The digital economy brings new opportunities for arts and culture

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Abstract

We are currently in the digital era of the 21st century, and the rapid advancement of artificial intelligence has brought new energy to the evolution of museums. Museums must inevitably advance towards digitisation. Therefore, the variety of applications for artificial intelligence and other related technologies should be broadened. At the same time, numerous arising issues need to be addressed. The focus of this paper is the objective of increasing young visitors' satisfaction. Herein, we leverage an assortment of digital technology tools and continuously evaluate their commercial feasibility. It is hoped that a rise in satisfaction can be accomplished through the exemplar business plan provided.

Keywords: *museums*, *digitisation*, *artificial intelligence*, *immersive technologies*, *script killing*

1. Project Background

At the start of the 21st century, with the emergence of big data, deep learning, and the widespread use of the internet, AI has progressed at a rapid pace. AI can learn and train upon vast amounts of data to produce accurate predictions and decisions. Nowadays, AI is extensively used in numerous areas, including health insurance, financial services, transportation, and education[1].

Since the 1990s, digital technology has been integral to the cultural sector and widely implemented. With evolving societal norms and museum perspectives, modern technologies have been utilised in various dimensions of museum exhibitions, interpretations, and research. However, despite the injection of new momentum from the technology, museums still cannot meet the expectations of visitors in terms of satisfaction.

2. Marketing Analyses

2.1 Low youth visit rate and satisfaction

As per the 2018 Museum Audience Report[3], visitors aged over 55 account for 41% of the visitors. The lowest proportion of visitors is comprised of young people aged 16-24 years.

As per the 'How Do They Feel' survey[2], museums score similarly to other art forms in terms of 'The Whole Experience and Value for Money', but they score lower for 'Quality of the Exhibition'. Contemporary-minded groups exhibit lower satisfaction levels. In the evaluation, visitors aged between 16 and 24 had the least recommended values for museums. Therefore, retaining this future-focused audience and promoting positive word of mouth is crucial.

Consequently, the survey above illustrates the significance of digitisation in museums. Digitisation has the potential to attract more young people and improve their experience. Thus, it can seize future market opportunities.

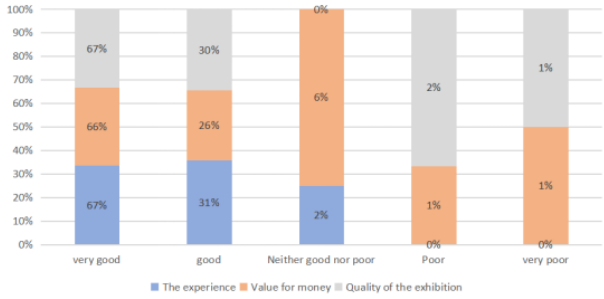

Fig.1. The age distribution of museum visitors[3]

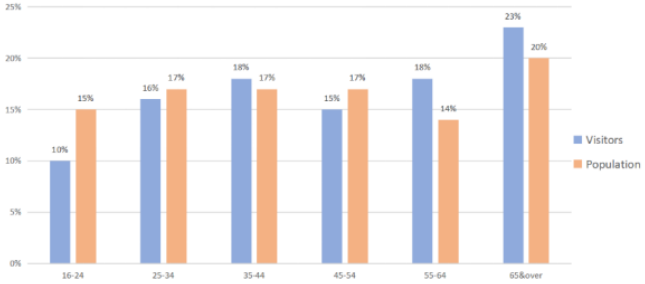

Fig.2. Visitor satisfaction rate[3]

2.2 Digitisation of museums

Over the last decade, digitisation of museums has significantly increased with a gradual shift from static displays to dynamic and interactive exhibits. Simultaneously, the emergence of the COVID-19 pandemic expedited the pace of museums' digitisation process. The ICOM report indicates that online activities of museums have notably increased compared to the pre-pandemic times, primarily due to online exhibitions, webcasts, and social media. In 2020, 16.4% of museums increased their online exhibitions, which rose to 22% in 2021. One example is the Henan Museum, which leveraged digital technology to launch an online archaeology campaign. The campaign was a massive success, attracting over 30 million participants within a week[4].

In the physical world, the digitisation of museums is being propelled by technologies such as AI, VR, and other technologies that deliver immersive experiences and other activities to engage with visi-

tors. The recent special exhibition “La Palette de Van Gogh” in Paris is a unique interactive and sensory experience that uses VR and Vincent van Gogh’s last used palette (which is now in the permanent collection of the Musée d’Orsay) to allow visitors to have a deeper appreciation of the artist’s major works from this period[5]. And in China, “Van Gogh Immersion Experience” has also demonstrated many stereoscopic VR images, creating a unique vertical wall interactive painting experience for the viewer[6].

According to a survey of museum management data, about one-third of museums globally intend to use augmented reality tools. Moreover, younger respondents are more interested in virtual museums from a visitor’s perspective[1]. The digitisation of museums has become commonplace, both at home and abroad. Based on the existing technology, we need to incorporate new ideas into digitisation to increase visitor interest while generating revenue for the museum.

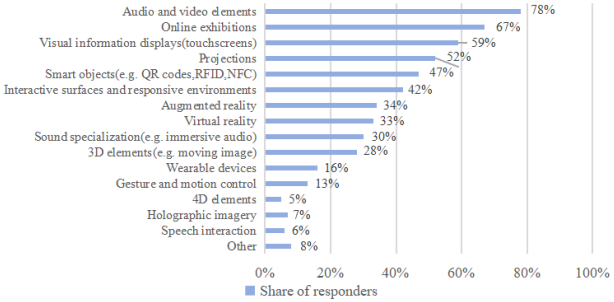

Fig.3. New technologies, tools, and digital formats for exhibitions planned to be implemented by museums worldwide as of May 2021 [3]

Table 1

Global interest in metaverse experiences 2022, by generation[3]

	Gen Z	Millennial	Gen X	Boomer	Silent
Virtual concert of a favorite musical artist	37%	38%	27%	15%	13%
Virtual international travel	35%	37%	28%	17%	15%
Virtual museums	31%	36%	26%	16%	13%
Socializing with friends in a virtual space	39%	36%	23%	10%	9%
Shopping in a virtual mall	35%	36%	24%	9%	8%
Playing games in a virtual space	40%	38%	24%	8%	6%
Watching a virtual sporting event	34%	35%	23%	11%	9%
Spending time at a virtual theme park	33%	35%	23%	11%	9%
Attending a virtual work conference	34%	34%	23%	8%	7%
Collaborating with colleagues in a virtual office	32%	36%	22%	8%	7%

2.3 Popularity of murder mystery

The immersive experience provided by our project can be analogised to the murder mystery game experience due to its strong storytelling and immersion.Therefore,to illustrate the potential success of immersive experiences among young people, we can look to the growing popularity of murder mystery games. These interactive experiences originated from western banquet live role playing and are a form of real-life role-playing reasoning game centred on plot interpretation. Murder mystery games are a novel form of leisure and social interaction that has instigated a development boom driven by market demand. Analysis of the Baidu search index and the Insight Research Report indicates that the murder mystery game industry is steadily growing and is projected to reach a market value of 38 billion yuan by 2025[7].

Fig.4. 2020 to 2025 China's murder mystery game market size and annual growth rate[3]

The demographics, consumption and preference characteristics of the murder mystery game audience can be understood through public industry data and relevant reviews of various commercial platforms. It is worth highlighting that 'script killing' game players are primarily aged between 20 and 35 years old, and over half of the players prefer offline games over other gaming experiences.

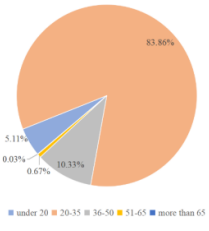

Fig.5. Murder mystery game player age distribution[3]

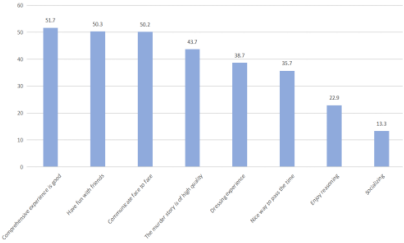

Fig.6. The reason that consumers like to play murder mystery games offline (Unit: percentage)[3]

In conclusion, the data indicates that pre-plotted combat modes, such as the 'campaign mode' in Call of Duty, are significantly popular among young people. According to a 2022 market research report, this mode is particularly favoured by players in the 18-24 age group, with 65% of respondents stating that they prefer it because it provides an immersive gaming experience. Well-designed storylines and character interactions create immersion, increasing player engagement and satisfaction. Therefore, it can be inferred that integrating game mechanics

like script killing will attract a younger audience.

3. Challenges & Solutions

3.1 Challenges

Museums encounter varying issues at different stages of digitisation. Museums that have not yet embarked on digitising face the challenge of accommodating a high number of visitors within the limited space available, resulting in the audience receiving only a fleeting tour experience[8]. Consequently, the audience may not get to thoroughly understand the historical background and significance of the collections and might require the use of up-to-date exhibition technology[2]. Here are a few examples of how digitisation has enhanced the museum experience: 1. The British Museum in London has created a virtual tour of its collection, allowing visitors to explore the museum's impressive galleries from the comfort of their own homes. The virtual tour includes detailed images and information about the museum's collection, giving visitors a more in-depth look at the exhibits. 2. The Smithsonian National Museum of Natural History in Washington, D.C. has created a mobile app that uses augmented reality to enhance the museum experience. The app allows visitors to scan exhibits and see virtual 3D models and animations overlaid on top of the real objects. 3. The Rijksmuseum in Amsterdam has digitised its entire collection, making it available online for anyone to access. The museum's website contains over 500,000 images of artwork and artefacts, accompanied by detailed information and historical context.

Museums that have undergone a specific stage of digitisation will experience poor immersion and hinder the museums' development if digital displays are too prevalent without fully matching the exhibits' cultures. One example of how a museum's immersion and development can be hindered if digital displays are not aligned with the exhibits' cultures is the controversy surrounding the use of digital displays at the National Museum of American Indian (NMAI) in Washington, D.C., operated by the Smithsonian Institution.

The NMAI faced criticism when it initially opened in 2004 for its heavy reliance on digital displays, which some argued were excessive and took away from the authentic experience of exploring Native American cultures. Visitors and Native American communities expressed concerns that the digital displays were not fully representative of the diverse traditions and histories they sought to showcase.

The museum recognized the need for a more balanced approach and subsequently made changes to enhance immersion and cultural authenticity. They incorporated traditional storytelling, living exhibits, and physical artifacts alongside digital displays to create a more holistic and immersive experience. This approach allowed visitors to engage with both the material culture and the living traditions of Native American communities.

Our project's focus is on utilising AI to avoid these problems, increase young people's satisfaction with museums and create more value for museums.

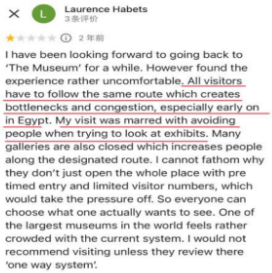

Fig.7. Review 1

Fig.8. Review 2

3.2 Solutions

The effective solution to the aforementioned problems is the utilisation of AI technology to enhance interaction between audiences and exhibitions, providing an immersive tour experience. Upon entering the premises, you can commence your immersive tour by following an intelligent robot and enjoying an AI audio guide[8]. The robot, serving as your guide, can provide detailed interpretation at various exhibition points, thereby improving efficiency. Moreover, interaction is a crucial factor for tour satisfaction.

Audiences can customise the content they want to experience by selecting various storylines that coincide with true historical facts,just like participating in a murder mystery game[11]. By making different choices, audiences are guided towards different historical stories through AI, which can help to simulate the different reactions of real historical figures to the audiences. This creates a space that helps the audience to interact directly with cultural relics, the exhibition hall environment, and historical figures. The personalised design allows au-

diences to choose the content and results of the cultural relic story, thus providing them with more immersive activities. Through an empathetic experience, they can establish personal connections with the cultural relic. This may deepen their understanding of the cultural relic's background information and further reinforce the concept behind the museum's exhibition.

Moreover, visitors may print photos of artefacts that leave a lasting impression by means of AI painting technology. Furthermore, they also employ 3D printing technology to produce a miniature replica of their favourite item[8]. It is common knowledge that souvenirs from museum shops are often expensive. As an example, souvenirs available at The National Gallery of England cost no less than ten pounds. Therefore, objects produced using AI printing technology can significantly decrease the expense of obtaining souvenirs for visitors from museums.

4. Strength & Limitations

4.1 Strength

4.1.1 Multi-technology integration, breaking space constraints

Compared to using technologies separately, we integrate multiple technologies fully. The complete integration of VR and AI technology can overcome limitations related to the completeness of cultural relics, viewing angles, and available viewing locations. Visitors can view exhibits from any position and angle using 3D images, Virtual Scenes, and other technologies, leading to an enhanced museum experience[8].

4.1.2 Museum + Immersive experience, the integration of interaction and fun

We offer distinctive historical stories to visitors in the virtual environment created by 5D and VR. For instance, visitors can immerse themselves in a specific historical and cultural context, interact with a renowned historical figure, and observe their different choices and life journey[4]. This can significantly enhance visitors' interest in engaging with AI virtual characters and broaden their knowledge about the history. While preserving the artistry of the exhibited cultural relics, historical figures can adapt to visitors' habits and preferences automatically.Specifically , AI can simulate the character by learning the existing related documents of the historical figures, then capture the language habits and character of the visitors in the process of commu-

nicating with them, and finally present the characters that are more in line with the visitors' communication habits.

4.2 Limitations

4.2.1 Technical limitations

Museums globally have gradually introduced digitisation over the last two decades. Nevertheless, there are technical limitations in data analysis, such as weakened causality and inaccurate judgement of human emotions[8]. AI-created characters may have flawed personalities and inadequate interaction skills. Additionally, VR stereo rendering may be unsatisfactory. Therefore, it is essential to explain the capability of modelling and establish ethical regulations that promote the production of historical characters for museum-goers.

4.2.2 Difficulty in financing

The proposed project requires the integration of various technologies such as VR and AI. A substantial amount of funding will be need to be invested in both the design and development stages, with continued investment required during operation and maintenance phases. Therefore, the museum may face difficulties in obtaining financing and finding partners.

4.2.3 The problem of story design

Designers may disregard the essence and implications of traditional culture as they keep pace with market trends. Also, designers may have some constraint in their comprehension of cultural artefacts and struggle to evidently convey their context and ideas.

5. Business Model

We have divided our customer segments into two parts. Previous surveys have shown that young people are generally less satisfied with museums. At the same time, the museum administrators aim to increase customer satisfaction while also continuing museum operations. Therefore, we aim to meet the needs of the museum manager and serve teenagers.

By focussing on these two objectives, we hope to establish a transactional relationship with teenagers and a long-term relationship with

museum managers. For owned channels, the museum has its own website which is the best way to advertise the product and attract an audience.

For partner channels, we will collaborate with various platforms such as TikTok to advertise the products to teenagers. To meet all the requirements for improving satisfaction, we combined different technologies to make this product novel enough to attract teenagers.

Moreover, during the product's run, the AI generates customised storylines that are unique to the participant via constant iterative updates. Script killing and VR are both increasing in terms of the market size, which implies that this product will attract a considerable number of people. The main activities consist of two parts: immersive game design and cultural and creative products. These require vital resources such as AI technology and the ability to adapt heritage history.

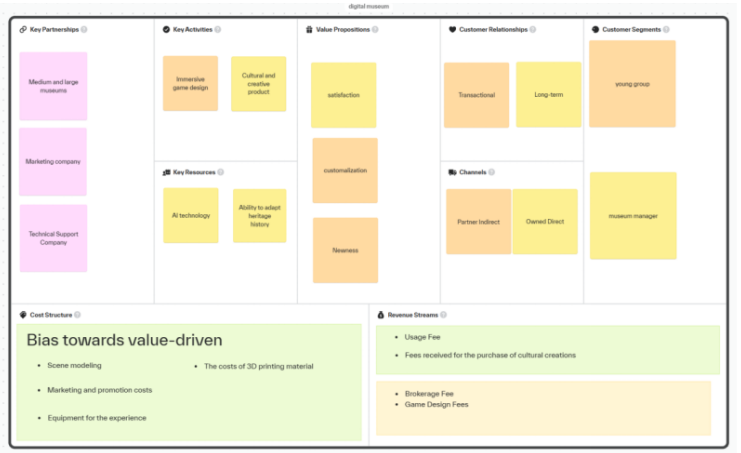

Fig.9. Business Canvas

We have three main partners: medium and large museums, a marketing company, and a technology company. During the early stages of the project, we primarily collaborate with medium and large museums. This is because they have the necessary funds, space, and visitors to support the project's operations. In the later stage of the project, we plan to implement in small museums after continuous improvement. The aim for this stage is to increase the customer flow in small museums. Collaborating with a marketing company is a crucial marketing

strategy that we expect to use to increase the project's revenue. Partnering with technology companies can significantly reduce the time required to design products, shorten the project preparation cycle and enhance the overall quality of game design.

From the above, we can summarise that the project costs mainly consist of designing the scenes and characters, marketing and promotion expenses, equipment costs, and cultural and creative material expenses.

Taking into account that the cost of 300,000 RMB in a VR tour in a small museum, the limited scope of our application and the high demand for scenes and characters, we anticipate the cost of VR design to be around 500,000 RMB[9]. Since the cost of an AI anchor is tens of thousands of yuan per year, we estimate that the cost of 3 AI characters would be 300,000 RMB per year[10].

The costs associated with promotion have two components. To build and operate a promotional website, the website design fee is generally 500 RMB, and the domain name price is 100 RMB. Therefore, we estimate the total cost to be 1,000 RMB. When cooperating with the short-video platform, this will apply: We will use the CPM billing method to charge this advertisement once for every one thousand views. One CPM for infomercials costs RMB, and we anticipate 10 million views for 40,000 RMB.

Regarding the cost of cultural and creative materials, a 12cm tall Pikachu 3D printed toy costs 69 RMB in the market, and the introductory unit price is 5.75 RMB. Therefore, we can manufacture approximately 84 dolls per day with a 1000 RMB material cost.

As for equipment costs, we will purchase five 3D printers at 5,000 RMB each, totalling 25,000 RMB. The VR glasses will be bought for 25,000 RMB a piece, resulting in a total cost of 250,000 RMB. In summary, the overall cost of the project amounts to 2,841,000 RMB.

Table 3

Income statement

participants（max）		participants（min）		list price
120		79		120/per
the price of cultural and creative product		turnovers		
		max turnovers	6840000	
70/per		min turnovers	2844000	
cost		statistical item		budgeted cost
		modeling cost		800000.00
		promotion cost		41000.00
		equipment cost		275000.00
		materials cost		1725000.00
		Total production costs		**2841000.00**
Broad categories of cost items	Cost item subcategories	costs		
		Estimated quantity to be used	Standard unit price	Budgeted cost amount
modeling cost	AR Design Production Fee(Scene)	4.00	100000.00	400000.00
	Development Team	6.00	15000.00	90000.00
	AR Design Production Fee (Charac	10.00	1000.00	10000.00
	AI technology (co-op)	3.00	100000.00	300000.00
	Subtotal costs	800000.00		
promotion cost	Cost item subcategories	Estimated quantity to be used	Standard unit price	Budgeted cost amount
	Website Setup Fee	1.00	1000.00	1000.00
	Short video co-operation platform i	10000	4.00	40000.00
	Subtotal costs	41000.00		
equipment cost	Cost item subcategories	costs		
		Estimated quantity to be used	Standard unit price	Budgeted cost amount
	3D Printer	5.00	5000.00	25000.00
	AR glasses	10.00	25000.00	250000.00
	Subtotal costs	275000.00		
materials cost	Cost item subcategories	costs		
		Estimated quantity to be used	Standard unit price	Budgeted cost amount
	Cultural and creative material costs	1000.00	5.75	1725000.00
	Subtotal costs	1725000.00		
Total costs		**2841000.00**		
profits max		3999000		
profits min		3000		

The project generates revenue primarily from participant fees and sales of cultural and creative items. Revenue, which is influenced by variations in customer traffic and purchasing intentions, is expected to range from 2,844,000 RMB to 6,840,000 RMB. Our team will earn from brokerage and game design.

6. Discussion

6.1 Project scale

Given the widespread adoption of AI in museums around the world, we will focus on conducting experiments on our project in the next three years in five county museums in the UK.

If the project generates a substantial profit, and the feedback received is mainly positive, we plan to expand our project's scope to implement it in eight national and provincial museums. This will enable us to achieve mutual benefits with these museums.

6.2 Cultural transmission

Our aim is for customers to gain a broader understanding of the stories behind artifacts through this immersive experience, thus fulfilling the museum's objective of disseminating excellent culture[8]. We are particularly excited about this project's potential to encourage a deeper and more innovative understanding of the culture of diverse cultural relics that can help transmit human civilisation to people across the globe.

6.3 Conclusions

Our programmes aim to enhance the museum experience and make a positive impact on the wider community. We introduce 'script killing', a popular form of interaction among young people, to stimulate curiosity and exploration of history and culture among the younger generation. This interactive experience engages young people and provides them with a platform to demonstrate their creativity and critical thinking.

Additionally, our project has the potential to create new employment opportunities for young people. As the market for script killing continues to expand, an increasing number of young people are becoming involved in storytelling. Our project will offer them a platform to transform their interests into career prospects, thereby promoting cultural innovation and economic development. This will not only promote our cultural heritage but also create new employment opportunities, particularly in the creative industries and technical services.

By collaborating with schools and educational institutions, we can introduce immersive learning experiences into the classroom as a supplement to traditional teaching methods. It is expected to increase students' interest and engagement in learning by providing a lively and interactive learning environment.

This project aims to enhance the museum visiting experience and have a far-reaching social impact in areas such as cultural heritage, job creation, and social education.

Author Contribution

Conceptualisation: Zhang Tianshu, Jiang Yuanyuan, Liu Mulin, Jiang Yingying, Yu Bohan, Chen Yiwen;

methodology, validation, formal analysis: Zhang Tianshu, Jiang Yuanyuan, Liu Mulin, Jiang Yingying, Yu Bohan, Chen Yiwen;

writing-original draft preparation, visualisation: Zhang Tianshu, Jiang Yuanyuan, Liu Mulin, Jiang Yingying, Yu Bohan, Chen Yiwen;
writing-reviewing and editing, visualisation and supervision: Zhang Tianshu, Jiang Yuanyuan, Liu Mulin, Jiang Yingying, Yu Bohan, Chen Yiwen;
Project administration: Zhang Tianshu. All authors have read and agreed to the published version of the manuscript.

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Research Guidelines
This study has followed the research guidelines of the Business Analysis and Innovation Entrepreneurship, Cambridge Programme 2022"

Informed Consent Statement
Informed consent was obtained from all subjects involved in the study.

Data Availability
Please contact the corresponding author(s) for all reasonable requests for access to the data.

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Conflicts of Interest
The authors declare no conflict of interest.

Intellectual Property
The authors attest that copyright belongs to them, the article has not been published elsewhere, and there is no infringement of any intellectual property rights as far as they are aware.

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