Fulldome in the UK

Written by **Live Cinema UK:** *Kate Wellham / Liz Harkman / Lisa Brook*
Funded by **Creative UK**

Contents

To discuss this report directly, contact **kate@livecinemauk.com**

Pease note that we have included links to external organisations, projects and artists throughout this report whenever they are initially mentioned.

Introduction

Fulldome is an emerging spherical media environment that combines projected 360 degree moving image with multi-channel surround sound to create a deeply embodied immersive experience. Rather than watching a film on a flat screen as cinema audiences do, fulldome audiences are placed within dynamic visual environments created by the filmmakers.

The fulldome medium has its origins in traditional planetarium spaces, but an increasing interest in the creative potential of this communal immersive media experience – as well as access to new tools for artists – has seen a growth of fulldome work that is artistic without intending to be educational.

However, there is currently a lack of funding for content creation, and a lack of established distribution and exhibition routes available for the kind of fulldome content which sits outside the space and science genres. There are also barriers for filmmakers, performers and fulldome venues which prevent them from connecting with new audiences.

Within this report we will seek to answer the following questions:

- What creative and cultural content currently exists for fulldome?
- What is the language of fulldome and its various formats?
- What current distribution and exhibition models are there for creators in the UK, both within the UK and internationally?
- Why should the UK be funding the creation of new work?
- What are the opportunities for creators and venues in the UK?
- How can these creators and venues take advantage of those opportunities?
- How can the sector collectively support the growth of this medium in the UK?

As we explore these questions in detail, we hope to share a better understanding of the opportunities for fulldome artists, VR and 360 filmmakers, and live performers of all kinds to access the distribution, circulation and discoverability of their own and work from the wider community.

Why we conducted this report

Live Cinema UK's background is in the exhibition of flat film and accompanying live activity to create in-person screening events. In 2016 we encountered the medium of fulldome for the first time and – like so many individuals and organisations before us – were immediately struck by its value and potential for the filmmakers, performers and audiences we work with.

As a screening events organisation, we work with many different artists and we have always sought to create new events that are immersive in many different ways, including through live performance, audience participation, non-traditional venues or new technology. Fulldome incorporates all of these factors and allows for a huge variety of live performance and interactivity, making it perfectly aligned with our own creative aims. In addition, we realised that fulldome allows for taking narrative virtual reality content normally exhibited in a headset and placing it in a collective viewing environment; as an organisation with a mission to provide in-person collective rather than solo or at-home experiences, this opened up new potential for our work.

After first becoming aware of the fulldome medium at SXSW 2016 through a presentation from Rapid VR about virtual reality in tourism, we went on to meet the founders of Fulldome UK festival and to attend that festival in 2016. Our report Virtually Together was funded by Innovate UK in 2019 and explored the use of immersive screen environments for cultural content. We met fulldome artist and academic Michaela French at IDFA DocLab Forum in 2019 and – with Michaela as Chair – together we launched the Fulldome Creative Network to bring together artists, venues, distributors and other fulldome professionals.

During the IDFA DocLab 2021, participants working in fulldome and immersive content identified that, while traditional filmmaking has established pipelines through industry support, funding and distribution, the fulldome medium does not. Yet there are more opportunities than ever before for creators to access fulldomes and create new work.

In order to explore how this medium might fit into the wider XR and film exhibition landscapes in the UK, we have applied our knowledge of audiences, live cinema

Why we conducted this report

events, the experience economy, distribution models, marketing, events, performance and funding to some of the issues around the growth of cultural fulldome exhibition within our research and this report.

However, without the existing work of other organisations and individuals from the fulldome sector – many of whom have been working in this field for decades – this report would have been impossible, as would the growth of fulldome itself.

This report builds on a great deal of previous work carried out by other organisations, including that of IDFA (International Documentary Festival Amsterdam), whose round table conversations and resulting reports have been invaluable in helping us to understand the problems and potential solutions when it comes to the cultural fulldome sector.

This study aims to support the developing fulldome sector in the UK by identifying some of the potential distribution models, exhibition opportunities, routes to wider audiences and legacy and access to fulldome work.

How we conducted this report

The research has been funded by Creative UK's New Ideas Fund and produced by Live Cinema UK. We worked collaboratively with Fulldome Festival UK, fulldome consultant Ruth Coalson and Fulldome Creative Network Chair and artist, Michaela French, to explore the possibility of building on existing planetarium infrastructure, to provide visibility to the narrative-storytelling content being made in the 360 degree format, and to research the standard licencing models and routes to market for existing narrative 360 and VR.

As part of this process, Fulldome UK Festival performed an audit of their back catalogue to identify and list existing fulldome narrative storytelling content that had performed particularly well at their events. We researched how an accessible online archive identifying high quality creative work would demonstrate the opportunities of the fulldome format for new creators and provide exhibitors with a tool to view the potential of narrative storytelling content in reaching broader audiences.

Between Jan-May 2023 the team conducted two surveys - one focused on gathering information from UK and Ireland fulldome venues on current engagement with cultural programming, and one on fulldome creators.

Our venues survey yielded responses from 13 of the 20 UK and Ireland fulldome venues we were able to identify as currently open and operating.

We have reviewed fulldome content at festivals and showcases around the world, attended XR, film and fulldome-specific conferences and events both in person and online. We have also visited fulldome venues in the UK, US, Canada and Europe.

We have conducted an audit of recent VR narrative work to look at pieces that have been converted to fulldome format, further making the case for fulldome exhibition as a viable form of exhibition for work originally conceived for headsets, and giving VR creators another outlet for their work and all audiences the opportunity to experience it.

Among the people we have spoken with to create this report are fulldome filmmakers, festival and conference organisers, fulldome venues, academics, distributors, artists, musicians, immersive venues, XR funders, and VR content creators.

How we conducted this report

The information and insights within this report have come from converations with a variety of contributors who have shared their knowledge, opinions, expertise and work with us over the last seven years, and we would especially like to acknowledge and thank the following:

- Ben Stern: Fulldome UK Festival / GaiaNova
- Philip Heard-Mayer: Fulldome UK Festival / GaiaNova
- Michaela French: Artist, Lecturer, Moving Image Designer, Researcher
- Ruth Coalson: Independent Consultant Creative, Attraction, Fulldome and Immersive Film Sector
- Fulldome Creative Network members: International network of fulldome artists, venues, exhibitors, producers and researchers
- IDFA: International Documentary Festival Amsterdam
- CultVR / 4Pi Productions: Founders of CultVR fulldome venue in Cardiff, UK, and producers of immersive content
- Market Hall: Fulldome venue in Plymouth, UK, founded by Real Ideas
- UK and Ireland planetarium venues: Peter Harrison Planetarium at the Royal Observatory Greenwich; World Museum Liverpool; Winchester Science Centre; Inishowen Maritime Museum & Planetarium; The Immersive Vision Theatre, i-DAT/University of Plymouth; Cultvr; Great North Museum: Hancock; Real Ideas Market Hall & Immersive Dome; The Planetarium at Glasgow Science Centre; Dynamic Earth; Jodrell Bank; Thinktank Planetarium, Birmingham Museums; Life Science Centre
- SAT Montreal / Society of Technological Arts, including the Satosphere dome: In particular residencies manager Mourad Bennacer and CEO Jenny Thibault
- SXSW conference: In particular XR programmer Blake Kammerdiener
- IMERSA: Immersive Media Entertainment, Research, Science and Arts network
- Professor Mike Phillips: Professor of Interdisciplinary Arts University of Plymouth, and Director of i-DAT.org

How we conducted this report

Thanks (cont)

- ARTIS: Planetarium in Amsterdam
- Wisdome LA: Temporary dome park
- Charles Hayden Planetarium at the Museum of Science, Boston: In particular director Dani LeBlanc and programmer James Wetzel Monroe
- Frances Adair McKenzie: Artist/Director/Animator
- Anagram: Creative studio
- DJ Yoda / Duncan Beiny: VJ, DJ and artist
- OASIS Immersion: Immersive exhibition space in Montreal
- Ed Lantz: CEO Vortex Immersion Media
- Kate McCallum: Co-Founder Dome-Fest West/MESMERICA Fulldome Immersive Content Producer/
- Pedro Zaz: VJ, Musician, interactive artist, Fulldomer
- Dario Tiveron: Founder & Director of Fulldome Database
- Dome Fest West fulldome festival: In particular Ryan Moore
- Jena Fulldome Festival: In particular Micky Remann
- NSC Creative fulldome productions studio: In particular Paul Mowbray, Aaron Bradbury, Max Crow
- Diversion Cinema: Virtual reality events agency
- Hub Montreal: Creative industries conference
- Hubblo: Immersive content distributor specialising in fulldome
- COSM: Immersive venue operators
- University of Leeds: In particular Dr Scott Palmer and Dr Tom Jackson
- XR Stories: Supporting research, development and innovation in technology-led creative content, experiences, and stories
- Avinash Changa: Founder of WeMakeVR

Terminology

The language around immersive experiences, content and venues is constantly evolving, but below is a snapshot of the current terminology being used by our contributors, by the sector, and throughout this report.

XR

XR is short for 'extended reality' and is a catch-all term that covers virtual reality (VR), augmented reality (AR), and mixed reality (MR). The Arts and Humanities Research Council (AHRC) recently launched a new programme supporting the implementation of immersive technologies within the arts and culture sector across the UK and named it XRtists in reference to this now broadly used term.

Virtual reality (VR)

Virtual reality usually refers to the experiences delivered in a VR headset, with visuals surrounding and fully immersing the viewer in the gaming or video content. VR content is referenced in this report when describing digital experiences made for a VR headset.

360 video / 360 degree video

This refers to video content that has been shot with a 360 degree camera, capturing the entire field of view at once. This kind of video can be shown in a VR headset, in a fulldome venue, or on mobile devices or computers with platforms that enable viewers to scroll around the image.

Transmedia

Transmedia experiences are those which span multiple platforms while presenting a single cohesive world. Examples may include walk-through experiences in which some elements are shown in an immersive screen, some in the form of physical art, and some as live performance.

Terminology

Immersive venues

While the term immersive venues is very broad, within this report it refers to venues which are not fulldome venues but which use video walls or projection mapping to create a sense of immersion within digital content. Examples of these kinds of venues are Frameless in London, and OASIS in Montreal. These kinds of venues are rooms with flat walls and which often have floor projection, differing from the curved screens of a fulldome. They are also often walk-through experiences, where most fulldome experiences are seated or standing.

Fulldome

The term fulldome is the most prevalent among the contributors to this report, and is the term used to describe both the dome-shaped screen – whether projection or LED – and also the medium displayed within it.

This term most likely originated as a way to differentiate the format from previous panoramic video systems, instead describing visuals that covered the entire hemisphere around the viewer. One early notable use of the term fulldome was in a 1999 article from the IPS (International Planetarium Society) Technical Committee.

Other terminology for the space or format within the sector includes digital dome, digital planetarium, immersion dome, and 360 dome. Contributors have also made reference to virtual reality in descriptions of the fulldome space when explaining the format to those unfamiliar with it, calling the fulldome 'headset-free VR' or 'VR for the masses'.

Cultural content

Throughout this report we will refer to 'cultural content' or 'cultural fulldome content'. By this we and our contributors are referring to screen content, which can also include live performance, that is not space or science focused and therefore would not fit within a planetarium's standard programming.

The language of new fulldome venues

Throughout this report we will refer to ‘cultural fulldomes’ or ‘cultural fulldome venues’, by which we mean fulldome spaces that are not planetariums and were instead created primarily for artistic and cultural content without the need for that content to have a space or science focus.

These venues, however, describe their spaces and activities in various different ways. Here are examples of non-planetarium dome venues around the world through the last few years, and how they describe themselves:

- The Vortex dome opened in Los Angeles in 2010 and operated until the pandemic forced its temporary closure. Vortex describes itself as a 360 digital dome and geodesic dome venue and its operator regularly uses the phrase ‘fulldome’.
- SAT in Montreal, which opened in 2011, refers to its fulldome venue as the Satosphere, a dome, and an immersive modular theatre.
- A cultural space in LA called Wisdome was opened in 2019 until 2022, featuring five temporary fulldome spaces of different sizes, and referred to itself as an ‘immersive art and music dome park’.
- CultVR opened in 2020 in Cardiff, and refers to its fulldome space as an immersive theatre, and an immersive 3D dome.
- Market Hall, which opened in Plymouth in 2021, refers to its fulldome space as an immersive dome.
- The Sphere, which opened in 2023, is a fulldome venue in that it has a dome-shaped screen surrounding the audience, but is branded simply as Sphere, with none of their public-facing communication referring to ‘fulldome’, instead describing themselves as an ‘immersive destination’.
- COSM, due to open their first public-facing venues in 2024, is both a studio and a venue operator currently working on opening their first public-facing venues. They refer to these venues as ‘Shared Reality’ and ‘immersive venues’ but not as ‘fulldome’. They do, however, refer to their expertise in ‘fulldome filmmaking’, ‘VR’, and ‘fulldome content’.

A brief history of fulldome

Planetarium origins

The Zeiss company opened the first planetarium projector in the early 1920s. This innovation allowed audiences to experience astronomy in a way that had never been possible before, and planetariums quickly spread worldwide. Over the years, the technology has evolved, from analog projectors to digital systems that can add more versatility and complexity to their initial remit of accurately recreating the night sky and celestial phenomena. With the evolution of technology – both in projection and in digital content creation – have come artists who see the planetarium as a place for the exhibition of art that is not necessarily attached to its space and science origins. This artform is generally referred to by artists and other sector professionals as 'fulldome'.

Evolution of tech

Projection domes are the norm in planetariums, with projectors being used to throw images onto the blank surface of the dome in a typical planetarium.

Planetariums have seen a fascinating evolution in projection and media systems. In the early days, the primary projection system was the star projector, which simulated the night sky by shining light through tiny holes in a spherical projection surface. As technology progressed, various systems were introduced, enhancing the immersive experience:

Opto-Mechanical Projectors: These were the first projectors used in planetariums, employing actual light sources to project stars and celestial bodies, and have long been the backbone of planetarium experiences. Despite the digital revolution in projection technology, there's emerging evidence of a renaissance in the use of opto-mechanical systems. Enthusiasts and purists appreciate the authentic and analog quality of the starry skies these projectors produce, unmatched by digital counterparts for their depth and realism. This resurgence is not just driven by nostalgia but also by the recognition of the unique educational value and tactile experience that opto-mechanical projectors provide. Institutions including GOTO HYBRID Planetariums and companies like ZEISS are increasingly integrating these projectors alongside digital systems, offering audiences a blend of historical authenticity and contemporary possibility.

A brief history of fulldome

Laser Systems: These played a pivotal role, acting as a bridge between opto-mechanical and digital projection technologies. These advanced systems marked a significant departure from traditional methods by allowing for the projection of content far beyond mere star fields. With the introduction of laser systems, fulldome experiences were enriched with vibrant, dynamic visuals, ranging from intricate astronomical phenomena to immersive abstract art. This innovation not only enhanced the visual experience but also expanded the scope of content that could be presented in planetariums and fulldome theatres, setting the stage for the fully digital fulldome systems that followed.

Digital Planetarium Systems: These modern systems replaced the older opto-mechanical projectors. They use digital projectors, computers, and specialised software to display incredibly detailed and accurate representations of the night sky. They can simulate not only the stars but also various celestial phenomena and educational content.

Fulldome Video Systems: Fulldome video systems project images and videos onto a hemispherical dome, offering immersive experiences beyond star projections. These can showcase educational content, simulated space flights, and visually stunning representations of celestial bodies and phenomena.

Hybrid Systems: Some planetariums use a combination of digital projectors, optical projectors, and video systems to create a comprehensive experience. These systems merge various technologies for a more dynamic and detailed representation of the cosmos.

Augmented Reality (AR) and Virtual Reality (VR): Some planetariums have started integrating AR and VR technologies to provide more interactive and immersive experiences for visitors. These systems allow users to explore the universe in a more hands-on and personalised manner.

The evolution of these systems has been marked by advancements in computing power, graphics capabilities, and our understanding of the cosmos. They have become more accurate, versatile, and engaging, offering visitors a more immersive and educational experience compared to the early days of the planetarium.

A brief history of fulldome

LED technology has, in the last few years, become advanced enough that curved surface LED screens can replace the previous blank surface and projection system. This provides a brighter and higher resolution image. Although the investment needed for these systems is very high.

In 2021 RSA Cosmos unveiled the world's first LED planetariums in Japan, and Dubai Expo 2020 (which took place in 2021) prominently featured an LED dome at the Al Wasl Plaza which was used for a variety of cultural content. Europe's first LED dome will be installed at Prague Planetarium and will open in the next 18 months.

While the kind of LED technology behind these and other newer planetarium and fulldome venues isn't currently installed in any fulldome venues in the UK, traditional projection works perfectly well in the smaller dome venues to deliver the same kind of content. Thus we can take advantage of the momentum these new venues are creating despite using pre-existing technology.

Cultural content evolution

Early milestones in the utilisation of planetariums for art and cultural expression mark the evolution of these spaces from purely scientific and educational to artistic and immersive experiences:

1950s-1960s:

San Francisco Morrison Planetarium: This planetarium in the California Academy of Sciences was among the first to use its dome for artistic presentations, integrating light shows and multimedia performances in the 1950s and 1960s. In 1957 the planetarium held the first of its *Vortex* concerts – the world's first psychedelic planetarium light show.

> **"In 1957, the world's first psychedelic planetarium light show was presented at Morrison Planetarium. These were the *Vortex* concerts.**
>
> **The original *Vortex* featured electronic music — which in the '50s didn't sound like what we might call electronic music today (if you're a fan of science fiction movies, think of the soundtrack to Forbidden Planet). Vortex was presented in five short runs through 1959, and even went outside the U.S. to Belgium and Canada.**
>
> **Ultimately, though, while audiences and critics liked it, the museum administration decided that *Vortex* attracted the 'wrong kind of crowd' — beatniks and other people who were more interested in art than in science."**
>
> **- Bing Quock, Morrison Planetarium**

Cultural content evolution

1990s-Present:

- The evolution of fulldome technology expanded the potential of planetariums for art and culture. Artists began to explore immersive storytelling, visual arts, and multimedia performances, pushing the boundaries of what could be achieved within these spaces
- Skyskan produced the first fulldome video system in 1998
- Also in 1998, the *Skyvision Project* was the very first fulldome animation ever produced, and was a collaboration between Albuquerque Natural History Museum and SkySkan, with work by Michaela French, Ryan Wyatt, David Beining and a team of creatives
- At Burning Man festival, the introduction of portable fulldome experiences, like the ones created by Pacific Domes and Fulldome Pro, marked a significant evolution in immersive environments. These domes paved the way for the multiple forms and sizes of portable planetarium domes available today.
- Established in the early 2000s, Elumenati projection systems are recognized for their role in immersive technology, catering to diverse sectors like education, entertainment, and research. The company has contributed to the evolution of immersive environments, particularly with the introduction of products like the GeoDome Panorama.

These milestones demonstrate the gradual transition of planetariums from spaces solely focused on astronomy education to venues that incorporate art, culture, and immersive experiences, reflecting a broader scope of human creativity and expression.

Artists can now create fulldome content exclusively for these spaces and see them screened at events celebrating the artform. Other forms of immersive media - such as virtual reality content made for VR headsets, or 360 degree video – can also be editorially and technically adapted for the dome.

Cultural content evolution

As fulldome technology developed, and the appetite for the creation and consumption of art and culture in these spaces developed alongside it, there were permanent or semi-permanent dome venues created purely or chiefly for artistic and cultural content.

In an early and very notable example from 2010, the Vortex dome opened in Los Angeles for the purpose of showcasing artistic and cultural content. Vortex collaborated with brands as well as artists from a variety of artforms, and brought together live and digital activity in a similar way to the Las Vegas Sphere today.

In 2019, the Wisdome dome park opened in Los Angeles with five temporary fulldome structures housing art exhibitions with physical and digital art, as well as fulldome film screenings, DJ and VJ events, and live music with fulldome visuals. The venue also held wellness events including gong baths and meditation with fulldome visuals.

Fulldome as a medium has more recently been brought to global attention with the opening of the Sphere in Las Vegas in October 2023, a form of fulldome venue never before attempted – either in scale, technology, cost or business model. Madison Square Gardens Entertainment (MSGE) opened Sphere in Las Vegas as a cultural fulldome venue with the largest and highest resolution LED screen in the world. It has huge visibility online thanks to its external projection visuals and advertising campaigns, as well as providing a creative display for passers-by. It is both a screening and a live performance venue, and its programme alternates between a custom fulldome film by director Darren Aronofsky, and a series of live performances by musicians such as U2, Phish and Dead & Company, all accompanied by custom fulldome visuals.

Regardless of the longer term plans for Sphere, it has inspired audiences both in-person and online with the possibilities offered by immersive screen venues. Multiple permanent cultural fulldome venues will open to the public in the US within a 12-month period – their marketing efforts contributing to growing awareness of an artform that fulldome professionals agree is difficult to describe.

In 2022 COSM created a form of fulldome venue which uses LED screens to show immersive content. Beginning with a prototype in Salt Lake City in the US, COSM will open a public-facing venue in Los Angeles and Dallas in 2024, while hinting at another two venues over the next 18 months. Content planned so far is a mixture of sporting and cultural event immersive screenings including Cirque du Soleil performances.

Cultural content evolution

These new big budget venues join smaller, well-established and world-leading cultural fulldome venues in Canada (SAT), the UK (Cult VR and Market Hall), Australia (Wonderdome) and Turkey (Digiverse) among others, who are pioneering the routes to audiences for fulldome artists and filmmakers.

There are now around 4000 planetariums and fulldome venues worldwide, and contributors estimate that only around 1% of these are cultural-led fulldome venues rather than planetariums. Of those planetariums, around 1500 are open to public-facing cultural content.

Contributors felt that the increasing number of very visible cultural fulldome venues such as Sphere and COSM may see audience expectations shifting to expect cultural content at their local planetarium, making this a timely opportunity for fulldome venues to diversify their programming to include cultural content.

The fulldome venue spectrum

The visual effect of being immersed in or surrounded by visual art within a curved dome-shaped screen is the single common trait of all planetarium or fulldome venues, but how they achieve this from a technical point of view can differ greatly from venue to venue.

Projection systems

By far the most common kind of fulldome venue is a planetarium – a space and science led venue the earliest examples of which used a star projector.

Depending on their budget, remit, interest, date of opening, and other considerations, some planetariums have systems at the older end of this spectrum while others have the most modern and flexible.

Systems include:

- Digital Planetarium Systems
- Fulldome Video Systems
- Hybrid Systems
- LED domes which don't use projection

Outputs

Video formats also vary, including:

- Fulldome Video
- Domemaster
- Warped and Blend
- 3D Stereoscopic
- Real-Time Rendering

Along with various audio setups, and current redevelopment of the UK's main planetaria to new digital and 3D systems (for example, Bristol's We the Curious is due to reopen in July 2024 after a refurbishment), there is no standard setup for individual planetariums (see Standardisation below). As part of our recommendations (see Recommendations section), logging of systems and requirements for content across UK venues should be

The fulldome venue spectrum

created to enable artists and cultural producers to format their work for venues in as standardised a way as possible. This exists on fddb.org, however the date of information input is not logged and may not reflect current developments, and is difficult to understand for those not already working in the planetarium sector or those with limited technical knowledge about each system's capabilties.

Physical space set-up

Aside from the projection systems, there can be differences in the physical set-up of each dome. These differences include:

- The capacity of the venue
- Whether there is seating
- Whether that seating is fixed or moveable
- If the seating is fixed, whether it is directional or in the round
- Whether the screen is tilted
- Whether the screen is 180 or 210 degrees
- Whether the floor is raked or flat
- Whether there is a stage area

These variables may not affect the technical display of content but they do bring up editorial considerations around how much of the image is visible, which parts of the image to show or not, and in which direction the audience may be looking at any time.

As part of our research for this report we reached out to the 24 public facing planetarium/fulldome venues in the UK and Ireland to understand what the variations of technology and set up currently exist. We made contact with 20 venues and received responses from 13.

From this research we understand that 85% of these venues have fixed single direction seating in rows and the capacity ranges from 24 to 168 for those with fixed seating and reaches up to 200 people for the 15% with unfixed seats. 31% have a tilted screen and 46% have some infrastructure to hold live performances, and 69% have some kind of stage area. As above, logging of current planetaria formats with 'last updated' information is recommended on any existing or new databases.

The fulldome venue spectrum

Standardisation

A challenge often faced within the sector is that ‘every dome is different’, which is evidenced to some extent by the consultation survey with the existing venues.

Fulldome and planetarium setups vary significantly from one venue to another with a unique mix of capacity, seating arrangement and projection system in each dome. The presents several challenges and barriers for creators and performances:

- Technical Specifications: Each fulldome or planetarium often has unique technical specifications, such as different dome sizes, resolutions, projection systems, and audio setups. Adapting content to fit these diverse technical specifications can be challenging for creators, requiring adjustments in content creation to ensure optimal viewing and auditory experiences for audiences in each venue.
- Content Adaptation: Content designed for one specific dome or projection system might not translate seamlessly to other setups. Creators may need to modify or adapt their content to suit various dome configurations and ensure that the visuals and audio align correctly across different venues.
- Production Costs: Creating content that is compatible with multiple fulldome or planetarium setups can increase production costs. Ensuring that the content looks and sounds its best across diverse venues may require additional resources, time, and specialised expertise.
- Limited Accessibility: Not all fulldome or planetarium venues have the same accessibility in terms of technology, equipment, or resources. This can limit the reach of certain performances or creations, as some venues may not have the necessary capabilities to host specific types of content.
- Testing and Calibration: Before a performance, creators often need time for testing and calibration to ensure that the content displays correctly within the unique specifications of each venue. This process can be time-consuming and may require adjustments for each location.
- Audience Experience: Variations in dome sizes, seating arrangements, and viewing angles can affect the audience experience. Some audience members may have a less optimal viewing position or experience based on the particular setup of a venue, impacting their overall immersion in the performance.

The fulldome venue spectrum

To mitigate these barriers, creators often employ strategies such as creating adaptable content that can be fine-tuned for different setups, collaborating closely with technical teams at each venue, and utilising technology that allows for more flexible and scalable content delivery. Additionally, standardisation efforts within the fulldome and planetarium industry could help reduce some of these challenges by establishing more consistent technical specifications across venues.

Standardisation of format would allow easier sharing of work between other venues such as planetariums and cultural fulldomes running on compatible systems and open to touring work, ensuring a minimum standard of quality. This is an issue raised by contributor and fulldome expert Ed Lantz, co-founder of IMERSA, who helped to author the industry-wide standards of the Giant Screen Cinema Association with their 'Unified Standards and Specifications' guidelines.

Added to this, new LED fulldome venues COSM and Sphere have their own proprietary media systems. As one contributor put it, these new venues are 'walled gardens' and do not appear to be set up to share content with other venues outside their own networks (though it should be noted that contributors were still overwhelmingly positive about these venues' work and influence on public awareness of fulldome).

"My future vision is for a dome theatre consortium or franchise where member theatres meet minimum tech specs, trade excellent positive social impact programming that meets minimum quality standards, and pool resources to produce new shows, plus serve as a resource for local communities as planetariums have for the last 100 years."

- Ed Lantz

The art of fulldome filmmaking

Fulldome filmmaking is a unique artform that should be acknowledged and presented as an important part of the history and creative language of fulldome as well as an active artistic medium.

There is a long history of artists making work that is specifically and only for the dome, using a variety of animation techniques – from hand drawn and stop animation to computer animation – and live capture video footage.

Tools used for the creation of other forms of immersive and digital media such as virtual reality, augmented reality, streaming, video games, 360 degree video, and spatial audio have all been used by fulldome artists to create fulldome-specific experiences.

Animated fulldome films may be tailored to the dome's curved surface, emphasising the shape of the dome itself. An example of work that uses the shape of the dome is *Climate Crimes* (2019) by Michaela French, which makes visual reference to the dome throughout, making audiences aware of the shape of the space.

Other work created specifically for the dome makes no reference to the shape of the dome at all. The dome shape allows the audience to be immersed in the infinite, which is why it is so effective for space-related content.

With no corners to give away its real dimensions – unlike other kinds of immersive venues – the dome can disappear completely should the artist wish, and the space can appear to be any size or shape desired.

Fulldome artists frequently play with this illusion, turning the dome into expansive landscapes, architecture and abstract patterns, or appearing to bring it closer to the audience. Live captured video footage, meanwhile, transforms the dome into different real world environments.

Contributors frequently discussed the difference between fulldome and traditional film formats, from both a creator and an audience perspective. Fulldome film is an immersive medium in which the filmmaker creates an environment in which to place the audience throughout the film, and is a more intense sensory experience than viewing a flat screen. When discussing the differences between the two formats, Jena Fulldome Festival said: "the dome is closest to human perception and reflects this most accurately".

The need for an archive

There is currently no active curated archive of fulldome art and cultural content that we are aware of, either for reference or exhibition, and this makes tracing the history of the format difficult for anyone wishing to learn more about it.

Different kinds of work are created for fulldome which may be narrative, abstract, animated, filmed, created specifically for fulldome, or adapted from other mediums. This also made it difficult to find a singular collection of historical cultural fulldome content online. Fulldome film festivals have been a useful place to find cultural content. To research the potential of a cultural content fulldome archive we worked with Fulldome UK Festival to explore their historical data and compile a list of content which could progress to an archive.

As part of this research, Michaela French surveyed members of the Fulldome Creative Network on their thoughts about the need for an archive documenting the history of fulldome art and cultural content.

This international collection of artists, venues, events and distributors meets regularly to share news, opportunities and conversations aimed at moving the sector forward together, and its members are familiar with the obstacles which currently need to be addressed.

Survey respondents within the existing fulldome community felt that an archive would be a useful resource for them, to see what others have done and to delve into the history and language of the medium, to stay on top of its development.

Respondents also suggested the archive could be a place to document experimentation and change, and an inclusive collection that demonstrated the breadth of work available. They suggested this could, however, include some adaptations from VR and 360 video pieces.

If this archive content were to be distributed, respondents were keen that licensing and copyright issues be properly covered to protect artists, and that artists should be paid for their work if that work were exhibited.

The need for an archive

These respondents also said that a content archive should be user-generated but with some element of moderation and tagging. When asked where such an archive should be hosted, there were a variety of responses, including existing resource Fulldome Database.

The Fulldome Database website fddb.org is very well established and is the closest thing to a cultural content archive online. This is a user-generated library of content for planetariums and fulldomes where filmmakers can upload imagery, clips and contact information about their work for venues and events to browse. The website is currently dominated by space and science content, although it does have some cultural work including live performances.

FDDB does not act as a distributor and does not licence any of the content on the website. Website founder Dario Tiveron told us that this is a service he has no plans to provide, although he says this is something content creators have approached him about. He also acknowledged gaps in the content where individual artists who have created short pieces of cultural content are often fearful of adding their work in the mistaken belief that their work does not belong there, and that the database is not for them.

Despite this, the two UK cultural fulldome venues we spoke with – CultVR and Market Hall – both cited FDDB as one of the places they regularly find work to screen. By Dario's calculations there are 12,000 registered users of the website around the world, which he estimates as "99% of anybody working in domes".

With planetariums and fulldome venues looking to FDDB to find new content, at the same time as individual artists may be self-excluding from it, this suggests that some cultural content is being missed by venues browsing the database.

Current cultural content and where to find it

Content creators

Creators of cultural fulldome content tend to fall into at least one of three categories: production studios, individual artists, and cultural venues. There are UK content creation studios based at planetariums, such as NSC Creative at the National Space Centre in Leicester, making space and science content for other planetariums while also making some cultural content (for example their recent show *Pink Floyd - The Dark Side of the Moon*). Cultural fulldome venue CultVR in Cardiff also runs the creative content studio 4Pi productions (winners of the Best Use of the Dome prize at Fulldome UK 2023 for *The Voyage of Arka Kinari*). Market Hall in the UK and SAT in Montreal also support artists to make their own cultural content through residencies, training and access to their facilities and expertise.

While studios and larger creative teams have the resources to make fulldome films of 20 minutes plus – enough to programme as standalone planetarium content – and the knowledge and networks to distribute them, much of the cultural content gathered by fulldome festivals is the work of individual artists and is only a few minutes long. Most of the content submitted to Fulldome UK Festival, for example, is between 3 and 7 minutes long, and this is typical of the submissions from individual artists.

In 2018 the team behind Vortex worked with musician James Hood to create *Mesmerica*. This is a music-led abstract film for planetariums and fulldomes which regularly plays at planetariums around the world, showing that cultural content can and does work in these spaces. However, running at one hour long, it is usually programmed as a standalone screening. Shorter pieces by individual artists are unable to do this without efforts to curate a longer programme. *Mesmerica* executive producer Ed Lantz recalls showing a shorter film of around 11 minutes at the Wisdome venue in Los Angeles, and curating live activity around it to create an evening programme which could be ticketed.

There are two very dominant niches that fulldome content has tended to fall into when it comes to individual ticketed films, both of which have found their audience through fulldome. The first being the space and science shown in planetariums, and the second being about psychedelia and consciousness expansion shown in some planetarium and cultural fulldome venues. *Mesmerica* and its follow-up, *Beautifica*, are examples of this kind of content, and it was largely this kind of content that Wisdome in Los Angeles

hosted along with gong baths and meditations. Both of these niches have found their place in the dome because of its communal experience and ability to inspire awe.

There are also a significant number of films submitted to fulldome festivals every year which do not fit into the two categories above, and which explore the dome in very different ways.

However, several of our contributors noted that it is a regular occurrence for an artist to create and submit one outstanding piece of work to a fulldome festival, only for that work and that artist to disappear with no follow-up screenings and no follow-up work. Among the reasons suggested for this are a lack of career routes for fulldome artists, a lack of knowledge of the sector, a lack of funding and support for their work, and a lack of lifespan for work beyond the festival circuit which may cause artists to reconsider creating further work.

Live performance

Live Cinema UK's initial interest in fulldome was sparked by the versatility of these spaces for live performance mixed with digital art. Sphere has demonstrated the potential for live music in fulldome to a broad audience most recently with their U2, Phish and Dead & Company shows, but this is not the first or only example of live music with immersive visuals in a fulldome venue. CultVR regularly hosts live music performances in their Cardiff dome, as do SAT in Montreal, and Market Hall in Plymouth. Wisdome in Los Angeles was a regular live music venue until its temporary closure in 2022.

Just as many festival headline sets and stadium shows include visual art on the big screens designed specifically to work with the artist's live performance and material, the visuals accompanying live music at Sphere are there to augment the live music and further immerse the audience.

A notable development for the Phish shows at Sphere was the production of the visuals by the live music division of immersive events studio Moment Factory, whose previous work with the band and with other musical artists has been at traditional large stage set-ups such as stadiums and festivals.

Current cultural content and where to find it

Gigs in fulldome venues have their roots in the laser shows of the 1970s, when planetariums in the US opened their doors to nighttime audiences for gigs and listening parties with immersive visuals. Music festivals like Glastonbury and Burning Man have also hosted dome venues with immersive visuals.

The *Mesmerica* film initially began life as a live music performance with accompanying visuals, and a screen-only version was created to enable it to tour more frequently independent of James Hood's presence at the show.

Theatre, dance, storytelling, DJing and VJing are also tried and tested live performances that work well in fulldome. In 2018 4Pi Productions created *Liminality* – a dance piece performed in a dome with accompanying visuals – and in 2022 they produced *Arka Kinari*, a fulldome documentary with accompanying live music performance and storytelling.

Examples of cultural content in fulldomes and planetariums

Some planetariums in the US and Europe are and have been showing cultural content and profiting from it in terms of audience reach and financial return. Where cultural content has been introduced, it has boomed, for example at the Museum of Science in Boston, cultural content now subsidises the regular science programming, generating over $100,000 annually. Current cultural programming includes *The Divas Experience*, *The Lady Gaga Experience*, *The David Bowie Experience* and *Laser Floyd*.

Wisdome temporary dome park in Los Angeles (cited by the NME as the future of music venues) opened in November 2018 as a commercial cultural fulldome venue. Its large dome space (capacity 600) hosted live music, immersive films, immersive events combining digital and in-person elements, and traditional film nights.

By January 2019 it had more than 16,000 visitors paying an average of $25 each for a ticket. At the SXSW conference in 2022, Wisdome created an unofficial 'dome park' in Austin for the duration of the event, showing film, live music and NFTs to an audience of delegates and members of the public.

Current cultural content and where to find it

Fulldome festivals

Fulldome festivals are well established around the world, largely serving a community of people who already have an interest – or a professional role – in fulldome. Fulldome festivals are the only consistent way artists can get their work into fulldome venues, with venues otherwise programming any cultural content internally and sporadically. These festivals exhibit a range of content including narrative, abstract, live capture, animation, cultural and space/science.

Europe's longest-running fulldome festival, Jena FullDome Festival in Germany, was established in 2007 and invites fulldome professionals to gather and hear from each other, but also has individually ticketed cultural events in the evening.

The Fulldome UK Festival began in 2010 at Plymouth University, and has moved around the UK to Thinktank Planetarium in Birmingham, the National Space Centre in Leicester and the Market Hall Dome in Plymouth. In 2023 it took place in Cardiff at CultVR, and will do again in 2024. The Festival has international links with other fulldome festivals and serves the fulldome community by showcasing new film and performance, technology demos, professional talks, and networking. In 2022 the festival had a separate public-facing programme showcasing some of the festival's film content for the first time.

Four international fulldome festivals synched up their events during the pandemic in 2021 in order to jointly promote and celebrate the best content that had been submitted to their festivals. This joint celebration is now the Best of Earth Awards, and work is submitted not by artists but by the participating festivals:

- SAT Fest, Montréal, Canada
- FullDome Festival, Jena, Germany
- Dome Fest West, Los Angeles, USA
- Fulldome UK Festival, United Kingdom
- Dome Under Festival, Melbourne, Australia

There are also conference events with a broader industry rather than an arts focus, such as IMERSA, which has a strong representation from planetariums but which still highlights cultural fulldome within their programme, showcasing both new work and new technology.

Current cultural content and where to find it

Traditional film and music festivals

Aside from dedicated fulldome festivals, it is also possible to see narrative fulldome content exhibited at other festivals and events either within planetariums or in smaller temporary domes.

For example, in 2019, International Documentary Festival Amsterdam (IDFA) together with IDFA DocLab introduced a new, complete cross-media market called IDFA DocLab Forum, where the projects presented can find their way to new partnerships, receive in-depth feedback, and explore new ways to move forward.

The DocLab Forum is open to all sorts of non-fiction artworks in all production and financing stages that use emerging media to represent reality, including web experiences, multimedia journalism, digital art, games, audio experiences, immersive experiences (such as VR/AR/MR, social VR and fulldome films), physical installations, live performances, and immersive theatre. The festival takes place around the city and exhibits fulldome films in the ARTIS planetarium.

Music festival Simple Things in Bristol has also previously used the planetarium venue at We The Curious to screen fulldome films and performances as part of its programming – including the visual album *Sphere* by artist Robot Koch. Mutek in Montreal has shown fulldome content in the SAT dome venue there, and Electric Dreams immersive festival during Adelaide Fringe in Australia has incorporated fulldome screenings into its programme with great success.

Immersive content has also screened in temporary domes such as at Widescreen Weekend festival in Bradford, Sheffield DocFest, Reeperbahn Festival in Hamburg, and at Burning Man and SXSW in the USA, among others. In these instances the dome is one of many experiences available to a more general festival audience.

Current licensing models and distribution

Licensing models

There are several licensing options currently being used to exhibit fulldome content to planetariums, either space and science films or longer form cultural content such as *Mesmerica*.

- Festival licence: A fixed price and fixed duration licence for the duration of a festival. This requires all legal documentation and transporting the drive.
- Day licence: A fixed price licence for a one-day event. This requires all legal documentation and transporting the drive.
- Gate share: A pricing model used mainly for portable domes. This is hard to police and to monitor numbers, and requires all legal documentation and transporting the drive.
- Pay per view / on demand: Content is made available to venues on a pay-per-view basis. This is usually low cost and it is hard to police the number of times a venue screens a piece of content.
- Venue Hire: The producer hires the fulldome venue outright, sells tickets and keeps the income as well as the audience data. This requires that the producer do all the marketing and take all the risk. For popular music-based shows with an established audience this can work well, however this was not a standard option offered by many of the venues who responded to our survey.
- Annual Subscription model: This is a model in which venues pay an annual price to a producer for which they expect a new show every year. This establishes long-running relationships between venues and creators. This model is currently in use by many planetariums, who may show the same film several times every day.
- Royalty Model: In this model the producer agrees a percentage split of ticket sales, and will only receive this income once their show has played.
- Creative Commons: This is when a project is agreed to be screened with no fee to the artist.
- Licensing scales: If a venue pays a fixed price for a show, that price may be dictated by the size of the planetarium or fulldome venue. Licences are sold for 1, 3, 5 or up to 20 years.
- Collaborative Productions: Collaborative efforts between content creators and fulldome venues may involve shared production costs and revenue-sharing agreements. In this model, both parties contribute to the creation and distribution of content.

Current licensing models and distribution

Distribution models

With an existing network of planetariums around the world whose remit is to deliver space and science related content, the producers of such content have a clear and well established distribution route for their work. There are two established distribution models for traditional planetarium content: direct distribution, or via an in-country distributor.

Direct distribution means producers keep the entire fee, but this can be a complex process which takes a lot of time, while also requiring the correct legal documents in the correct languages, and making the creator responsible for shipping a physical drive to the exhibitor.

Working with an in-country distributor can make the contracting easier where there is a language barrier between creator and exhibitor, and offers instant access to a network of exhibitors which may otherwise be difficult to reach. This way of working also means marketing is taken care of by the distributor. The downside is that distributors will take a cut of up to 30% and sometimes charge for marketing costs as well, and producers are never directly in contact with the exhibitors to build those relationships.

Notable distributors of fulldome include Diversion Cinema in Paris – who work in wider XR exhibition but distribute a curated package of the fulldome content they represent – and Hubblo in Montreal, who focus on fulldome content.

For cultural content the pathways are less established as the landscape, growth of the sector and technology evolves. Currently the primary routes to distribution for cultural content are:

Fulldome festivals

As previously mentioned, there are multiple fulldome-specific festivals around the world. These festivals hold open calls each year which individual artists or studios can respond to with their latest work. The audience for these festivals is largely artists/creatives and festival or conference delegates with some connection to the sector, but some do also have a public programme too.

Current licensing models and distribution

Film festivals

There are a growing number of traditional film festivals which have access to a planetarium or which have a temporary fulldome available during the festival, who have introduced immersive sections which enable fulldome filmmakers or distributors to submit their work. As with fulldome festivals, these events are a mixture of artists, industry professionals and a public audience.

Individual planetariums

Our survey of UK and Ireland planetariums showed that all surveyed programme their content independently. It also showed that venues want to programme cultural content more regularly, and that they have specific outcomes they want to achieve which cultural content could support. When asked about their specific goals as an organisation, 100% of venues surveyed cited expanding their programming and 89% said working with local creatives, while 78% also wanted to grow their audience numbers and 89% to expand their audience demographic.

Of the 13 UK fulldome venues we surveyed, 69% said they programme any cultural content, but with the exception of Market Hall (which programmes weekly cultural content) and CultVR (which programmes monthly cultural content) the frequency of this programming is ad hoc.

Cultural content in planetarium venues is sporadic, and quarterly at best, but the examples of SAT, Market Hall and CultVR show that it is possible to build a regular local audience based around this kind of programming.

When asked about how they source their cultural content, both Market Hall and CultVR cited the website fddb.org – the Fulldome Database website – alongside the more sporadic activities of scouting content at fulldome festivals, direct contact with artists, and producing their own work.

Challenges for artists and venues

“Each artist is required to be a pioneer as they carve out their individual fulldome careers”

- IDFA DocLab Forum 2021

As identified in the reports from the IDFA Doclab Forum roundtable discussions, there are limited pathway for individual artists to have their cultural fulldome work seen by audiences over the long term or outside fulldome festivals. The process of getting cultural work exhibited in fulldome is currently artist-led, with creators responsible for getting their work in front of programmers, whether they approach individual venues or festivals.

Independent creators are more likely to create shorter pieces of work that cannot be screened alone and which – if they are exhibited in a fulldome – are screened as part of a larger programme. These larger programmes may include fulldome festivals at either planetariums or cultural fulldome venues; screening events at the few cultural fulldome venues; or the rare curated slates of content for planetariums such as the package of four fulldome films distributed by Diversion Cinema.

This is not the case with space and science content, or breakthrough cultural content such as *Mesmerica (*60 mins, 2018*)* or *Pink Floyd - The Dark Side of the Moon* (44 mins, 2023) which are longer and can be screened as standalone films.

With few clear routes to have their work seen and toured, independent artists have limited opportunities for career development in the medium. There is also the issue of a lack of access to fulldome spaces for research and testing, a vital part for the development of new work.

According to our research, venues claim the biggest barriers to programming cultural content is financial risk and/or lack of resources, with some citing challenges with audience engagement and a lack of knowledge of existing content. To overcome these challenges, 78% of venues said they need financial support, 50% need support with marketing and 44% need content ideas.

Challenges for artists and venues

Three out of the four venues who are not currently exhibiting cultural fulldome content – but have expressed a desire to do so – have a lack of resources, and two venues lack the knowledge to find enough cultural content to develop regular activity to reach and retain new audiences.

A comparison with traditional film exhibition

Compare the above with the way independent film releases reach their intended audiences:

Theatrical release into cinemas: Distributors work with a network of available cultural venues to enable new work to connect with established audiences, supported by marketing activity. Fulldome work has only a very small network of fulldome venues in the UK regularly showing cultural content. Most potential screening venues, such as planetariums, have no established audiences for cultural content and there is no one-size-fits-all licensing in place for such content.

Film festivals: This is an area of crossover for some fulldome work, with immersive content forming a growing part of film festival programming, and fulldome exhibition could see significant growth at traditional film festivals.

Online platforms and streaming services: Fulldome has been and can be exhibited online, for example in virtual domes within AltSpaceVR on Oculus (now Meta) VR headsets during the online version of Burning Man in 2020. Without a headset, however, there is none of the intended sense of immersion; even with a headset, the audience experience is very different from seeing the same work in a physical dome.

There is also an issue with headset ownership and limited access. According to Kantar TGI consumer data 2023, 6% of adults (3.2 million people) claim to own a VR headset, with 3% of adults (1.6million people) claiming to actually use one themselves. Prohibitive cost, access needs, and lack of knowledge or confidence can all affect use and ownership of VR headsets, as can the perception of headsets as devices for gaming rather than other kinds of cultural experiences.

Potential content

The following are all forms of cultural content that could be available for cultural programming in fulldome or planetarium venues, both now and in the future.

Live performance

Domes can act as scenography, an interactive environment, or a canvas for a live performer, and live performances of all kinds are currently available for fulldome. With such a versatile and flexible space there are opportunities for live performers from an array of disciplines to develop new work for the space even if they have never worked – or even been in – a fulldome before.

Through our work with artists as part of our XR Stories funded Surround Stories project, we brought a cohort of artists from different disciplines to the CultVR dome in Cardiff so they could learn about the space and come up with new ideas around how to use it for a project of their own. Among the work developed during this lab was a theatre piece, a live music performance with immersive visuals, and an audio-responsive piece of art to accompany live discussion-based events.

One of the artists in the lab was UK-based turntablist Duncan Beiny (DJ Yoda) who created an AV (audio-visual) performance for the dome, with audio and visuals mixed live. Duncan has previously created a range of AV shows for traditional flat screen venues using content including film clips, memes, TV shows and social media content, including one themed around the Netflix show *Stranger Things*. The new fulldome show created from the lab was performed at CultVR during lockdowns and streamed live online, has since been performed to live audiences at CultVR and Market Hall, and is looking to tour more fulldome venues.

"I work with samples, especially video samples from YouTube and movies, but I feel the dome aspect allows you to make that much more immersive and much more about environment rather than just samples from TV programs. For instance, I've done a lot of stuff with *Stranger Things*, and previously I would have taken clips from *Stranger Things* and used that in an audio visual show. But with the dome, it made me think, I can actually put people in The Upside Down, in the actual environment."

- DJ Yoda

Potential content

Live interactivity

Interactivity in fulldome experiences enhances engagement, immersion, and user agency, offering a dynamic and personalised dimension to the overall experience. Interactivity allows participants to actively influence and shape the narrative or content within a fulldome environment, transforming the audience from passive spectators into active participants.

This engagement fosters a deeper connection with the content, as users feel a sense of control and influence over their virtual surroundings. Interactive elements can include real-time manipulation of visuals, exploration of virtual environments, or participation in decision-making processes within the immersive setting.

New forms of interactivity in the dome are regularly tested and showcased at fulldome festivals and conferences, from talks and tech demos to live performances, yet wider public engagement with this work is limited.

A few examples of fulldome interactivity exhibited or created by report contributors:

- A dance performance by a performer wearing motion capture equipment, affecting visuals in real time
- A beatboxing performance with audio affecting the visuals in real time
- A VJing performance using both immersive and flat content
- Kinect motion sensors creating real time visual effects
- Visual elements created by audience members inserted into realtime scenes
- Multiplayer games using phone web browsers to manipulate each player's avatar
- Live voting via mobile web browser to show real time poll results
- Live data visualisation of weather in multiple remote locations
- Wearable tech monitoring audience breathing, affecting visuals in real time
- Physical props which affect the the dome visuals when moved by the audience
- Live video gameplay by a single player for an audience

Potential content

Fulldome festival submissions

Fulldome festivals are one of a small number of established ways artists producing cultural content can have their work shown in a fulldome venue. Fulldome festivals are a key part of the cultural content pipeline and we have found them to be an invaluable resource for scoping cultural content being created by individual artists that we may not otherwise have seen. The fact that this work has made it through the evaluation process of a fulldome festival ensures it meets standards already set by those festivals for exhibition to an audience.

Best of Earth submissions

All cultural content chosen by the Best of Earth panel – made up of five international fulldome festivals – has not only met the fulldome festivals' standards but gone through a further round of filtering to produce an annual collection of what they judge to be the best fulldome work from around the world.

Narrative VR headset content

'From 2019 to 2024, it is expected there will be a 78.3% growth rate for spending on AR and VR in the UK. Growth is predicted to reach £62.5 billion by 2030' - UK DBT

Headset-based virtual reality narrative content, such as films and story-led immersive experiences, is now commonplace at film festivals around the world and its cultural value is recognised alongside traditional flat film formats.

Exhibited in headsets as experiences for one audience member at a time, virtual reality narrative content can be found at Cannes, Sundance, SXSW, Sheffield DocFest and Tribeca among many others.

Apart from festivals there have been examples of VR experiences touring traditional screen venues in the UK. In 2022, StoryFutures toured Asif Kapadia's *Laika* to five cinema venues across the UK (Chapter, Cardiff; Watershed, Bristol; Broadway, Nottingham; Showroom, Sheffield; BFI Southbank, London). In 2023, StoryFutures launched the VR R&D National Showcasing Programme to support creators with VR content that could be adapted or repurposed for Meta Quest 2 headsets to find a new audience via an extensive network of

Potential content

libraries and independent cinemas and arts venues across the UK. This R&D resulted in StoryFutures Xperience, which has showcased VR experiences in leading independent cinemas and arts centres across the UK including: Chapter, Cardiff; Dundee Contemporary Arts Centre, Dundee; Queens Film Theatre, Belfast; Showroom Cinema, Sheffield; and Depot, Lewes.

All received specialist equipment and training from the StoryFutures team for audiences to enjoy a range of VR experiences. As a part of the programme, the five partner venues pioneered innovative types of distribution models for VR location-based entertainment that connects with new audiences.

The Metaverse

Another potential source of content comes from the Metaverse, where live events in mass participatory online digital platforms can be captured and converted for dome audiences.

Avinash Changa, of AR and VR company WeMakeVR, said: "This is something that I see emerging in the more Metaverse type performance performative XR type world where we start to see a lot of content that is going to come to make sense commercially and creatively for domes. We see a lot of live performances taking place, either virtual concerts, or interactive life experiences, live actors, stages, operas, you name it. There are filmmakers who specialise in filming these experiences that take place in the metaverse, and converting those to something that looks interesting in a YouTube stream or potentially even a dome."

Transmedia experiences

The dome doesn't have to be standalone, and can play a part in a larger experience that brings in multiple kinds of media. For example, Wisdome used their multiple domes to create walk-through exhibitions that related to *Samskara*, the fulldome film they were showing as their main opening content in their largest dome.

The team behind Vortex are currently working with the producers of Amazon series *The Wheel Of Time* to create a walkthrough immersive experience which includes a dome as well as other elements.

Case study: Emika

Emika (Ema Jolly) is a classically trained musician and independent electronic music artist who rose to success in 2011 with her self-titled debut album. Her individual tracks on Spotify have been streamed up to 17 million times, she has ranked top of the iTunes charts in Canada and number 2 in the US, and her work has featured on Hollywood soundtracks and in ads for international brands.

Emika began exploring planetarium shows at the Berlin ZeissGrossplanetarium as part of a drive by the venue to create a concert series there.

Continuing her collaboration with László Bordos, who created 3D mapped visuals in philharmonic spaces for her symphony *Melanfonie*, Emike created a new piano-led live music show for planetariums: *If We Disappear*.

Emika said: “In over 10+ years since my first album, I struggled to find the right kind of place and setting for my music live. As I am a solo performer, classically trained and with a BA in Creative Music Technology. I love to perform live, sing, play piano, bring my synthesisers from my studio, and all of this doesn’t work well live in a club as that world is for DJs. And often my music is too Electronic for Classical venues, and live music venues look for bands generally not solo performers.

“This is not about clubbing. It’s about building a beautiful immersive live-show that has a special kind of value as an experience, one that is worth charging people tickets for, not as a way to promote an album release.”

Emika has found that the planetarium space was somewhere she could take advantage of the available technology to make new experiences for her fans in a controlled environment, with no age barriers and no focus on alcohol, which can be the case with other live shows.

The show has visited new planetarium venues in Europe since first appearing in Berlin, including Hamburg, Prague, Chórzow, Moscow, Munster and Jena, sometimes over multiple nights in the same venue. The team works with each planetarium and adjusts to the differing environments to ensure consistency between shows and seats.

It has received positive feedback from audiences and has sold out every time at around €27 per ticket, enabling Emika to cover the entire cost of production.

Case study: Goliath

The UK's investment in producing narrative VR work has yielded some notable examples that have toured the festival circuit, such as *Goliath*. This 25-minute animation began life as a narrative piece for the headset, has to date featured at 38 international festivals, and is still being programmed.

Goliath won the following awards:

- Grand Jury Prize for Best VR Work at the 78th Venice International Film Festival
- 8 awards (including Impact Award and Best Interactive Experience) at the 2021 XR Awards
- Best XR International Documentary at PRIX NUMIX
- Jury Distinction (VR Work) at Annecy Festival
- Best XR/VR at Brazil's Independent Games Festival
- GIFFMX 2022 - Ganador - Mejor Uso de la Realidad Virtual at GIFF

Goliath was also nominated for the following awards:

- Emmy Award in the Outstanding Interactive Media Innovation category
- International Immersive Award at Geneva International Film Festival
- Official VR competition selection at Anifilm Festival

Goliath then became available on VR distribution platforms; a multi award-winning international phenomenon with an at-home audience limited to headset-owners, or programmed into public VR exhibition limited by headset capacity,

But *Goliath* found a new form of exhibition beyond the headset, as an immersive projection experience at OASIS in Montreal – the largest immersive exhibit of its kind in Canada. OASIS opened in 2021 and had 150,000 visitors in its first year, all of whom were able to see immersive content in an immersive way without the need for their own devices. The screening of *Goliath* was part of a larger exhibition in which several VR pieces that were repurposed for the projection mapped OASIS venue – where VR is not something the venue usually exhibits.

As part of the process of repurposing the content for OASIS, new content was created to map onto the floor during the screening, and some of the narrative experience was edited to remove some elements of interactivity.

By taking these experiences out of headsets and into an immersive screen environments, the number of people able to see these pieces increases significantly as the demographic widens and public exhibitions have more capacity.

VR to fulldome

Filmmakers may repurpose their work for fulldome or other immersive spaces, either to attract a broader audience, to address accessibility issues, or to create a new experience entirely.

SAT Montreal have spoken to multiple exhibitors who have approached the venue to hire space for the exhibition of work in headsets. The SAT team has explained each time the economic benefit of showcasing that same work in their dome, due to the significant increase in the number of people who will be able to experience the work in the same period of time.

There are numerous examples of specific pieces being created for the VR headset and for fulldome simultaneously, or repurposed for exhibition between the two. One such example is *The Orchid And The Bee* (5 mins, 2020) by Frances Adair McKenzie, who is based in Montreal. The piece has been shown in VR headset and in dome and has been programmed either in dome or VR headset at SAT Fest, Mutek, Geneva International Film Festival, Spark Animation Festival, Annecy International Animation Festival, Ottawa International Animation Festival, Fantoche International Animation Festival, and Bucheon International Animation Festival, among others. Frances told us how she had produced a fulldome version of the stop-motion animation piece after shooting for a VR headset, using the same original files. The fulldome version has screened at events including the IMERSA conference in Montreal.

By her estimation, exporting a fulldome version added only a few hours to overall production time, and was an easier process preferable to creating for a VR headset. Frances and her team also had access to the physical space of the dome at SAT during production, a benefit that cannot be underestimated when it comes to creating work for the dome.

“How we originally ended up going into fulldome was my producer said ‘we should have a walkthrough’ because we were dealing with all these issues of the pandemic. We created this beautiful piece for VR, and no one ever saw it, because really one of the places where the public has access to VR headsets is in the public realm of a festival, and most of the festivals went online, and that was very sad. We had the walkthrough, which was just really used for uploading on YouTube and pitching the piece to festivals, etc. Fulldome was the next step, it was really exciting to develop the pipeline and now I would never do a project without that feed. VR is interesting to me, but I think spending time with other people is more important than being locked into one realm.”

- Frances Adair Mckenzie

VR to fulldome

A UK-produced example of this diversion between headset and fulldome is *Vestige* (13 mins, 2018, NSC Creative), a short film that has shown both at Fulldome UK and is available for headsets via online platforms.

Live Cinema UK has also worked with Yorkshire-based production company Tyke Films to explore the production of a fulldome version of their animated VR film *Plunge*. This process involved taking part in a lab at CultVR and working with the CultVR team to look at the pre production process ensuring a fulldome piece could be produced at the same time as the version for the VR headset.

Digital artist Marco Brambilla has had a single piece of work, *Heaven's Gate*, shown in VR headsets and on flat screens in galleries such at the PHI Centre in Montreal. It has also been shown on the Outernet immersive screen venue in London on its video walls, and most recently on the outside of Sphere in Las Vegas. One of his works, *King Size*, was made for the U2 show at Sphere, to be shown on the inside of the venue. Both pieces of work are highly detailed, with some of that detail being visible only when screened in the immersive venues and not in the headset.

In the specific cases of Sphere and Outernet, these both have high resolution LED screens and, while these same levels of resolution are not something most planetariums can currently replicate, projection domes can offer higher resolution than the VR headset; this is an important consideration for artists.

Avinash has explored in depth the technical and editorial challenges of putting VR work into fulldome. He said: "When you shoot something in VR, your resolution is not super high, especially pieces that already exist, anything that's been shot in, let's say 2014 to 2019 is going to be 2k at best. Most domes use minimum 4k projection."

Upscaling existing work for domes using Artificial Intelligence tools is possible in some cases, and so is creating new work with a greater level of detail without that detail getting lost in VR presentation.

VR to fulldome

Editorial considerations

Contributors to our report felt that repurposing a VR piece for a dome may be a more faithful form of exhibition than other kinds of immersive venues, with both VR and fulldome presenting 'cornerless' exhibition which allows artists to play with audiences' perception of space.

But even though it may be technically possible to convert VR for fulldome, this won't be a suitable or desirable output for every piece. For example, where the headset is a useful tool for inspiring one-to-one empathy – placing a single viewer into a human scale experience alone – the dome has been referred to by contributors as a tool for inspiring awe.

Editorially the filmmaker must consider whether the change in perspective, from human scale to much larger fulldome scale, changes the experience of the work in any unintended or undesirable way; a face-to-face conversation with a human scale character in virtual reality, which is intended to be a positive experience, may instead become an intimidating one when that character is displayed in the dome and is so much larger than the audience.

When shooting and editing 360 degree video, filmmakers must consider that the entire image is captured but that it cannot all be shown in the dome at once – as the dome is a hemisphere and not a full sphere. Understanding how the footage will look in a dome is a key editorial consideration.

Any elements of interactivity in a VR experience must also be considered when repurposing this content for a fulldome. This may be as simple as filming a play-through or walk-through version of the experience within the software, creating a fulldome-ready screen recording of the piece which can then be played in the dome without interactivity. There are also ways to incorporate interactivity into the fulldome experience, as already highlighted.

Avinash said that while "technically, getting something to be projected on a dome can be quite simple in a sense", there are multiple things to consider that impact the way the work appears in the dome. These include resolution, field of view, interactivity, warping, perspective and vision comfort, among others.

Some of these issues can be tackled with specific processes and software, some must be considered at the point of production, and some are at the filmmaker's creative discretion.

VR to fulldome

Avinash said: “I think it's case by case because in some cases, it can be super simple. ‘We've got this project, it's been set up in Unreal or Unity, we drop in a camera, render it out, done’, and you can go from your VR piece to showing something in your dome in under a couple of days. And in some cases, there are even tools that could make this happen in real time – ‘Here's your VR piece, now it's on the dome and it took us only five minutes’. Whereas the other end of the spectrum, it can be really involved.”

Even when the process is a simple one, there are still barriers around knowledge, made more difficult by the lack of standardised and documented language of fulldome. With these two artforms being so distinctly different in terms of exhibition and audience experience, understanding those differences is key for artists wanting to adapt work or to move from one medium to another.

“One of the hardest things with tackling and documenting or reporting the process and the challenges and the domain of going from VR to fulldome,” said Avinash, “is that most of the audience don't have the language, they don't have the terminology that is involved. So that's something that you need to tackle first.”

Opportunities

Worldwide there are 3,000 fulldome spaces, the majority being planetariums. 30 of those are in the UK. Only a handful are public-facing and devoted purely to cultural activity, and two of these are in the UK – CultVR in Cardiff, and the Market Hall in Plymouth. We have evidenced throughout this report how these spaces are used for a huge variety of cultural events in the US, Canada, Europe and the UK, and how their use is growing as they become tipped as 'the future of venues'.

This is a particularly exciting and important moment for the fulldome sector. Prominent examples like Sphere and COSM will draw attention to the potential of fulldome. As a result will highlight the use of planetarium venues for arts and culture, inspire audiences to seek out these kinds of experiences, and show creatives that this is a medium in which cultural work can be made.

While the opportunities presented in this report existed prior to the opening of Sphere and COSM, these new venues have added more momentum to the spread and awareness of this collective immersive artform.

Through research, discussion with our contributors, feedback from surveys and observations of the fulldome and XR sectors, we have identified some key opportunities.

Quality of current UK talent and growing number of resources

The UK is not currently cohesively supporting and promoting our cultural fulldome work in the same way as Canada, for example, with whom the cultural fulldome sector regularly collaborates. This is evidenced by the difficulty some of our partners have found in attracting funding support for their work, which falls between different types of funding for different artforms.

This is despite sitting on a wealth of expertise and resources – already connected to the international fulldome community – that could prepare the UK for a prominent position within the growth of fulldome.

Should the growing XR sector in the UK in particular seek to capitalise on this new awareness of and interest in fulldome venues, the following people and organisations are UK-based, with many fulldome professionals playing multiple roles across content creation and exhibition internationally:

Opportunities

- 4Pi Productions and NSC Creative, for example, are creating cultural fulldome work that is regularly screened around the world, and both are working with interactive technology and with other artists to experiment with what is possible in the medium.

- The UK has one of the longest established fulldome festivals in the world, Fulldome UK, which attracts international guests and has a database of cultural fulldome work spanning the last 15 years.

- The UK has two cultural fulldome venues who regularly share and develop work in relationship with each other and with world-leading cultural fulldome SAT Montreal.

- CultVR in Cardiff is a fulldome venue in a former warehouse space and is operated by the team behind 4Pi Productions. They created the venue out of a need to have a space in the UK similar to SAT Montreal for the development and exhibition of their own and others' fulldome work. Their 12m 180 degree temporary dome is suspended from the ceiling, and regularly hosts immersive film screens, parties, VJ gigs, live music performance and theatre. Live Cinema UK has used this venue and the expertise of the team behind it to train artists from various mediums in taking their work into a fulldome space, and to create new work there.

- Market Hall in Plymouth is a 15m 210 degree dome which is a permanent structure with full immersion all the way down the floor, exactly the same kind of dome as SAT in Montreal. This venue is part of a larger renovation of an historic building which sought to bring the building back into use, specifically for the creative and cultural sectors. As well as the fulldome venue, the building houses co-working and meeting spaces and a cafe. Market Hall are also now producing their own fulldome work and working with other artists.

- The UK is home to academics who are internationally-renowned experts in fulldome technology, history and art, notably Professor Mike Phillips and Michaela French.

- The UK has technical experts who are regularly deployed around the world to venues and events where fulldome forms part of the programming. As well as running the Fulldome UK festival, Ben and Phil from GaiaNova provide technical support for other dome projects, as do the team behind 4Pi/CultVR.

Opportunities

This report also shows that the UK has multiple planetariums willing to screen cultural content.

In addition to the existing fulldome resources and expertise listed above, we also have creators making work for VR headsets which could be easily repurposed for these immersive screens, and examples of VR content creators who either have been through this process or would like to go through this process to make their work available for fulldome and showcase their work collectively to wider audiences.

Under-seen works potentially available to screen to new audiences

Considering the otherwise short lifespan of newly-released fulldome work, and the list of content gathered by Fulldome UK, there exists an opportunity to screen some of this work to new audiences within UK planetarium venues. This is work which has already met a quality threshold that has seen it included in at least one fulldome festival.

The age of the work is irrelevant to audiences who are new to this medium and looking for cultural content, meaning work that was exhibited even 10-15 years ago can be brought into planetariums for the first time, subject to any required upscaling and to obtaining the most suitable licensing agreements.

Potential for exhibition of VR/360 work to audiences without headsets

As we have seen from the headset-to-fulldome examples within this report, as well as the technical capabilities many planetariums in the UK currently possess, there is an opportunity to take 360 degree work made for the VR headset and exhibit it in a fulldome space. This opens up the potential audience for this work to include those who do not attend film festivals, do not own a headset, or self exclude from headset-based experiences. It also offers those with certain access needs the opportunity to see this work where they may not otherwise be able to.

Crucially, it gives audiences the chance to experience the work in an immersive way. This does not have to compete with VR headset work but can also be a way to promote it to new audiences.

Opportunities

Cross-artform collaborations with live performers to develop new work for fulldome

By supporting planetariums to develop cultural programmes and audiences, there is an opportunity to encourage live performers to consider these spaces for their work as well. In our and our contributors' experience, artists and performers of all kinds are able to work in a fulldome and to imagine ways to use these spaces to augment their art in some way.

As an organisation that seeks to mix live performance with big screen exhibition, Live Cinema UK is particularly keen to support new live performance in these kinds of venues as their numbers grow, creating an international touring circuit for artists who can develop work for these spaces.

According to our survey, most planetarium and dome venues in the UK and Ireland who are exhibiting cultural content are already incorporating some kind of live performance, so this is an area that can be developed, creating work that can tour.

Current 'immersive venues' boom

As big budget cultural fulldome venues are opening, audiences are becoming aware of and desiring access to them. Multiple contributors predicted that an ecosystem of cultural fulldome venues is likely to follow the opening of Sphere and COSM. This is in addition to the growing number of planetariums looking for cultural content, which contributors also predicted would also follow the hype around these new venues.

Along with so many of our contributors, we have found it difficult to explain the fulldome medium and cultural fulldome content to anyone who hasn't yet experienced it; this has changed dramatically since the images and videos from Sphere have been shared across social media, creating an easy reference point.

What we are also seeing from responses on social media is that interest in visiting Sphere, for example, is not only driven by the desire to see specific musical artists, but by a desire to experience the venue and visuals.

The opportunity exists to offer this experience to audiences in the UK by taking cultural work into planetariums which – although smaller and with projection rather than LED systems – can provide cultural fulldome screenings. With the majority of planetariums who responded to our

Opportunities

survey seeking to expand their audiences and also their programming, this is a moment in which they could do both. There is a clear opportunity to build a regular audience for cultural programming among the UK's planetariums.

The success of the Charles Hayden Planetarium in Boston is a perfect example of what can happen when planetariums open their programming – especially their evening programming – to cultural content. The team in Boston regularly host cultural evening events including drag shows and music listening parties, and have been so successful that the cultural programme now subsidises the science and education programming.

Fulldome producer Kate McCulloch said that smaller venues can also explore smaller scale cultural content. Talking about her work with the much smaller Vortex dome, Kate said: "We had amazing projects come through: Ballet, opera, performance art, music, dance, musicals, theatre, comedy, poetry readings, cinema, music videos, shoots." She went on to describe the dome in general as "a synergistic hybrid" that could open up to multiple artforms regardless of its scale.

Opportunities for new content routes to market

Taking into account our findings so far, and the resources already available within the fulldome and wider XR sectors, there are some potential ways new work could follow a pipeline to reach new audiences.

From fulldome festivals to content archive

Fulldome festivals are already flashpoints for the discovery and exhibition of new fulldome cultural content. Creators are familiar enough with these annual events to submit more work each year than can feasibly be screened.

As Fulldome UK's content list demonstrates, this work can be gathered each year and curated for exhibition or archived for future use, making fulldome festivals an important part of the potential distribution routes for cultural fulldome content.

From fulldome venues to content archive

Fulldome venues such as CultVR, Market Hall and SAT Montreal – which run residencies and labs and fund the creation of new work – are active places to find new fulldome films and filmmaking talent, whether or not this work is showcased at festivals. With the creation of a content archive, this work can become available to tour at any point, regardless of festivals' cycles.

From VR headset to content archive

As new narrative VR work is created for the headset, content creators, funders, distributors and festivals can all play a part in identifying work that could be repurposed for fulldome exhibition. Ideally this would be considered at the point of pre-production, ensuring it is created in a way that allows easy conversion to fulldome.

As new narrative VR work is submitted to festivals each year, this same work would be put into a content archive for potential fulldome exhibition and made available to fulldome venues and planetariums.

Opportunities for new content routes to market

Curation of content packages for planetariums

Finding work is one of the obstacles identified by planetariums when it comes to exhibiting cultural content. Cultural content is not their main focus, and allocating resources to finding and curating cultural content is not something many planetariums feel able to do. However, with VR distributors and fulldome festivals feeding content into an archive, cultural content packages can be curated for planetariums to screen.

When licensing this content to planetarium and fulldome venues, any agreements should take into account the varying sizes of venues and recognise that a per screening model will not suit every planetarium. Instead, licensing should be tailored to the capacity of each planetarium, giving them each the opportunity to profit from successful screenings.

Recommendations

In order for the fulldome sector in the UK to grow, and for there are some clear courses of action that we and our contributors recommend.

Build a network of planetariums for fulldome cultural content to reach audiences

Fulldome as a medium is growing rapidly, both in audience awareness and in the number of venue operators and creators venturing into it. Meanwhile, planetariums are venues which were created to show immersive screen content in fulldome format, albeit for content of a specific nature.

If planetariums are able and prepared to make their venues available for content that falls outside their space and science focus, these venues can fulfil their own ambitions to find new audiences and diversify their programming, while also creating new audiences for artists, and creating a touring network of venues in which to see cultural fulldome work. This could in turn highlight the UK as a place where fulldome art is created and exhibited, preparing for the inevitable growth of the medium worldwide.

Opening up space and time in existing planetarium venues' programming where cultural work can be exhibited can contribute to the career pipeline for both live performers and filmmakers or visual artists who are interested in making work for this medium. There is the potential for the UK's planetariums to play a role in supporting the creation and exhibition of new fulldome shows which can then go on to tour internationally and to take advantage of this emerging ecosystem.

Among the intentions of Ed Lantz and the Dome Fest West team is to bring Hollywood-level filmmaking to fulldome screens. With director Darren Aronofsky creating the opening film for Sphere in Las Vegas, this is a logical route for the future.

Foster collaboration between visual/digital artist and live performers

As the concerts at Sphere have demonstrated, live shows in these venues inevitably involve a collaboration between performers and visual artists. In the same way as U2 worked with artists like Industrial Light & Magic and Marco Brambilla, any live performer creating a show for a planetarium or fulldome venue can collaborate with an artist who knows how to create or adapt visual work for a dome using any of the readily-available software. This offers

Recommendations

opportunities not only for live musicians, theatre performers, dancers etc, but also games designers, digital artists, animators and filmmakers to contribute to live shows.

Work with other events and venues

As with events like Simple Things in Bristol, Mutek in Montreal and IDFA, there is the opportunity to help planetariums to make links with larger cultural events and festivals around them and to incorporate some of this activity into their programming.

There is also an opportunity to work with existing events and festivals that do not have access to a permanent fulldome venue, supporting them in bringing in a temporary fulldome structure and programming it in line with their needs. This is something Live Cinema UK has done with the Widescreen Weekend at the National Science and Media Museum in Bradford and the Glasgow Film Festival as well as conference clients and academic partners.

Content packages

Roundtable discussions at IDFA identified a need for pre-packaged cultural programmes for trial distribution to planetariums, as well as an archive for educational purposes. The purpose of this project was to progress this idea with a UK-specific focus; to create and tour a package for UK planetariums and to monitor the progress of these screenings in reaching new audiences as well as audience feedback.

While the funding for this project did not cover the creation and implementation of a content package to tour planetariums in the UK, we have identified ways that this could be done as part of any future project. This includes programming, licensing terms, and an outline of which venues in the UK would be open to exhibiting this content.

Licensing for planetariums and artists

Among our recommendations for the above programme would be a licensing model in which artists are paid a fee each time their work is screened to a predefined number of people. Due to the varying sizes of planetariums and domes in the UK, a per-screening fee would be unrealistic for some venues. Instead we suggest a capacity-based fee structure which would allow smaller planetariums to screen a film a greater number of times to reach an audience equivalent to that of a larger venue.

Recommendations

A fulldome-specific cultural content archive

Through this research we have learned that there are multiple reasons that creating a content archive of work specifically created for fulldome could benefit the fulldome community as a whole. This includes artists, academics and venues. The survey conducted as part of this project outlined the need to document the work that has already been done in fulldome specifically, and to make it available as a learning resource.

To this we must also add the need to collate and document the individual artists' work which currently appears at festivals and nowhere else, potentially giving it more visibility and opportunities to be screened again.

Our proposal here is largely focused on the aim of expanding distribution pathways in order to establish new audiences as quickly as possible to take advantage of the current moment. However, we also understand and acknowledge that the elements of research and scholarship and sharing best practice are equally important, and further discussion about how this archive could support those needs is required.

As part of this process, the content list we have built and continue to build would need its own archive, and this could be listed on an existing site or a custom site, seeking all relevant permissions from artists as part of this process. To move to an archive of fulldome content, existing best practice in the moving image sector should be investigated with fulldome formats to be built into current and future planning; for example consulting the BFI National Archives, and engaging in wider discussion over how new technologies including XR and games are being archived by national institutions.

Standardisation

We recommend that the planetarium network in the UK work towards standardisation of technology, if not layout and capacity, as this is the main obstacle to showing content that does not include live performance. This would enable new creators to make a single version of any piece of work for a network of venues. Unless and until this time, we recommend supporting any project which demystifies and streamlines the process of creating work for multiple fulldome venues and their existing set-ups.

Recommendations

This could include any software project that covers presets for a number of different planetariums, and a single database outlining the capabilities of each planetarium. For any future project which includes the curation of content for exhibition across a number of UK planetariums, detailed information about the capabilities of each participating planetarium would be required in advance.

The work of 4Pi Productions and Ed Lantz should be supported as each of these is working towards creating materials to tackle this issue – 4Pi Productions with a software to replicate specific domes' settings, and Ed Lantz to create standardisation guidelines.

Building on the information gathered by fddb.org, we recommend a survey of all UK fulldome venues and planetariums to ensure any and all information about their current technical capabilities can be made available and presented in terms that can be easily understood by new artists and others interested in making work for these spaces. This requires a standardised approach to gathering the most relevant information for creators and exhibitors of fulldome art or art that can be adapted to fulldome.

Standardisation of language around fulldome should be encouraged and supported, not least because fulldome is a particular artform in itself, distinct from other artforms that can be adapted for fulldome venues.

Distribution support

While individual artists produce so much of the available fulldome work, including that already gathered in our growing content list, it is a different skill set altogether to sell and distribute this work – which currently would need to be done by approaching planetariums one-by-one. Added to this that the fulldome sector has no standard licensing model for cultural content, and there is a clear need for an intermediary process which finds this work and gives it a life beyond a single year of fulldome festivals.

Our ideal outcome is based on the model of the independent film sector. This would be for organisations to work directly with artists to acquire their work, curate programmes, and act as a single point of contact for planetariums. This is currently being done successfully by companies like Diversion Cinema, who offer packages such as *Dôme Électronique* – a 50-minute programme featuring four of the pieces they distribute.

Recommendations

With public funding support for a pilot programme, we can then enable planetariums to promote and screen this work. Those planetariums can then begin to build the cultural audiences they need to fulfil their ambitions, while facing minimal administration and financial risk.

It is not Live Cinema's intention to select fulldome films to be part of an archive for distribution. There are multiple international fulldome festivals within a single organised network who assess new content every year, and whose judgement and expertise is based on decades of experience in the artform. Their collective event, the Best of Earth Awards, creates a pipeline through which particularly outstanding new work can be identified and shared on a regular timetable, which could form the basis of an archive of films for potential distribution.

Enable and empower VR content creators

Finding suitable existing VR work that can be put into a fulldome can be done by monitoring film festival submissions, and working directly with funders supporting the development and/or exhibition of VR work.

By auditing existing UK fulldome narrative storytelling content and exhibiting this in a fulldome setting, we can present this as a new form of exhibition to VR creators, demystifying the reformatting of VR content for collective viewing, and making VR more accessible to wider audiences. In doing so, we would hope to inspire future creators of VR content to consider fulldome as another output at the point of production further expanding the knowledge of the medium and the content available for it.

Open fulldome spaces to creators

Access to the fulldome space is vital when creating work for the medium, as it's not always easy to predict whether something will work in the space otherwise. While there is software that can help to preview content, this is not comparable with having access to a physical space. We recommend that funders work with planetariums to give residency opportunities to artists in the same way as venues like SAT and CultVR currently do.

Through our work with artists in lab programmes we have seen the impact of physical access to spaces on both inspiration and understanding of the potential of the format, resulting in work that likely would not have been produced from just a digital approximation of a dome.

Recommendations

WeMakeVR are currently working on a global resource for creators which outlines – among other things – the technical and editorial decisions involved in repurposing work for fulldome, as well as the tools and resources required.

Avinash said: “We see that there is a need and a desire, from makers and from the industry at large to say, ‘we've got VR pieces, how can we share these pieces with a larger audience that does not is not wearing VR headsets?’

“We're sitting on this pile of knowledge, let's turn that into something interesting, because there's such a gap between the policymakers and the funding organisations in terms of their knowledge, versus the current real world needs. It makes sense to have this in a more structured format.”

We recommend supporting the work of WeMakeVR on the creation of resources for creators which covers the issues artists may face when repurposing or creating work for fulldome from VR tools.

Identify transmedia opportunities

Domes need not be closed spaces operating in isolation, or competing with VR and other forms of exhibition and entertainment. Instead they can be factored into overarching experiences and projects. The presence of a dome can enhance a larger project, while introducing new audiences to the medium and giving artists the opportunity to work across different mediums. Added to this there is an opportunity for event or experience producers to reach people who cannot use a headset, or currently have no interest in headset-based content.

Mapping fulldome into the wider landscape

We recommend that fulldome as a medium be explored by arts funders in the UK, and in particular we recommend that they look at areas where fulldome can enhance activity and help to meet long term goals around accessibility, immersive technology, and creative collaboration.

Further reading

In addition to the organisations and projects linked throughout this report, we would also like to include the following resources for further reading:

- Association of Fulldome Innovators - AFDI, the Association of Fulldome Innovators is a special interest group operating under the auspices and government of IMERSA. AFDI supports community-wide, professional standards to facilitate convergence of film domes and digital domes, and move the immersive dome medium forward. The de-facto industry standard dome master files are listed here

- Association of Fulldome Innovators (AFDI) Standards - This document describes a standard for metadata for distribution of sequences of frames. This work was initiated by and at the IMERSA Best Practices and Standards Summit in Denver in March 2014

- Fulldome Content Delivery Specifications: (from IMERSA / ADFA Industry specifications)

- Loch Ness Productions - UK-based fulldome content production company whose website also houses a list of suppliers and resources for fulldome venues

- British Fulldome Institute - Independent organisation promoting greater understanding of and access to fulldome

Appendix 1: Venue survey highlights

Of the UK and Ireland fulldome venues and planetariums we surveyed:

- 69% currently have cultural programming
- 46% have no cultural programming

Of those who have cultural programming:

- 67% include live performance.

100% of planetarium programming are made internally at each planetarium

When asked whether cultural programming attracts a different audience, one said:
“Yes, seems to attract more of a theatre/festival-going crowd, many people I spoke to haven't been to our centre before which gives the sense we're reaching outside of the science-centre bubble so-to-speak.”

These were the most common barriers preventing planetariums from doing any or more cultural programming:

- Financial risk 62%
- Lack of resources 85%

Only one planetarium cited programming policies as a barrier
Only one planetarium cited a lack of available timeslots

When asked what would help planetariums to do any or more cultural programming:

- Financial support 77%
- Marketing support 62%
- Content / content ideas 54%

When asked what their goals were as organisations, the most common answers were:

- Expand programming 62%
- Expand audience demographic 77%