audience to construct games which can function as "public artifacts" and can be added to the museum's assets, enhancing audience engagement and community building. Game creation in cultural institutions as participatory learning activity should be integrated in activities that will give the chance to visitors to interact with museum staff and discuss, negotiate, and integrate in their games different aspects of cultural content. It becomes apparent then that if we want to employ game design in cultural experience, we need to create a platform that engages users with what is considered crucial for cultural experience.		
	The State of Play: An exploration of games and their value in museum exhibitions	https://www.semanticscholar.org/paper/The-State-of-Play%3A-An-Exploration-of-Games-and-in%C2%A0-Berndt/fc39aedfb36b3bbf6c8a7a988321d5d0b2286f6c	A, B, 1, 5, 7
20	What do practitioners currently think about games in museum exhibitions and how could museum games be improved? Case study: Museum of New Zealand, Te Papa Tongarewa (MA thesis). The research findings illuminate the current understanding of games and factors that inhibit the successful implementation of games at Te Papa. It was found that practitioners thought games in exhibitions at the museum have not been particularly successful in achieving either the goals of exhibitions or the potential that games offer. It is concluded that the introduction of theories on play and on games into museum theory and practice has potential for significant advances in this area of exhibition development.		
	Co-designing Gaming Experiences for Museums with Teenagers	https://link.springer.com/chapter/10.1007/978-3-030-06134-0_5	D
	Throughout this paper, we discuss teenagers as an important group to be considered within the Children-Computer Interaction field, and we report some techniques on designing with teens, in particular, arguing that participatory design methods can involve teenagers in the design process of technology for museums. For this purpose, we conceptualized, designed, and deployed a co-design activity for teenagers (aged 15–17), where teenagers together with a researcher jointly created and designed a medium fidelity prototype. All the prototypes were made by the participants with the support and guidance of the researcher and the Aurasma software, an augmented reality tool.		
21	Digital Readiness and innovation in museums	https://knightfoundation.org/reports/digital-readiness-and-innovation-in-museums/	B, 5,7
	Report for understanding of digital readiness and innovation maturity in the museum sector (US), 2020		
	Analyzing the educational design, use and effect of spatial games for cultural heritage: A literature review. Computers and Education	https://www.zotero.org/groups/5436521/igame/collections/5G4RCFN2/items/MP2EGJ5Z/attachment/96UILUEK/reader	A, 5
22	Integrating game-based approaches with learning constitutes a prevailing trend in education and training, applied in several domains, one of which is cultural heritage. The present paper attempts a literature review of such approaches developed in the cultural domain.		

8.1.2 Museo del Tessuto di Prato (TMP) - Findings

#	TITLE	LINK	Relevance Section / Impact- Outcome area
1	A Virtual Reality Educational Game for the Ethics of Cultural Heritage Repatriation.	Link here	B, 5
	Provides a model for other institutions with game design and art history departments to collaborate and create educational experiences that optimize the user's experience and learning outcomes.		
2	Lessons Learned on Engaging Teenage Visitors in Museums with Story-Based and Game-Based Strategies.	Link here	E, 1
	It is challenging for a museum to remain exciting and relevant to a young, tech-savvy audience. Lessons learned that museum experience designers and curators can use in designing enjoyable, interactive experiences for teenage visitors.		
3	Mobile Serious Game for Enhancing User Experience in Museum.	Link here	E, 1
	In developing the game, we wondered whether it could appropriately motivate and engage different age groups in the museum experience with its challenges of different difficulty levels; whether a mobile game could, through its challenges interacting with the museum environment, prevent "head-down" behavior; and whether museum exhibits could be better recalled by visitors participating in a tour with a mobile game.		
4	Designing with teenagers: A teenage perspective on enhancing mobile museum experiences.	Link here	E, 3
	This work generates design recommendations for mobile museum tour guides for teenagers, to be used by both curators and museum designers in engaging teenagers in museum exhibitions. We also contrast the game and narrative mechanics produced by teenagers with what is already known.		
5	Interaction design for cultural heritage. A robotic cultural game for visiting the museum's inaccessible areas.	Link here	D, 1, 5, 7
	Remote visiting, space accessibility and new skills for both visitors and museums' staff. The paper describes the design of a roboethics activity conceived in codesign with museum stakeholders (Museum Guides, Museum Curators, Telecommunication Experts, Designers and Final Users)		
6	Gamification of Digital Heritage as an Approach to Improving Museum and Art Gallery Engagement for Blind and Partially Sighted Visitors.	Link here	E, 3, 6
	The implementation of 3D models as gamified objects can improve viewership, sharing, learning, and open discussion on redress for BPS members of historically excluded groups when it comes to their heritage.		
7	Comparison of gamified and non-gamified mixed reality in enhancing museum visitor engagement, motivation, and learning outcome	Link here	E, 3
	The findings indicate that while gamification significantly boosts the reward dimension of visitor engagement, its influence is most pronounced in the effort dimension of motivation; however, its impact on learning outcomes is less marked. Combination of a tech tool as VR and gamified experience.		
9	Gamification Practices in Museums	Link here	A, 5
	Identify possible gamification methods in museums and explore the impact of gamification on the visitor experience. // In addition to the benefits of gamification, some difficulties and challenges were also explored.		

11	Museums and the Post-Digital: Revisiting Challenges in the Digital Transformation of Museums	Link here	A, C, 1
	This essay shows that, although digital technologies have acquired a normative presence, organisational and technical challenges in the "backstage" of museums pose systemic problems in their digital transformation.		
12	Exploring the Impact of an IoT-based Game on the Experience of Visitors at a Natural Science Museum	Link here	E
13	Gamification and cultural institutions in cultural heritage promotion: a successful example from Italy	Link here	F, 5
	The research highlights the changing practices of cultural institutions, which are increasingly involved in producing serious games, considering them as strategic digital marketing tools to promote cultural heritage.		
14	A Systematic Literature Review of Gamification in/for Cultural Heritage: Leveling up, Going Beyond	Link here	A, 1
	It offers a panorama on the Sci Literature about cultural heritage and gamification based on type of tech tool, users, field, and future directions.		
15	Serious Games in Cultural Heritage: A Review of Practices and Considerations in the Design of Location-Based Games	Link here	A, D, 1, 7
	The study identifies elements in creating games in CH contexts. This work aimed to identify design practices and considerations in the design of Location-Based Games (like Pokemon Go). Focus on CH but it can also include cross-sectoral considerations.		

8.1.3 MuseoSpace Stichting (MSS) - Best Practices

The listed best practices are collected by attending the ***MuseumNext Game&Play Summits*** /Digital Summits. Access to the video presentations are only for signed participants available.

#	TITLE	LINK	Relevance Section / Impact-Outcome area
1	Young V&A - Playing the museum at Young V&A - UK	MuseumNext Game&Play Summits	F / C 1, 4, 6
	The Young V&A team uses video games to enhance engagement and challenge opinions on gaming. They advocate for play as a way of developing skills, being creative and having fun. Those spaces are a hive for creativity for a wide variety of ages playing together.		
2	National Gallery Singapore - Play at the Museum with a Children's Biennal - Singapore	MuseumNext Game&Play Summits	F / C 1, 4, 6
	The Gallery Children's Biennale is a special event at the National Gallery Singapore for kids and families. The use of the Pedagogy of Play helped them to identify diverse ways of engagement with artworks through co-creation, participatory art making, and multi-sensorial experiences. They reduced their digital offerings, to increase quality. As they understood their lack of expertise as a limiting factor, they called in the experts and game developers. They commissioned game development		

	for their core value areas "Care, Respect, Imagine, Collaborate".		
3	Art Fund and award-winning games studio - Sharing the lessons we learned making an ambitious new digital experience for The Wild Escape - UK	MuseumNext Game&Play Summits	F, E 2, 3
	Art Fund is an award-winning games studio PRELOADED. They share practical insights from The Wild Escape, a nation-wide digitally enabled celebration of UK wildlife and creativity that united hundreds of museums with schools and families.		
4	Museum of Applied Arts and Science - Gaming Community Engagement in Museums - Australia	MuseumNext Game&Play Summits	All
	Alysha Connor shed light on the diverse ways of consulting with the gaming community and how it can revolutionize curatorial, archival, and conservation practices. Through community consultation, they can embrace an innovative approach, forge connections with gamers, and reimagine the museum experience for future audiences.		
5	Rijksmuseum Amsterdam - Sherlocked - Designing an Escape Game in a Building Where Everything is Worth a Fortune - Netherlands	MuseumNext Game&Play Summits	F, E 4, 5,
	Designing an escape game in a well-known museum. From crafting a story based on the collection to secretly educating young players about art history. They shared lessons learned on the influence of timing, wording, things to watch out for, the use of actors and how to cater to both kids, adolescents, and adults. Through that they got 10.000 extra visitors to the museum in 3 months.		
6	National Gallery of Art - Double your online engagement through funseekers - USA	MuseumNext Game&Play Summits	F, E 4, 5,
	They consider the different audience segments that engage with museums on-site and online and found that the Funseeker is a powerful group in terms of engagement. They learn to tap into that fun-seeking motivation through online games.		
7	Wolverhampton Arts and Culture - The Multiverse of Museums	MuseumNext Game&Play Summits	F, A, D, E 1, 4, 5, 7
	Creating an art gallery in an alternate virtual reality that lets visitors explore in real time. Wolverhampton Art Gallery and Digital T students from Walsall College created a Roblox escape game in a dystopian version of reality. Looking for a place where creativity, technology, in person experience and digital discovery collide, the Escape the Gallery project was a jump into the deep end of hybrid gaming experiences with a steep learning curve and some fun along the way.		
8	Goosechase - From Distraction to Attraction: Using Tech to Enable an Engaged Visitor Experience	MuseumNext Game&Play Summits	F, A, D 1, 2, 4, 7
	Goosechase is an online platform that helps to create interactive experiences. Their vision is to be the interactive experience platform that allows people to engage,		

	educate, and activate communities through unforgettable experiences.		
9	Canada's Museums of Science and Innovation - Exploring Accessibility and Gaming in an Immersive Tractor Interactive	MuseumNext Game&Play Summits	F, D, E 1, 3, 6
	This presentation shared their key findings from the creation of “Farming Adventure”: an accessible and digitally immersive tractor game that encourages play and learning at the Canada Agriculture and Food Museum. Through collaboration with the accessible community, rapid prototyping, and user and accessibility testing, feedback was incorporated in multiple stages throughout the process, leading to a more inclusive and engaging experience for its many visitors.		
10	Fairfield Museum & History Centre - Building Community through Play: Low-Tech Strategies	MuseumNext Game&Play Summits	F, C, D, E 1, 5, 6
	The Museum balances serious and fun, aims to teach young people about the value of history, and builds a sense of community. While certain exhibition spaces and interactives are designed for children, the Museum builds opportunities for intergenerational and lifelong learning. They introduced the low-tech interpretation and audience engagement strategies that the Fairfield Museum uses to make history personal, engaging, and meaningful.		
11	San Francisco Museum of Modern Art - US / - Mission 57 / FableVision Studios - Testing 1-2-3: How to Playtest Your Game - USA	MuseumNext Game&Play Summits	F, A, B, C, E 7, 5, 1, 4
	Game playtesting - A few informal playtests can mean the difference between a game that is a successful light lift and a game that is broken, frustrating and hard to use. In this presentation, three experienced game designers and museum professionals explain how they test games in their spaces and give tips and tricks to make playtesting a regular, easy, and even fun part of the game design process!		
12	ACMI - Learning with videogames and a very naughty goose! -	MuseumNext Game&Play Summits	F, B, D, E 7, 5, 1
	ACMI‘s Game Lessons Library provides teachers with free lesson plans to bring the classroom syllabus alive and to get students engaged and excited. They showcase the indie-comedy hit game Untitled Goose Game and use it as a springboard for integrating media and literacy with reluctant readers to show how easy game-based learning can be.		
	Archivo-Museo Carmen Funes (Neuquén, Plaza Huincul) Museo Histórico Sarmiento (Buenos Aires) - Argentina	ICOM Article -	F, A, C, E 2, 3, 4
	The Museo Histórico Sarmiento (Buenos Aires) and the Archivo-Museo Carmen Funes (Neuquén, Plaza Huincul) have both succeeded in producing two video games based on their assets, both aimed at children. The first, entitled Búsqueda Interestelar [Interstellar Quest], belongs to the platform game genre, while the second, Carmen Funes, aventuras en al pasado [Carmen Funes, adventures in the past] belongs to the graphic adventure game genre.		

8.2 Appendix A2: Informed Consent Form Template

i-Game

Building a community for the co-creation of games with high impact on innovation, sustainability, social cohesion, and growth

HORIZON - 101132449

Informed Consent Form

Funded by
the European Union

GDPR AND DETAILED BACKGROUND INFORMATION

Thank you for your interest in participating in the activities of the EU-funded project "i-Game: Building a Community for the Co-creation of Games with High Impact on Innovation, Sustainability, Social Cohesion, and Growth."

The i-Game project is aiming at creating an accessible open-source game development platform that will facilitate the co-creation of games by diverse actors, in an inclusive approach by ensuring participation of under-represented groups, within different ecosystems of cultural and creative sectors and industries, to enhance innovation and to bring positive impact on social cohesion and sustainability.

The project consortium includes members of universities, law experts, technical experts, research organizations, user organizations from the culture, museum, fashion, and textile domains, as well as experts on inclusion. The EU (Horizon Europe) funds the project.

In order to ensure compliance with the General Data Protection Regulation (GDPR), we would like to provide you with important information regarding the processing of your personal data in the course of the project activities. The protection of your personal data is of particular concern to us.

Please read this document carefully and indicate your consent by signing at the bottom. If there is anything that is not clear, or if you would like more information please contact the research team (contact details below).

1. Purpose and procedure of data processing:

The personal data you provide will be used exclusively for establishing the context of use and analysing the needs and requirements in relation to the co-creation platform and the development of serious games for culture, museums, fashion, and textile industry, as part of the research project iGame.

Your interests, opinions, knowledge, experiences, and ideas, help the project team of i-Game to guide the design and development of the co-creation platform and of the pilot games.

For this process, personal information such as your name or your interests in regard to the project topics, or your experience with other innovative tools and approaches used in the culture and creative domains, including personal barriers, will be gathered, and processed by the project team. We will also gather your contact information (name, e-mail address, phone number) in order to contact you and inform you on the project activities. This data will not be associated, nor stored with any other personal or sensitive information (e.g. socio-demographic data) you provide while involved in the project activities.

If you choose to participate, you will be asked to:

1) participate in a focus group discussion or interview to help us understand which are the interests, needs, preferences, and best practices in your domain in regard to serious game usage and co-creation platforms and tools. The interview and focus group questions will also be included as an optional part in the survey at point (2), if you prefer to provide input in written format.
2) participate in an online anonymised survey to provide some socio-demographic information (e.g. gender, age, cultural background) and information related to your experience and expertise in regard to technologies use, digital skills, and serious games.

These research activities will respectively approximately take:

(1) approximately 45 minutes for the direct personal interview, and 1 hour and 30 minutes for the focus group discussion
(2) 15 minutes to answer the questions related to the socio-demographic information, and another 30 minutes if you opt to also do the interview or focus group discussion questions on written format.

Additionally, this consent form enables you to consent to:

3) be further reached out by the i-Game contact partner for additional research opportunities in the project's framework.
4) be signed up to the i-Game project newsletter. By subscribing to the i-Game newsletter, you confirm reading and agreeing with our privacy policy. You may unsubscribe at any time.

Important:
By providing your consent below, you will need to consent to the processing of your personal data for each of the specified activities. Please note that each consent request is independent, and you have the right to grant or deny consent for each processing activity individually. Your decision to consent or not to any specific activity will not affect your ability to provide or withhold consent for other activities. You are under no obligation to consent, and your choices will have no negative consequences on your collaboration with the i-Game project or our contact partner or any other aspect of your relationship with us.

2. Type of data collected and processed:

The personal data collected during this event include:

- **Personal Identifiable Information & Contact data**, including: first and last name, phone number and e-mail.
- **Socio-demographic information**, including age, gender, education level, cultural background, occupation, country of residence, residence location
- **Information related to expertise, work context, knowledge, and skills**, including area of expertise, job, years of experience, organization, digital and technology skills, digital accessibility needs and preference, language accessibility needs and preferences, serious games knowledge, and knowledge related to legal and ethical aspects of applied Information Technology (IT) and Artificial Intelligence (AI).
- **Audio recording of** [interview/ focus group] sessions will be used for notes-taking purposes (only) to prepare the aggregated data needed for the project deliverables and reports.

3. Responsible partner of the research activity

Personal Data gathered through your participation in this i-Game research activity will only be collected and processed by the partner that has contacted you in regard to your participation in the iGame project activities (hereafter contact partner). The data will not be shared with other project partners or third parties. In your case the partner responsible for the research activity (contact partner) is :
INSERT DATA :

- Institution Name
- Address
- tell if any
- email if any
- website if any

To participate in the survey, contact partners will reach out to the participants the focus group's participants and/or interviewees and provide them with a unique identifier to access the survey. The survey has been designed and is operated by Raising the Floor (RtF). However, they do not collect any personal data as the unique identifier does not enable identification of respondents. Raising the Floor (RtF) will do research on these aggregated and anonymized data related to socio-demographic information and the information related to expertise, work context, knowledge, and skills. Raising the Floor (RtF). RtF is responsible for the storage and processing of this data and will include these aggregated data needed for the project deliverables and reports.

4. Consequences of your participation and the provision of your data

The activity is limited to your participation in the iGame field research activities, which will involve one or more of the following data collection approaches: individual interview, focus group discussion, and online survey. You can withdraw your consent at any time.

There are no costs associated with your participation in the iGame project. Your information will have neither positive nor negative consequences and will not be processed for no other than the stated purpose. There are no right or wrong answers.

5. Data Processing and Security:

We assure you that your personal data will be processed lawfully, fairly, and transparently. The data gathered during the study will be used for analysis and included in the relevant deliverables of the project. Your data will only be used by the contact partner's staff for the specific purposes mentioned above and will be securely stored and protected against unauthorized access, loss, or disclosure. The collection of this data is solely based on your communication, and it will be processed in accordance with your consent and our legal obligation to be compliant with relevant legislation (e.g. GDPR). We store the information provided , and data transmitted by you during the contact request in order to process your participation and any follow-up questions that may arise.

We will not share your personal data with any third parties unless required by law or with your explicit consent. You have the right to withdraw this consent at any time. To do so, a simple email notification or a phone call to us is sufficient. Please note that the legality of data processing that occurred before the withdrawal will not be affected by this revocation.

6. Data Retention:

Your personal data will be retained for as long as necessary to fulfil the purposes mentioned above, and no longer than 5 years after the iGame project ends. After completion of the required processing and analysis, we will securely delete your personal data, unless you have explicitly consented to receiving further communications from us.

7. Participant Rights:

Under the GDPR, you may have the following rights regarding your personal data:

- Right to Access: You have the right to request access to the personal data we hold about you.
- Right to Rectification: You have the right to request the correction of any inaccurate or incomplete personal data we hold about you.

- Right to Erasure: You have the right to request the deletion of your personal data, under certain circumstances.
- Right to Restrict Processing: You have the right to request the restriction of processing your personal data, under certain circumstances.
- Right to Data Portability: You have the right to request a copy of your personal data in a structured, commonly used, and machine-readable format.
- Right to Object: You have the right to object to the processing of your personal data, under certain circumstances.
- Right to Withdraw Consent: If you have provided your consent for the processing of your personal data, you have the right to withdraw that consent at any time without any explanation.

8. More information

Ask us! If you have any questions about the project or your participation in it, you can contact [Contact Partner] or the international researchers in charge of the project activity (for contact information, see below) now or later.

If you want to get a better understanding of the i-Game project you can visit our website (igameproject.eu), check your activities on social media: LinkedIn.

In addition to the researcher in charge of the study and the data protection officer of [Contact Partner], you have the right to lodge a complaint with the National Data Protection Commission about the processing of your personal data by e-mail: [National Data Protection Contact - e-mail & phone].

By signing this form, you consent to the processing of your personal data by the contact partner of the iGame project in line with the provisions of the General Data Protection Regulation (GDPR). By signing below, you also confirm that you have read and understood the information provided in this document and that all the information you have provided is true and that you are 18 years of age or older.

Full Name: _____

Phone Number: _____

E-mail: _____

Please carefully read the following statements, and indicate your agreement/disagreement with YES or NO. As a reminder, each consent request is independent, and your decision to consent or not to any specific activity will not affect your ability to provide or withhold consent for other activities, nor will it have any negative consequences on your collaboration with i-Game or relationship with us.	YES/NO
1) I agree to participate in the focus group discussions /interviews.	
2) I agree to participate in the survey.	
3) I agree to be contacted by the contact partner for participation in future project activities related to i-Game.	
4) I agree to receive the i-Game project newsletter. By subscribing to the i-Game newsletter, you confirm reading and agreeing with our privacy policy. You may un-subscribe at any time.	

Signature:_____

Date: _____

If you have any questions or concerns regarding the processing of your personal data, please do not hesitate to contact the [Contact Partner]:

- Contact of Data Protection Officer of [Contact Partner]:

  [Name, e-mail, phone number]

- Contact of the researcher(s) in charge of the research activity by the i-Game contact partner.

  [Name, e-mail, phone number]

ii) Contact of Researchers responsible for the survey

Eva de Lera, Otilia Kocsis - eva@raisingthefloor.org; otilia@raisingthefloor.org; +306980139058

Thank you for your cooperation.

Sincerely

i-Game Project Team

8.3 Appendix A3: iGame Designing for Inclusion - guide for application and assessment of WCAG accessibility

This guide has been created by RtF in as a support document during the design and implementation activities, and it incorporates existing web accessibility information in a format that aims at making it easier to help iGame designers and developers. It is designed specifically for the iGame consortium use, and it will be further refined during the technical implementation, to account for all platform design choices (e.g. integrated functionality and tools) as these are shaped in the process (e.g. during the co-creation workshops).

WCAG ACCESSIBILITY ASSESSMENT
WCAG v2.2[242] (Oct 2023)
Test and Evaluate[243]
Accessibility Report Tool[244]

What is typically included in an accessibility assessment report?

- **About the Evaluation**
  - Report Creator
  - Evaluation Commissioner
  - Evaluation date
- **Executive Summary**
  - Description
- **Scope of the Evaluation**
  - Website name
  - Scope of the website
  - WCAG Version
  - 2.2 (for example)
  - Conformance target
  - AA (for example)
  - Accessibility support baseline
  - Additional evaluation requirements
- **Detailed Assessment Results**
- **Summary**

Reported on 0 of 55 WCAG 2.2 AA Success Criteria.

- 0 Passed
- 0 Failed
- 0 Cannot tell
- 0 Not present
- 55 Not checked

WCAG v2.2 Guidelines

Guideline num	Guideline	Level	Summary
1.1.1	Non-text Content	A	Provide text alternatives for non-text content
1.2.1	Audio-only and Video-only (Pre-recorded)	A	Provide an alternative to video-only and audio-only content

[242] https://www.w3.org/TR/WCAG22/
[243] https://www.w3.org/WAI/test-evaluate/
[244] https://www.w3.org/WAI/eval/report-tool

1.2.2	Captions (Pre-recorded)	A	Provide captions for videos with audio
1.2.3	Audio Description or Media Alternative (Pre-recorded)	A	Video with audio has a second alternative
1.2.4	Captions (Live)	AA	Live videos have captions
1.2.5	Audio Description (Pre-recorded)	AA	Users have access to audio description for video content
1.2.6	Sign Language (Pre-recorded)	AAA	Provide sign language translations for videos
1.2.7	Extended Audio description (Pre-recorded)	AAA	Provide extended audio description for videos
1.2.8	Media Alternative (Pre-recorded)	AAA	Provide a text alternative to videos
1.2.9	Audio Only (Live)	AAA	Provide alternatives for live audio
1.3.1	Info and Relationships	A	Logical structure
1.3.2	Meaningful Sequence	A	Present content in a meaningful order
1.3.3	Sensory Characteristics	A	Use more than one sense for instructions
1.3.4	Orientation (WCAG 2.1)	AA	Content can be display in portrait and landscape orientation
1.3.5	Identify Input Purpose (WCAG 2.1)	AA	Each input field must be able to be determined programmatically, a user should be able for example to autofill inputs
1.3.6	Identify Purpose (WCAG 2.1)	AAA	Interface components, icons, and landmarks (sections, article, main, etc.) must be able to be identified programmatically to help navigation for assistive technologies
1.4.1	Use of Colour	A	Do not use presentation that relies solely on colour
1.4.2	Audio Control	A	Do not play audio automatically
1.4.3	Contrast (Minimum)	AA	Contrast ratio between text and background is at least 4.5:1
1.4.4	Resize Text	AA	Text can be resized to 200% without loss of content or function
1.4.5	Images of Text	AA	Do not use images of text
1.4.6	Contrast (Enhanced)	AAA	Contrast ratio between text and background is at least 7:1
1.4.7	Low or No Background Audio	AAA	Audio is clear for listeners to hear
1.4.8	Visual Presentation	AAA	Offer users a range of presentation options
1.4.9	Images of Text (No Exception)	AAA	Do not use images of text

1.4.10	Reflow (WCAG 2.1)	AA	User must be able to browse a website using a 320-pixel wide screen without having to scroll horizontally (There are some exceptions)
1.4.11	Non-Text Contrast (WCAG 2.1)	AA	Extend colour contrast of at least 3:1 to non-text content such as infographics, diagrams, states, etc.
1.4.12	Text Spacing (WCAG 2.1)	AA	Changing text style properties should not break the page (line height, spacing after paragraph, letter spacing, word spacing)
1.4.13	Content on Hover or Focus (WCAG 2.1)	AA	Elements that are being shown on focus or hover (skip navigation, tooltip) should be dismissible(Esc), hoverable, persistent
2.1.1	Keyboard	A	Accessible by keyboard only
2.1.2	No Keyboard Trap	A	Do not trap keyboard users
2.1.3	Keyboard (No Exception)	AAA	Accessible by keyboard only, without exception
2.1.4	Character Key Shortcuts (WCAG 2.1)	A	If using single letter keyboard shortcut, the shortcut should be able to be turned off, or remap, or active only on focus
2.2.1	Timing Adjustable	A	Time limits have user controls
2.2.2	Pause, Stop, Hide	A	Provide user controls for moving content
2.2.3	No Timing	AAA	No time limits
2.2.4	Interruptions	AAA	Do not interrupt users
2.2.5	Re-authenticating	AAA	Save user data when re-authenticating
2.2.6	Timeouts (WCAG 2.1)	AAA	Users should be warned if user inactivity could cause data loss, unless data is preserved for more than 20h
2.3.1	Three Flashes or Below	A	No content flashes more than three times per second
2.3.2	Three Flashes	AAA	No content flashes more than three times per second
2.3.3	Animation from Interactions (WCAG 2.1)	AAA	Motion animation triggered by interaction can be disabled
2.4.1	Bypass Blocks	A	Provide a ‘Skip to Content’ link
2.4.10	Section Headings	AAA	Break up content with headings
2.4.2	Page Titled	A	Use helpful and clear page titles
2.4.3	Focus Order	A	Logical order
2.4.4	Link Purpose (In Context)	A	Every link’s purpose is clear from its context
2.4.5	Multiple Ways	AA	Offer several ways to find pages

2.4.6	Headings and Labels	AA	Use clear headings and labels
2.4.7	Focus Visible	AA	Ensure keyboard focus is visible and clear
2.4.8	Location	AAA	Let users know where they are
2.4.9	Link Purpose (Link Only)	AAA	Every link's purpose is clear from its text
2.5.1	Pointer Gestures (WCAG 2.1)	A	Complex gestures (Pinch, zooming, swiping) should have a simpler gesture alternative (Tap, double taps, long press)
2.5.2	Pointer Cancellation (WCAG 2.1)	A	When using single pointer events, one of the following should be true, No Down-Event, Abort or Undo, Up Reversal, Essential
2.5.3	Label in Name (WCAG 2.1)	A	Text in buttons or label should be readable by assistant technologies and can be used with Text-to-speech
2.5.4	Motion Actuation (WCAG 2.1)	A	Functionalities trigger by moving the device should have a fallback without (E.g. some apps use shake to undo)
2.5.5	Target Size (WCAG 2.1)	AAA	The size of the target for pointer inputs is at least 44 by 44 CSS pixels
2.5.6	Concurrent Input Mechanisms (WCAG 2.1)	AAA	Input must be available to use with a different mechanism (Mouse, keyboard, stylus, touch, voice)
3.1.1	Language of Page	A	Page has a language assigned
3.1.2	Language of Parts	AA	Tell users when the language on a page changes
3.1.3	Unusual words	AAA	Explain any strange words
3.1.4	Abbreviations	AAA	Explain any abbreviations
3.1.5	Reading Level	AAA	Users with nine years of school can read your content
3.1.6	Pronunciation	AAA	Explain any words that are hard to pronounce
3.2.1	On Focus	A	Elements do not change when they receive focus
3.2.2	On Input	A	Elements do not change when they receive input
3.2.3	Consistent Navigation	AA	Use menus consistently
3.2.4	Consistent Identification	AA	Use icons and buttons consistently
3.2.5	Change on Request	AAA	Do not change elements on your website until users ask
3.3.1	Error Identification	A	Clearly identify input errors
3.3.2	Labels or Instructions	A	Label elements and give instructions
3.3.3	Error Suggestion	AA	Suggest fixes when users make errors

3.3.4	Error Prevention (Legal, Financial, Data)	AA	Reduce the risk of input errors for sensitive data
3.3.5	Help	AAA	Provide detailed help and instructions
3.3.6	Error Prevention (All)	AAA	Reduce the risk of all input errors
3.3.9	Accessible Authentication (Enhanced)	AAA	When a cognitive function test is used to authenticate a user, at least one other authentication method is available which is not a cognitive function test.
4.1.1	Parsing	A	No major code errors
4.1.2	Name, Role, Value	A	Build all elements for accessibility
4.1.3	Status Messages (WCAG 2.1)	AA	Content that is updated dynamically must be notified to users of assistive technologies without getting visual focus

8.4 Appendix A4: Overview of methods for user needs identification

This section presents the most used methods for user needs identification, which are relevant for the i-Game project.

Information gathering: is a process mostly employing desktop research to analyse the main stakeholders (e.g. identify all relevant stakeholders and their roles and responsibilities, values and business interests, etc) with direct benefit or involvement in the system being developed, document and review the processes (e.g. how such systems are designed/developed, what features they have, etc.), perform a secondary market research (e.g. research reports, best practices, examples, review reports, etc.), and context of use (e.g. usability factors, social aspects, etc.).

- **Benefits:** provides the ground for the identification of the most common and relevant design choices; it accounts for state-of-the art developments; does not require direct interaction with the end users and stakeholders.
- **Disadvantages:** innovation and creativity may be limited by the existing knowledge; system/product users are not directly consulted in the process.

User Surveys/Questionnaires: a set of questions are used to collect answers from the users, either in a closed-ended manner, with a predefined set of answers being provided, or in an open-ended approach, with the respondent having the freedom to formulate the answer.

- **Benefits:** relatively quick method of determining the preferences of large groups of users, can lead to collection of accurate information in particular in the closed-ended approach, and it is well suited for statistical analysis.
- **Disadvantages:** questions may not be clear to all participants and follow-up surveys or interviews may be required to further clarify requirements.

Focus group: brings together a cross-section of stakeholders in a focus group format, to discuss potential issues/problems and gather feedback on a specific topic. Session outcomes may require further expert analysis in order to identify user needs and requirements.

- **Benefits:** actively discussing with participants creates a healthy environment, where one can learn from others' experience, and allow the expert analysis to quickly obtain a wide variety of user views and possibly a consensus over the aggregated results.
- **Disadvantages:** it may be difficult to gather the group at the same date and time; when implemented in an online format the interaction may be limited; dominant participants may influence the group disproportionately and a skilled moderator may be required.

Interviewing: the interviewer directs the questions to the interested parties to obtain information about their needs or requirements in relation to the new system, in an individual approach. The interview can be structured, including a predefined set of questions, or unstructured with the interviewer discussing in an unstructured and more open setting (e.g. no specific format or questions) about the issue at hand.

- **Benefits:** interviews enable rapid acquisition of ideas and concepts, encourage participation, and build relationships.
- **Disadvantages:** it is a timely process requiring commitment from all participants; it is not easy to implement it with a large number of users; the process of combining/aggregating a range of possibly different views from different stakeholders and users may be very complex.

Scenarios/use cases, personas: provide detailed and realistic examples of how users can perform tasks in a specified context. Characters are usually employed, in the form of fictional representations of a typical user, with created name, personality and image to represent important user groups.

- **Benefits:** it is an efficient way to think about the future use of the system in context; characters bring usability needs to life.
- **Disadvantages:** scripts can raise expectations too high; characters may oversimplify the represented user population.

Co-design development/ Requirements workshops: are more process-oriented and formal techniques, having structured meetings with users and involved stakeholders to clarify and complete requirements.

- **Benefits:** triggers creative thinking of the participants by presenting issues and asking questions to a group of stakeholders; group discussion may lead to reaching consensus in the presence of users with

potentially diverging views or diverse needs.

- **Disadvantages:** the results may seem too ambitious for the current needs; the success rate depends on the expertise of the facilitator/moderator and on how well the implementation approach has been defined.

Evaluating an existing or competitor system: can provide valuable information about the extent to which current systems meet users' needs.

- **Benefits:** effective means to identify current issues, possible new features, and acceptance criteria.
- **Disadvantages:** may lead to the inclusion of too many new features or make the system too similar to an existing one.

Delphi Study: a structured approach to the problem analysis process, involving the formation of a group of experts to make a series of judgements regarding the designed/analysed system. Consultation is done through thematic questionnaires in an iterative approach, with the integrator of the results (facilitator) playing an important role in aggregating and disseminating the summary of the opinions expressed, and respective arguments/justification, at each iteration.

- **Benefits:** encourages objective debate, devoid of the propagation of self-interests; confers the anonymity of the ideas generated to avoid the halo effect.
- **Disadvantages:** the facilitator may influence the outcomes (e.g. section of answers) due to his/her personal background; it is not suitable for complex situations, where the forecast must consider the simultaneous evolution of several factors.

Brainstorming: stimulates creativity and ideation in a group to find the solution to a specific problem.

- **Benefits:** it is a blank page approach that allows for rapid acquisition and innovative thinking; promotes equal participation.
- **Disadvantages:** does not cover detailed design aspects; there may be multiple duplicate ideas; user expertise and knowledge may heavily impact the outcomes.

Card Sorting and Affinity Diagramming: is a technique for discovering and organizing user requirements in a hierarchical manner.

- **Benefits:** provides means to prioritize and organize system options/content, etc.
- **Disadvantages:** if results are obtained by separate individuals or groups, it requires a way to combine them.

Storyboards: consist of sequences of images that show the relationship between user actions or inputs and system outputs. The images show system features such as menus, dialog boxes and displayed windows.

- **Benefits:** demonstrates software interactions and possibly user context in a simple manner at an early stage in the development cycle.
- **Disadvantages:** lacks the interactive quality of the prototype.

Prototyping and mock-ups are used to identify missing or unspecified technical/functional requirements and describe the process using diagrams.

- **Benefits:** quick method to build, refine and provide a visual representation of the product, enabling early detection of usability issues in response to user feedback.
- **Disadvantages:** difficult to implement full prototypes/mock-ups for complex systems; multiple throwaway software prototypes are built that may take a lot of time.