CATAPULT Digital

Creative tools and workflows for immersive content creation

A report produced by Opposable Group and TechSpark for Digital Catapult, June 2018

Opposable Group

TechSPARK

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This report was produced by Opposable Group and TechSpark for Digital Catapult, and funded by Innovate UK.

Digital Catapult, Immerse UK and the High Value Manufacturing Catapult have been working together on a large-scale programme of business support, funded by Innovate UK, for the UK's immersive technology industries since September 2017.

This report forms part of that work along with the following complimentary reports:

- The Immersive Economy in the UK
  (Innovate UK, Immerse UK & Nesta)
- Growing Your VR/AR Business in the UK: A business and legal handbook
  (Digital Catapult and PwC)
- Immersive Content Formats for Future Audiences
  (Digital Catapult and Limina Immersive)
- Evaluating Immersive User Experience and Audience Impact
  (Digital Catapult, Nesta and i2Media Research)
- Immersive in manufacturing – the adoption and use of immersive technologies in manufacturing and a report covering the feasibility of the use of immersion in a digital twin
  (High Value Manufacturing Catapult).

Innovate UK is part of UK Research and Innovation, a non-departmental public body funded by a grant-in-aid from the UK government. We drive productivity and economic growth by supporting businesses to develop and realise the potential of new ideas, including those from the UK's world-class research base.

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Working with Innovate UK

FOREWORD

From fantastical virtual worlds, to augmented design tools and immersive training environments; VR and AR technology is opening doors to new opportunities every day.

Innovate UK's recent Knowledge Transfer Network report on The Immersive Economy in the UK estimates that Britain has around 1,000 immersive-specialist companies employing around 4,500 people and potentially representing as much as 9% of global market share. UK Creative Industries have a huge amount to contribute to this emerging immersive sector, not least because many of the skills involved are derived from different corners of this thriving, diverse and crucial part of the economy (such as film, TV, games, visual effects, etc).

But the challenges remain. As an early stage market with a varied set of creatives, technologists and researchers driving its development, we lack a common language to describe the way we create, define, refine and value immersive content.

Digital Catapult has commissioned a set of three reports from industry-leading companies to help demystify some of the common questions around the creation of immersive content. While there is a focus on the creative industries, much of this insight will extend across industry boundaries to other sectors implementing and experimenting with a broad and exciting range of immersive applications.

This report on creative tools and workflows for the immersive content creation, conducted by Opposable Group and TechSpark, looks at the key questions around content creation: How is content authored? What tools, techniques, skills, people, equipment will they need? What is best practice? What are the impacts of one workflow over another?

The report asks ten of the top UK immersive content makers drawn from across industry sectors to explain how they make their content, where they draw their influences, and any tips or tricks they have learnt. In doing so, the report puts together a snapshot of workflows, and examples of how content is being made right now across the creative industries, and provides original research into where the challenges and opportunities lie.

By sharing the insights from these reports, Digital Catapult hopes to consolidate key industry insights and help lower the barrier to entry to this exciting and rapidly growing market. The diversity of entrepreneurs, technologists, educators, developers and content makers working in this space is one of its greatest strengths, which is why we believe the UK will become the best place in the world to create immersive content and applications.

Jeremy Silver
CEO, Digital Catapult

Rebecca Gregory-Clarke
Lead Technologist - Immersive, Digital Catapult


oculus
VRWC
AMD
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VRWC
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EXPO WEDNESDAY
WILL WATSON
EDITOR
SKYLARK MEDIA

EXECUTIVE SUMMARY

The process by which any company creates products has a huge impact on its ability to do business profitably and to adapt to changing market demands; this will hold as true in the emerging immersive industries as it does in games, TV, film, video effects (VFX), animation and manufacturing enterprises.

This report finds that the immersive industry is still in a period of experimentation, largely driven by small teams from the games, TV, film, VFX and animation creative industries, but also by a number of enterprises, brands and within education. Content is commonly produced by creating interactive computer animated 3D models usually by games, VFX and animation companies or the use of 360° cameras, generally used by companies with a film background, or even by importing CAD models from data driven software packages by engineering or architectural firms. Audio also plays a key part of immersive productions, with new 3D sound techniques being developed in line with the visuals.

There are a number of different skills that need to be represented in an immersive team whatever their industry, but regardless of their specialism, most roles will be working in teams using one of a small number of technical and creative tools.

Based on interviews with VR producing companies including Aardman Animations, Airbus, BBC, BDH Productions, Make Media, REWIND, Sony Studios, Tiny Planets, Wales Interactive and UWE.

This report identifies a number of trends which have a direct impact on the way content is made:

BUDGETS are typically small in comparison to traditional games, film, TV, VFX or animation productions, largely because VR is not a mainstream activity and the commercial market is therefore not yet proven.

TEAM SIZES are typically fairly small, in general a VR team will consist of three to five core members, usually including a designer/director/producer, a coder, and 3D, animation and audio artists. Additional expertise and skills are then brought in as necessary depending on the project, with the largest teams working on a single production being about 30 people.

CONSUMER EXPECTATIONS are high based on 'AAA' budget game, film, TV, VFX and animation projects which can be a challenge to recreate on small budgets, however consumers are also enthusiastic for this new medium and the new creative experiences it can offer which companies can capitalise on.

DESIGNING for a medium where people can look anywhere at any time, yet otherwise have limited interaction with the virtual space, is a challenge; as teams are having to design new control and player direction methods.

WORKFLOWS are dynamic and based upon a project's desired outcome, studio working practice and the skills available to a team. In almost every case, studios are identifying challenges to their workflow, and using creativity and skills from outside their traditional base to solve these problems.

TOOLS are generally suitable for the task, with game engines such as Unity and Unreal becoming key components of immersive content production. The tools already available now enable a broad range of experiences to be created using a number of different techniques, however there is scope for improvement to make tools easier to use or generate new creative opportunities, already evidenced by growth of new tools.

SKILLS AND EXPERIENCE are in limited supply right now, however the immersive industry is creating new challenges that require solutions from unusual directions, encouraging a great deal of cross discipline experimentation and collaboration.

The report finds that within each industry there is an overlap of techniques with nascent workflows largely driven by previous experience, pulling in outside skills and adaptaions made on-the-fly to overcome creative challenges. The convergence of many different roles and industry backgrounds to solve problems with few standard practices, as well as a lack of education and professional training, is surfacing as a challenge in a number of areas. The industry will need to develop methods of coping with this, leading to faster workflows and new tools that will encourage more people to create and consume immersive experiences over the next decade.

INTRODUCTION AND METHODOLOGY

Immersive technologies, including Virtual Reality (VR) Augmented Reality (AR) and Mixed Reality (MR) form one of the priority growth technology areas for companies and startups, joining Artificial Intelligence (AI) and the Cloud as areas for innovation and investment by UK Government and Industry.

Despite only recently reaching market readiness, the immersive industry has seen rapid growth in the last few years, with the UK playing a leading part in terms of corporate exploration, prototyping and early services. The market is still small as there has not been enough time for consumers to find the killer app for Immersive, which means that investment into VR and AR content and software has been held back by expected short term returns.

Limitations on budget have an impact on the size of project teams and the amount of creative or technical input that can be put into developments. Small, experimental teams working with a new technology, with no given rules on how to treat the medium, have created an explosion of applications and experiences. But as the industry grows the teams will expand, and workflow and technique will become a key factor to separate the highly successful few from the failed many.

This report investigates the workflows and techniques, as well as some of the team makeups and skills represented from the primary industries creating VR content.

Interviews have been sought from teams working in VR from the following groups:

GAMES DEVELOPERS who traditionally create scenes using computer graphics, that are dynamic and react to player actions.

TV AND FILM PRODUCERS who traditionally create linear narratives and content using 2D cameras and stereo sound.

ANIMATION AND VFX STUDIOS who traditionally use computer graphics to generate scenes into linear narratives.

ENTERPRISE who are using information systems to manage processes and simulations to run scenarios looking for cost savings and new products.

BRANDS who traditionally create linear narratives using film, sound effects and animation to relay a message to new and existing audiences for a product.

MEDIA EDUCATORS who use and teach traditional linear narrative production techniques using a variety of production methods.

Company	Interviewee	Sector or Industry Background / Heritage	Project	Appendix
Aardman Animations	Dan Efergan Group Creative Director of Interactive	VFX & Animation	We Wait http://www.aardman.com/aardman-and-bbc-rd-launch-interactive-vr-experience-we-wait/	A1
Airbus	John Arundell Wing Engineering Specialist and Digital Transformation Leader	Enterprise	General Practice	A2
BBC	Paul Deane Digital Development Lead & Producer, Natural History Unit	TV & Film	Planet Earth II http://www.bbc.co.uk/programmes/articles/365zWpz7HypS4MxYmd0sS36/planet-earth-ii-in-360	A3
BDH Immersive	John Durrant Director	VFX & Animation	Wonderful You https://www.bdh.net/immersive/wonderful-you)	A4
Make Real	Sam Watts Director of Immersive Technologies	Brands	Top of the Crop http://www.makereal.co.uk/portfolio/mcdonalds-food-steps-vr-experiences/	A5
Rewind	Greg Furber VR Director	VFX & Animation	Ghost in the Shell http://rewind.co/portfolio/ghost-shell-virtual-reality-experience/	A6
Sony Studios	Stuart Whyte, Director of VR development, and Will Burdon, Technical Director	Games	VR Worlds https://www.playstation.com/en-gb/games/vr-worlds-ps4/	A7
Tiny Planets	Landia Egal Co-Founder	TV & Film	Welcome to the Savoy (In development)	A8
Wales Interactive	David Banner Managing Director	Games	Don't Knock Twice (http://www.walesinteractive.com/dontknocktwice)	A9
UWE	Jen Stein Professor of Design Futures	Education	General Practice	A10

There are many other companies and industries producing immersive content and given that the industry is moving so quickly there may be justification for further interviews and an extension to more industries, to create an expanding list of case studies and body of knowledge, however at this stage the main activity appears to be in these groups.

Grouping the companies is a challenge, for while all the companies have a heritage from one of the industries, many are now focusing on immersive technologies and so inventing their own techniques, collaborating across disciplines, finding new customers and testing different business models and becoming the first members of the emerging immersive industry.

Relevant excerpts of these interviews have been included in the Appendices. In general the key points of these interviews have been summarised to a few key points that highlight practical examples of these emerging production processes and workflows, alongside industry trends discussed with hundreds of industry professionals between 2015 and early 2018.

Finally, the report reviews the techniques and tools highlighted within the case studies and in each sector, and identifies challenges and opportunities presented in immersive workflows for the near future.

This report investigates the workflows and techniques, as well as some of the team makeups and skills represented, from the primary industries creating VR content.


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VR WORLD CONGRESS
HEADLINE SPONSOR
AMD
RADEON
DELEGATE
DR ALISON DIAPER
RESEARCHER
UNIVERSITY OF BRISTOL

GAMES - INSIGHTS FROM INTERACTIVE CONTENT CREATORS

Within the creative industries, the first adopters of VR headsets were gamers and the games industry largely because the tools used to build games and interactive 3D experiences are readily convertible to authoring immersive content. It therefore follows that immersive gaming is currently at the heart of everything VR and AR. There is still a lot other sectors can learn from how games companies go about building experiences.

There is a sense of energy and enthusiasm among games developers when it comes to VR and AR. There seems to be a belief that they are forging new ground, creating workarounds where problems in the workflow crop up, building their own tools and solutions to cope with unforeseen issues.

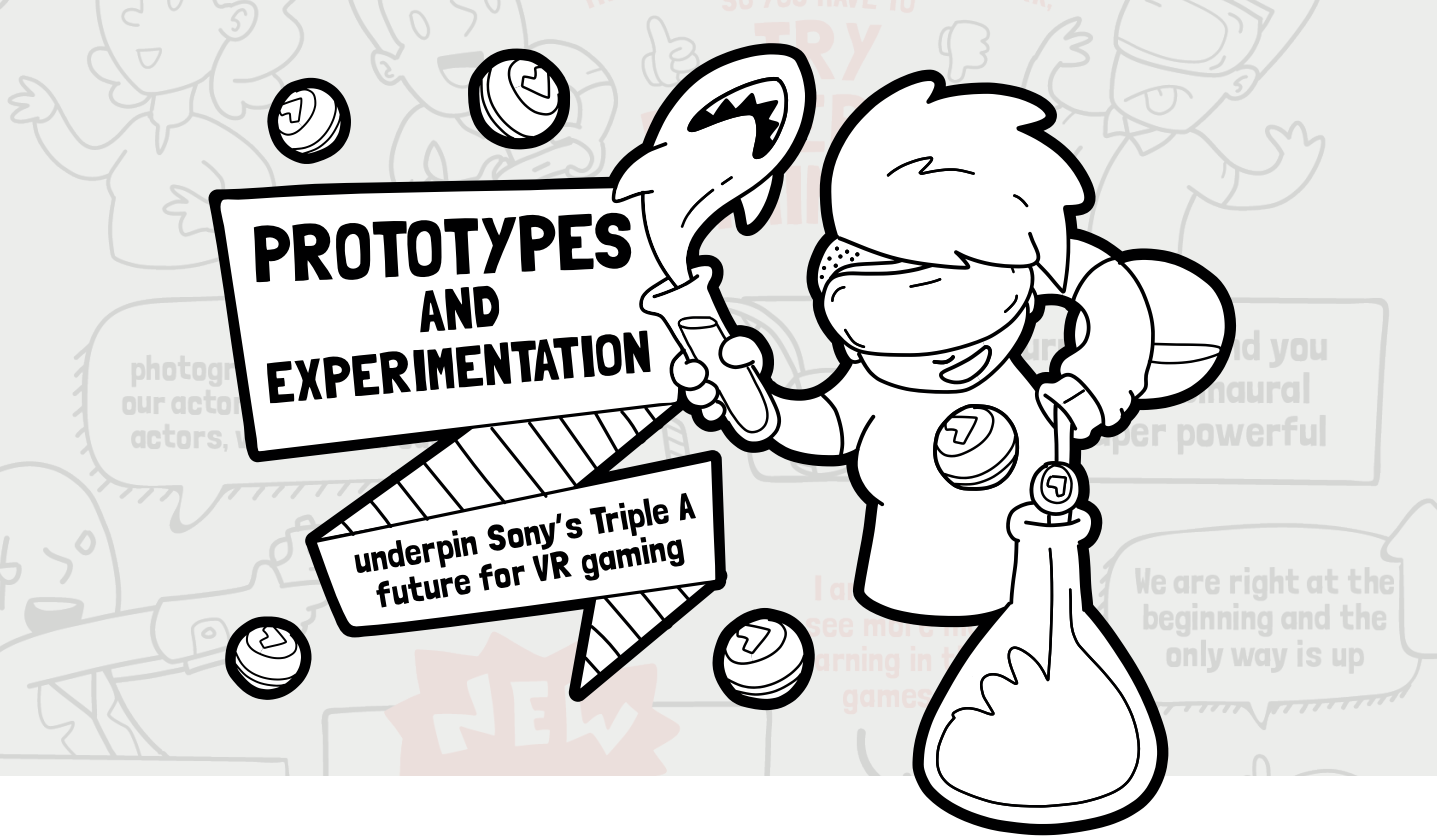
As a very brief summary of a complicated topic, a traditional game will be produced for players on mobile, PC or console with market demographics and competition being surprisingly broad across each. A game will be produced by a studio to their own design or commissioned by a publisher or property owner with team sizes ranging from one lone developer to a small independent (self financed) micro team through to large studios that may employ hundreds of people over many continents with budgets ranging accordingly.

A game will usually have a number of stages to development including concepting and design, prototyping, development, testing, launch and then post launch support and updates. There has been a recent trend for games to be developed as a service, with an early 'beta' version made available to test audiences with the bulk of development being completed as updates to the game made available to the test audiences, in some cases never finishing.

Funding can come from many angles, including the UK's prototype game fund or other competitions, crowd sourced finance, equity funding or publisher advances, often supported by R&D tax credits for video games.

The game development workflow has to revolve around the game being created, in general a game engine will be used to create the gameplay logic, and assets including code, 3D models, textures, effects and audio, must then be imported into the engine so that the gameplay logic can link in and coordinate the gameplay experience. Each asset type is created by specialist roles, who must all have some working knowledge of how their individual components contribute to the project for assets to be included without errors.

These interviews explore how game developers are changing their workflow for VR and the challenges they face.



Stuart Whyte, Director of VR product development, SIE London Studio and Will Burdon, Technical Director, SIE London Studio

Project:
VR Worlds

View Project

SONY STUDIOS

BACKGROUND

Sony Interactive Entertainment launched PlayStation VR (PS VR) in October 2016, with one of the most popular launch titles proving to be VR Worlds, conceived and developed by SIE London Studio. A collection of five different experiences, the overall objective for the game was to introduce players to what PS VR makes possible.

TEAM

Each mini-game had it's own team made up of artists, gameplay developers, producers and designers to provide a rich set of experiences.

WORKFLOW AND TOOLS

Team was split into pairs to explore different ideas, the results of which were evaluated and fed back into the design of the final games.

The workflow followed that of traditional game development, however assumptions based on decades of console game development had to be tested in VR and often new designs and solutions created for the medium.

The challenge and excitement around VR is that it is a very new space and some of those designs and languages from other games just don't work so well in this medium and yet there are alternate ways you can do it that are even better.

VERTICAL SLICE / TECHNICAL DEMO / PROTOTYPE

Often in the development of a VR project, a team will want to know if the application is technically feasible and produces the desired effect in the viewer. This may be a test of a specific design, or be used as a way of evaluating a number of designs against each other in a form of market testing. In these situations they may work on a technical demo, which is generally used where a new technology is being created or used and will demonstrate that the technology will perform as required within suitable frame rates or other criteria. In some cases a vertical slice is more suitable, particularly where the potential application is being evaluated against creative criteria, for example ensuring a game is fun in VR. Either way, such early developments are used to work out if a full production is justified.

MULTIPLAYER

VR experiences can be made multiplayer using one of many networking solutions provided by Unity, Unreal or third parties. Most development studios will be able to create multiplayer games which either use peer-to-peer connections in which all the players computers talk to each other or client-server connections, whereby all players' computers are in contact with a central server that passes messages around. Being immersed in VR with other people adds a great deal to any experience and there will be new applications and even workflows that are only possible with multiplayer VR. However efficient and error-free networking is a highly complex task which can add a great deal of development time to a production.

Most of the software tools used in VR development were the same as in game development, including Maya for creating 3D assets.

SIE London Studio tailored their own bespoke game development engine rather than Unity or Unreal, based upon their own experience creating game engines for console. This allows far more control, integration with PSVR features and optimisation of the software by their team, rather than relying on support from Unity or Unreal who have to support multiple platforms. Use of their own internal game engine means the gameplay programmers can access the properties (things like weight and friction of objects) that allow them to create unique gameplay logic.

Use of photogrammetry, volumetric capture or motion capture to scan in actors is allowing for unprecedented levels of realism in games. Part of this is managing actors similar to a film or theatre production, even going as far as maintaining a wardrobe for actors.

Use of 3D sound is a very powerful part of a VR game. Sony employ a doctorate in acoustic design to simulate, test and program incredibly subtle effects. These are key to the depth of immersion in the games.

CHALLENGES

VR games are very different from traditional screen based console games, which means that understanding what would and would not work could not be drawn from previous experience.

VR experiences have to run at a very high and stable framerate to avoid player sickness, which requires a lot of optimisation and ensuring models render efficiently. With VR this needs to be built in from the beginning to aid testing, whereas in traditional game development optimisation often occurs once the majority of gameplay has been created.

VR has no established control schemes, whereas in traditional games there have been generations of iterating control improvements. While this can be a challenge, there are many opportunities as there are alternate and better ways to interact with interactive experiences, and exploring how existing genres work in the freedom of VR.

In order to maintain frame rates there is a heavier emphasis on VFX and effects programming skills to get more impact from less complex models.

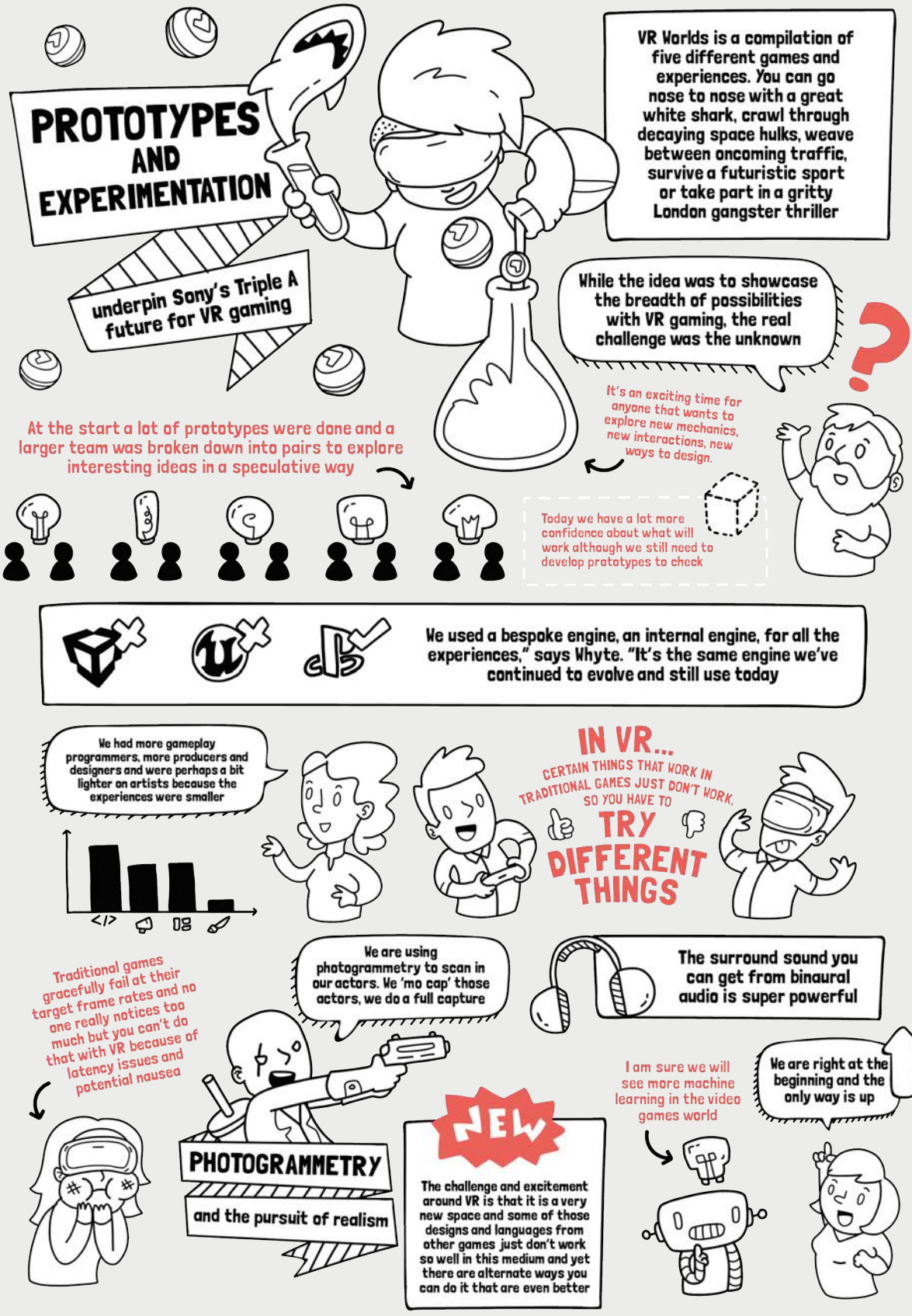
Physicality, or the lack of being able to interact with real-world, physical objects, is currently an area of interest for Sony.

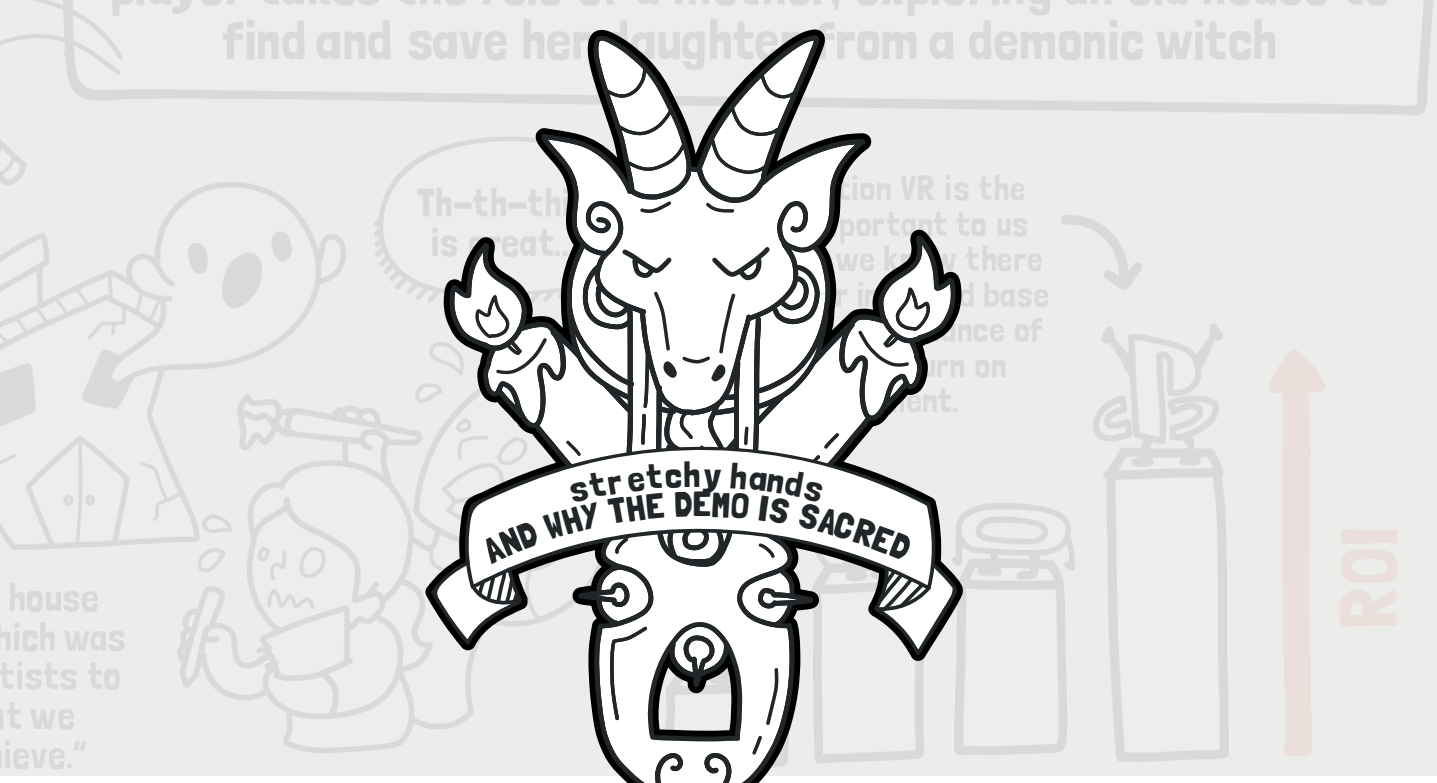
"It's so new. I think in traditional games we've taken many generations and iterations of designs, around control schemes, and so on.The challenge and excitement around VR is that it is a very new space and some of those designs and languages from other games just don't work so well in this medium and yet there are alternate ways you can do it that are even better."

Stuart Whyte SIE London Studio

GREY-BOXING

When a project is being prototyped, many elements of the scene will be unknown and so the developer will use grey-box analysis to debug software and propose the placement of objects that will later on be replaced with high definition models. It enables a tester to try out scenarios with limited knowledge of the internal details of a programme.These are literally grey boxes or cubes that do not have any colours, textures or lightmaps applied and hence look grey.


PROTOTYPES AND EXPERIMENTATION
underpin Sony's Triple A future for VR gaming
VR Worlds is a compilation of five different games and experiences. You can go nose to nose with a great white shark, crawl through decaying space hulks, weave between oncoming traffic, survive a futuristic sport or take part in a gritty London gangster thriller
While the idea was to showcase the breadth of possibilities with VR gaming, the real challenge was the unknown
It's an exciting time for anyone that wants to explore new mechanics, new interactions, new ways to design.
At the start a lot of prototypes were done and a larger team was broken down into pairs to explore interesting ideas in a speculative way
Today we have a lot more confidence about what will work although we still need to develop prototypes to check
We used a bespoke engine, an internal engine, for all the experiences," says Whyte. "It's the same engine we've continued to evolve and still use today
We had more gameplay programmers, more producers and designers and were perhaps a bit lighter on artists because the experiences were smaller
IN VR...
CERTAIN THINGS THAT WORK IN TRADITIONAL GAMES JUST DON'T WORK, SO YOU HAVE TO
TRY DIFFERENT THINGS
Traditional games gracefully fail at their target frame rates and no one really notices too much but you can't do that with VR because of latency issues and potential nausea
We are using photogrammetry to scan in our actors. We 'mo cap' those actors, we do a full capture
The surround sound you can get from binaural audio is super powerful
PHOTOGRAMMETRY
and the pursuit of realism
NEW
The challenge and excitement around VR is that it is a very new space and some of those designs and languages from other games just don't work so well in this medium and yet there are alternate ways you can do it that are even better
I am sure we will see more machine learning in the video games world
We are right at the beginning and the only way is up



David Banner, Managing Director, Wales Interactive

Project:
Don't Knock Twice

View Project

WALES INTERACTIVE

BACKGROUND

Based on the film of the same name, Don't Knock Twice is a first-person adventure VR game where the player takes the role of a mother exploring an old house to find and save her daughter from a demonic witch. It was released on PSVR as a boxed product in Europe and the US in October 2017.

TEAM

Ten people worked on the project, including a game director for design and artwork, a director for programming, two gameplay programmers, a technical art lead, two artists and an animator who also provided UI art as well as a sound designer. Outside of the development team external testers were brought in for playtesting and a PR specialist helped promote and sell the game.

We learned a lot from the demo, particularly about keeping people in the game in the various devices, including dealing with potential motion sickness issues.

GAME ENGINE

The majority of VR applications are made using tools that are repurposed from creating games which are either company developed bespoke frameworks, or more often, an off the shelf product like Unity or Unreal. These are tools that came out of the games industry, sometimes referred to as Integrated Development Environments (IDEs) that developers, artists, 3D modellers and others incorporate the various code, images, models and audio into a complete application.

The tools themselves are graphics based and allow models and images to be placed in scenes with animations and other behaviours added either graphically or using code. The simplicity and quality of the tools has lowered the barriers to entry for many developers.

Most development studios will stick with either Unity or Unreal for the majority of their projects, with Unity providing more flexibility and a simpler coding language, whereas Unreal enforces a specific structure language, which can give an advantage in graphics performance.

WORKFLOW AND TOOLS

The project began with a full development document, which included flow diagrams and images describing the ideas and workflow for the project.

From there a 10 minute demo or gameplay prototype was created, allowing the team to get a feel for the project and to anticipate potential technical or creative problems or ways in which VR would add to or complicate the design. The prototype was also used to test with a trial audience as well as the team for feedback prior to committing to the full development.

Unity was chosen above Unreal for this project, as it allowed all the disciplines within the team to contribute to development. Each scene was created as a grey-box to understand the scale and implement basic interactions. From there models were created in Maya and 3DS Max, textured in Photoshop and Substance Painter then swapped in to replace grey-box models.

Outside of content creation tools, project files were stored on various internal code repository servers, meaning that a full version history of the full game, each individual asset, and design documentation was maintained, so that the team could coordinate code and any mistakes could be quickly rectified. Project management was handled using Trello.

For this project the team avoided motion capture due to the amount of noise or errors created in the capture process, that then need to be corrected manually, and could have easily taken more time than the usual process of animating by posing characters in engine.

CHALLENGES

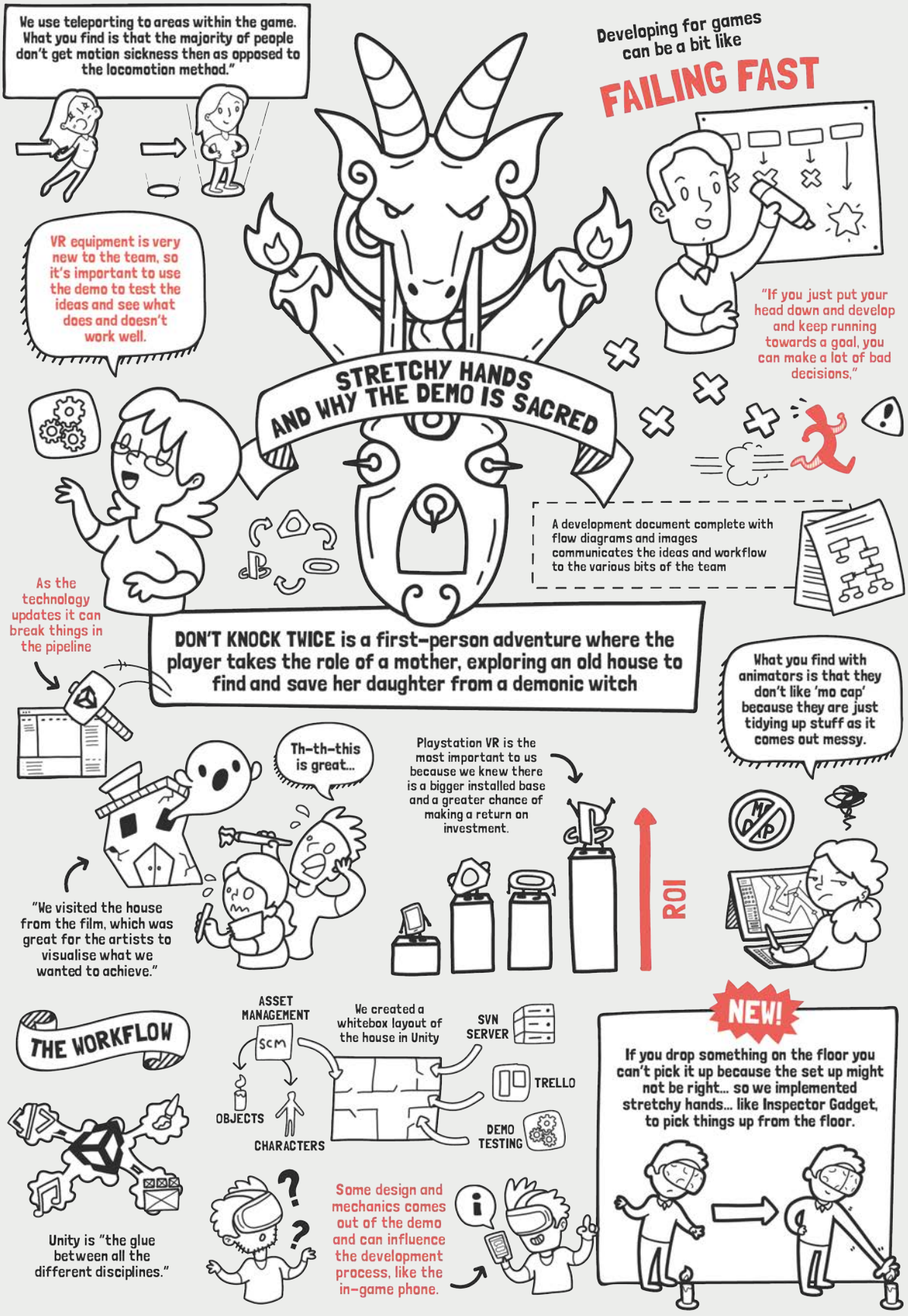
VR has different interaction rules to games development, and so what has been tried and tested does not naturally follow across the VR divide, it needs to be re-evaluated for suitability in this new medium.

Developing for a number of devices is a challenge, as well as the asset sizes and graphical complexity. Some devices have different operating systems which means bug testing needs to happen across all devices and writing specialist bits of code for each device to interact with the headsets or provide different lighting conditions.

Controls and interaction in VR are very different to traditional games. For example it is possible to give the player motion sickness if they move too fast in VR and some headsets allow the user to reach the ground whereas others do not. All of these can be counteracted by clever design and techniques, but these have to be invented from scratch.

Unity provides a lot of power however it is updated often and any update can break the game logic, particularly where a team have built their own production pipelines.

"We learned a lot from the demo, particularly about keeping people in the game in the various devices, including dealing with potential motion sickness issues. So our workflow is built around the three main devices – PlayStation VR, the Vive and the Rift – and we are constantly rotating; building the game with subtle variations to suit specific headsets."


We use teleporting to areas within the game. What you find is that the majority of people don't get motion sickness then as opposed to the locomotion method."
Developing for games can be a bit like
FAILING FAST
VR equipment is very new to the team, so it's important to use the demo to test the ideas and see what does and doesn't work well.
"If you just put your head down and develop and keep running towards a goal, you can make a lot of bad decisions."
STRETCHY HANDS AND WHY THE DEMO IS SACRED
A development document complete with flow diagrams and images communicates the ideas and workflow to the various bits of the team
As the technology updates it can break things in the pipeline
DON'T KNOCK TWICE is a first-person adventure where the player takes the role of a mother, exploring an old house to find and save her daughter from a demonic witch
What you find with animators is that they don't like 'mo cap' because they are just tidying up stuff as it comes out messy.
Th-th-this is great...
"We visited the house from the film, which was great for the artists to visualise what we wanted to achieve."
Playstation VR is the most important to us because we knew there is a bigger installed base and a greater chance of making a return on investment.
ROI
THE WORKFLOW
ASSET MANAGEMENT
SCM
OBJECTS
CHARACTERS
We created a whitebox layout of the house in Unity
SVN SERVER
TRELLO
DEMO TESTING
Unity is "the glue between all the different disciplines."
Some design and mechanics comes out of the demo and can influence the development process, like the in-game phone.
NEW!
If you drop something on the floor you can't pick it up because the set up might not be right... so we implemented stretchy hands... like Inspector Gadget, to pick things up from the floor.

KEY FINDINGS: GAMES

Whilst being at the forefront of VR and immersive experiences, game developers are finding themselves at an advantage with experience using the main interactive production tools. However they are having to adapt their working practices for the creative demands and opportunities within VR.

WORKFLOW HIGHLIGHTS:

- In comparison to a traditional game development, VR projects require more regular in-headset testing of a project and prototyping becomes more important.
- Projects generally start with a demo containing grey-box models to understand what the game is about and what needs to be produced. This technique is sometimes used in games, but more necessary here where the medium has slightly different rules.
- Asset stores can provide holder content for games in development which allows scenes to be tested quickly prior to committing to full asset production.
- Production tools used in games development (including Maya, 3Ds Max, Photoshop, Unity, Unreal or in house engine) are largely suitable for creating VR content, with Unity being the most well used central software tool.

CHALLENGES:

- Technical; maintaining high frame rates, working within battery life and GPU to create great experiences and avoid motion sickness.
- Commercial; budgets need to be tightly managed where the commercial model is not proven.
- Creative; working with a new medium requires experimentation and problem solving on the fly.

OPPORTUNITIES / WHERE ARE THE GAPS?

Use of new tools to produce content in VR (Tiltbrush, Quill) are being successfully explored. In general these are very early versions of new software types and will most likely grow in functionality to studio requirements.

Volumetric capture is being used successfully to capture scenes and characters, increasing quality and reducing costs. These do require the use of a volumetric studio, and require operators skilled in using the technique and data it produces. (See page 32 for more information).

Teams are coordinating project files (code, 3D models, graphics, audio etc) using well tested source code repositories, however these require technical management. Tools such as Google Docs are now enabling real-time collaboration in files, and this can allow teams to increase speed of development and prototyping, an essential gain within experimental VR projects.

Gamers are used to large file sizes and downloading games in advance, however as VR allows the player to view content as close as they wish, file sizes have been growing alongside the definition of the assets. This means that VR games can be very large, which in turn can put players off, particularly for a short experience or on mobile devices. At this stage streaming services have been trialed for traditional console and PC games, however VR may create a new demand for streaming services, which will need to deliver higher amounts of information at vastly greater speeds.


oculus

TV AND FILM - PRODUCING IN 360°

Film and TV makers are beginning to experiment with VR as a new visual storytelling medium. They have identified the technology as compelling and an inevitable development within film and TV genres. Some genres such as drama, natural history, news and sport are more suitable for creating enhanced immersive experiences in 360°.

Many of the early immersive experiences to come out of film and TV sector were born from research and development departments or marketing departments. The BBC was an early adopter of immersive experiences through its various R&D and digital departments producing 360° films films and interactive experiences for both web and VR platforms. Early examples include the 2016, 360° film 'Step Inside The Large Hadron Collider' (web), and the 2017 CGI/interactive 'Home-A VR Spacewalk', (Oculus). BBC Worldwide has also adopted the technology to support BBC brands such as BBC Earth's 360°/CGI interactive experience 'Cat Flight' in 2016 (Oculus) and 'BBC Earth: Life In VR' in 2018 (Google Daydream).

Sky launched its own VR app for the Oculus Rift platform in 2017, and has invested significantly in original content such as 'Hold the World' (Oculus), while Channel 4 has invested in a VR content studio called Parable Ventures. The introduction of Facebook 360 and YouTube 360 platforms have also enabled news organisations across the globe to publish web-based, 360° films.

Immersive experiences produced by film and TV filmmakers tend to be story-driven, often using 360° cameras. However, the sector has not limited itself to only 360° films, drawing in creators from a variety of traditional roles within TV and film production such as fiction and factual directors, journalists, VFX directors, digital producer/directors, animators and technologists.

Traditional film and TV business models and workflows operate from the principle that content is produced for a specific broadcaster or theatrical release and distribution. This requires a project to be researched, conceived and pitched in order to be funded or commissioned. A pitch consists of a paper document and a 'sizzle clip' and is part of the development phase of the production workflow. Once funding is secured a second period of research and development takes place to flesh out the concept into a full treatment and script. Editorial is then approved and the project goes into production. Once all image and sound assets have been created and captured the project will enter the post-production phase and includes all aspects of picture editing and sound design. After a number of screenings and final editorial approval, the project will be 'on-lined' and finally mixed. The final content is delivered as a digital file in a specified codec to the broadcaster or distributor.

Immersive experiences produced by film and TV producers tend to follow the above workflow. However key differences include deciding on the immersive platform and HMD delivery at the development stage and creating the editorial content of the experience to align with the platform specifications and delivery technology. Unless produced by a broadcaster, funding does not come from the traditional sources so producers have to explore alternative funding models, often from multiple sources. From a technical point of view 360° cameras, CGI and binaural sound are used to capture and create immersive content. Post-production requires support from VR/360 specific software but can pull on traditional editing hardware and software systems. Finally, delivering content to a VR platform and a head mounted display (HMD) requires a completely different approach to traditional broadcast, often involving complex code and the creation of a mobile, PC or web application.

The following interviews highlight some of the challenges that film and TV content makers face when creating 360° imagery, 3D sound and immersive content, as well as some of the adaptations they've had to make to workflows and creative teams.

Paul Deane, Digital Development Lead, Natural History Unit, BBC

Project:
Planet Earth II

View Project

BBC

BACKGROUND

Planet Earth II VR experience was launched in 2016 as a series of six 360° films commissioned by the BBC, to accompany the Planet Earth II TV series.

The BBC was keen to explore the medium and so provided a remit to try out different filming techniques on location but also in post production edit. They selected a variety of environments and points of view to understand what works best.

TEAM

With six films in production, the team varied across productions but within defined roles and tasks including production manager, production coordinator, stitching, colour grading, compositing and graphics. In addition a sound team provided audio at the end, which crucially required spatial sound in order to not break the sense of immersion.

We always want more processing power. The final composite render was taking days to do because they're big files with a lot of composite render or graphics put on top, so that's the same problem everyone has but more power would of course have helped.

STITCHING

When capturing 360 ° images or video, there are usually between two and eight lenses used to take individual pictures or footage, and this can easily double for stereoscopic capture (images that mimic parallax and depth to the viewer). These images need to be lined up and put together into a single asset that can be played back on a 360 ° viewer. In some cases this process is automatically provided by the camera or associated software, but the automatic process often leaves areas where the images to do line up perfectly or lighting is different. For high quality applications, it will take a large amount of time to ensure that the images are carefully lined up into a single asset in a manual process known as stitching.

WORKFLOW AND TOOLS

Following the traditional TV process, available locations were scouted and scheduled shoots were reviewed to identify the best opportunities to shoot in 360°.

Each production was entirely story driven, and the narrative reviewed to see how it would work in 360°. Storyboards were used to choreograph filming.

For this project GoPros were the standard choice of camera, which are easy to set up and place in the environment, aided by a Sony A7S rig for low light conditions, capturing 240° images which were overlapped to produce a 360° image. SD Cards were taken from cameras and files transferred to hard drives, which were then taken back to the post production studio and transferred to NAS servers. At this point the video was stitched together and composited in post production.

Software tools include AutoPano for stitching, Adobe Premier for editing, and DaVinci for colour grading.

CHALLENGES

Media management with so many cameras is complex, requiring careful logging and a VR data imaging technician (DIT) on location to ensure consistency and match files in edit.

Previewing scenes whilst filming can be a challenge in 360°, as in most cases the images have to be stitched before providing a full 360° image, which means shots are often performed blind. Adobe Premier and other tools are beginning to provide preview options.

Processing power can be a limitation, with final renders taking days to complete due to file sizes.

"We always want more processing power. The final composite render was taking days to do because they're big files with a lot of composite render or graphics put on top, so that's the same problem everyone has but more power would of course have helped"

Paul Deane BBC 360° Filming

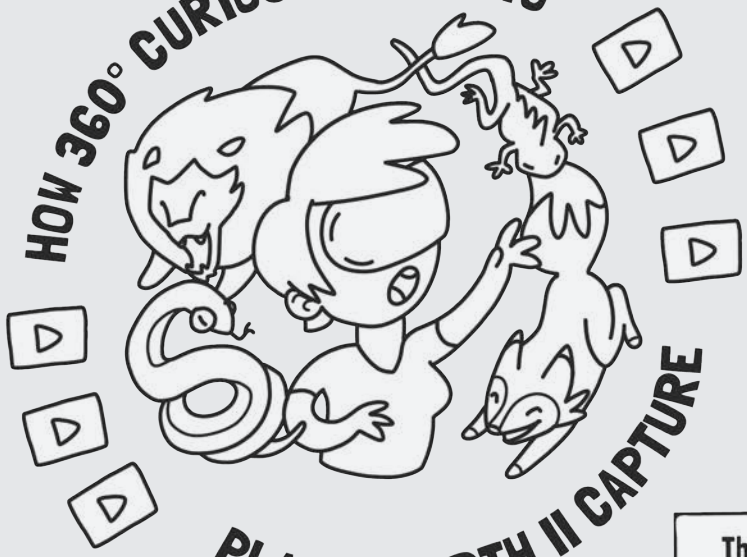
360° FILMING

One of the simplest ways to create VR content is to use a 360° camera. At a simple level a 360° camera uses an array of camera lenses arranged to capture images from all directions, which is then stitched together manually or by computer algorithm. There is a large number of devices on the market, from the high end Nokio Ozo to the very affordable Gear 360. Smartphones are often used to capture 360° or 180° content which can be uploaded directly to YouTube or Facebook, both of which provide means for mobile phone and VR headset users to quickly replay the immersive content.

3D SOUND/SPATIAL SOUND

As many developers have noted, audio is often more important than graphics for immersing the player fully in a VR experience. The human brain is very well adapted to locating sound sources, and if audio does not play in a VR experience where they are expecting it, this can easily break the immersion. Now most developers will accommodate 3D audio positioning within their experiences either by constructing sound stems in a game engine or utilizing capture methods such as binaural or ambisonic technology.

HOW 360° CURIOSITY LED TO PLANET EARTH II CAPTURE

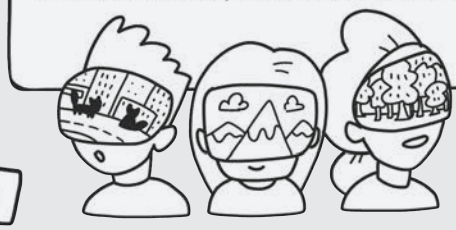


A series of six 360° films commissioned by the BBC, the Planet II VR experience was launched in 2016 to accompany the Planet Earth II TV series

How to make it **RELEVANT**

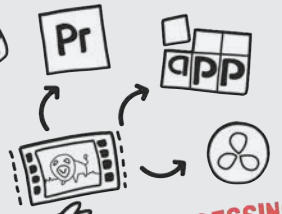
Getting the story straight and ensuring it is engaging enough to sustain interest is of course what it's all about

The brief was to do a 360° film for each episode of Planet Earth II covering the different environments, such as deserts, snow and mountains



The BBC wanted to test and innovate with new formats and new audience propositions, so the films were deliberately experimental

The aim was for the films to be watched on a headset or just on YouTube

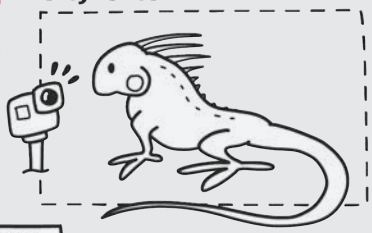


We are dealing with the restrictions of what cameras and lenses can do but things are getting better

PROCESSING POWER PROBLEMS

Basically, you plank a bunch of GoPros in the sand and press record

It's relatively easy to use a **360 CAMERA**

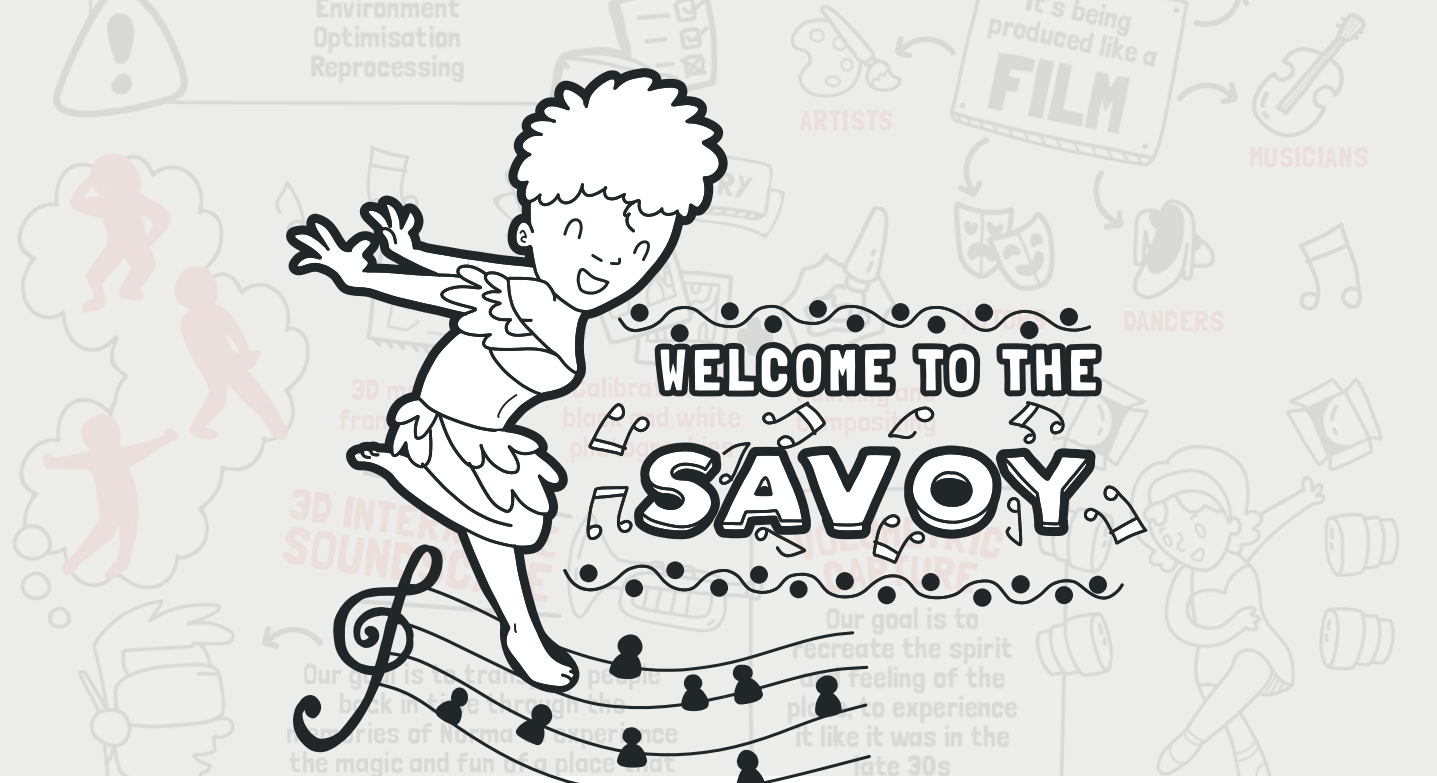


Screens can hardly play back video at a high enough bit rate and high enough screen quality and refresh rate now... We're some distance away from volumetric capture being a real thing

SOUND was a crucial element

Four of films have a spatial sound mix, so as you turn your head you hear the sound change direction

There is a clear appetite for 360 – they get a good response



Landia Egal, Co-Founder, Tiny Planets

Project:
Welcome to the Savoy!

TINY PLANETS

BACKGROUND

Currently in post production phase, 'Welcome to the Savoy!' is an interactive VR experience produced by Tiny Planets, transporting people back in time to experience the thrills of swinging big bands, breath-taking dancers and jazz age glamour by reopening the doors of Harlem's most captivating nightspot: the Savoy Ballroom.

TEAM

Developed by a small core team, creating the project relied heavily on a network of specialised companies for separate parts including historians, musicians, dancers, actors, model makers and developers.

WORKFLOW AND TOOLS

The project was approached as if it were a film production, utilising a core team alongside a number of external consultants, experts and supplier companies.

For the photogrammetry, we used a hybrid pipeline for the most faithful recreation of the Savoy. 3D modelling from blueprint to get the layouts, scales and shape of furniture and objects and photogrammetry to add the details.

STORYBOARDING

VR Experiences are very often telling a story where the user or player will move through a scene with a beginning, middle and end, with events that can be triggered or sequences that can be explored. In most cases the design of the application begins with a storyboard which describes each sequence or event in a comic book-like fashion. This is very helpful for Producers, Directors, Creative Directors, Developers, 3D artists and animators to get an idea of the story structure, work involved, the assets that need to be created and the camera angles that will be used.

Extensive use was made of photogrammetry and volumetric capture to record actors and place them in VR. This created large volumes of data, which needed to be processed and optimised to use in a VR experience.

To create the environments a mixture of 3D modelling from blueprints and archive pictures, as well as photogrammetry was used.

Binaural recording was used to recreate the acoustics of the building.

The full tool list included a great number of software tools, specifically Unity 3D, Maya, Enwaii, Photoshop, Mari & Substance painter, Fusion, Pro Tools & Reaper, LeSound and Houdini, each of which required staff with skills to operate.

CHALLENGES

Photogrammetric techniques can only capture so many people at any one time and can be expensive when factoring retakes.They can also take a lot of time to process and often have noise or errors in capture that need to be corrected by hand.

"For the photogrammetry, we used a hybrid pipeline for the most faithful recreation of the Savoy, with 3D modelling from blueprints to get the layout, scale, shape of furniture and objects, and photogrammetry to add the details. We are using calibration of black and white archive pictures in the existing geometry and a mix of painting and compositing for textures and colourisation, using archives and testimonies as a guidance."

Landia Egal Tiny Planets

PHOTOGRAMMETRY

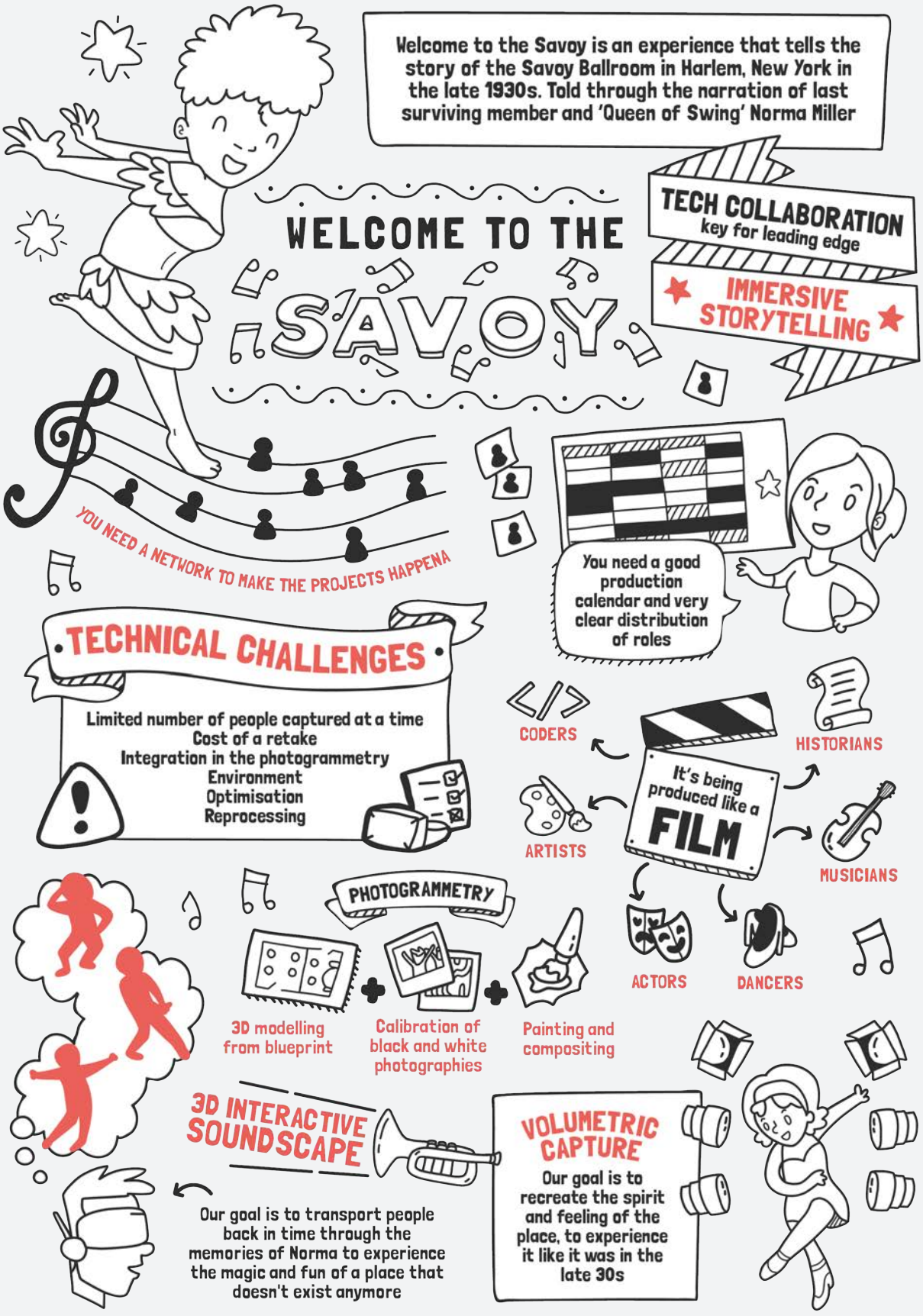
Photogrammetry is the process of taking measurements from images, which is often used in the context of VR as taking depth data to capture object and scene dimensions alongside colour information. From this information a scene can often be reconstructed in a 3D modelling tool, which can speed up environment creation.

VOLUMETRIC CAPTURE

Where 3D laser scanning and photogrammetry capture a 3D model of a static environment, volumetric capture does the same but with the model or environment in motion. An array of cameras capture the model from all angles at the same time in a green screen studio. The imagery and data is then processed into a single 3D asset that can be placed in multiple 360 image or CGI environments.

PRODUCER / DIRECTOR / CREATIVE DIRECTOR

Producers, Directors and Creative Directors tend to take overall responsibility for the creation and delivery of an immersive application overseeing every aspect of production workflow, quality control and delivery to a brief. In small teams the roles are often performed by one person, however in larger teams the roles would be independent, where the producer leans more towards project and team management, and a Director and Creative Director would ensure that the look and feel of the experience and all the elements within it work together for the desired outcome.


Welcome to the Savoy is an experience that tells the story of the Savoy Ballroom in Harlem, New York in the late 1930s. Told through the narration of last surviving member and 'Queen of Swing' Norma Miller
WELCOME TO THE SAVOY
TECH COLLABORATION
key for leading edge
IMMERSIVE STORYTELLING
YOU NEED A NETWORK TO MAKE THE PROJECTS HAPPENA
You need a good production calendar and very clear distribution of roles
TECHNICAL CHALLENGES
Limited number of people captured at a time
Cost of a retake
Integration in the photogrammetry
Environment
Optimisation
Reprocessing
CODERS
HISTORIANS
It's being produced like a FILM
ARTISTS
MUSICIANS
ACTORS
DANCERS
PHOTOGRAMMETRY
3D modelling from blueprint
Calibration of black and white photographies
Painting and compositing
3D INTERACTIVE SOUNDSCAPE
Our goal is to transport people back in time through the memories of Norma to experience the magic and fun of a place that doesn't exist anymore
VOLUMETRIC CAPTURE
Our goal is to recreate the spirit and feeling of the place, to experience it like it was in the late 30s

KEY FINDINGS: TV AND FILM

Immersive content is a powerful visual and auditory medium, with unlimited scope for telling stories. It's natural for creatives working in TV and film to take a keen interest in immersive technology to create new and compelling stories. Their greatest challenge is to disconnect from the linear narrative and to embrace the challenges presented by the capture and delivery technology and the new platforms on which an audience will be able to engage with their immersive content.

WORKFLOW HIGHLIGHTS:

- Complementary 360° projects are being filmed alongside 2D broadcast and film projects, most often to support marketing activities. This allows traditional 2D filmmakers to experience and experiment with 360° workflows, expanding the 360° skill base, however the parallel filming requirements can add complexity to a shoot.
- Specialist cameras capture multiple images through a variety of 360° camera models and techniques. The images are captured on multiple SD cards which are then processed by a skilled operator into a 360 image, known as stitching, using software such as Kolor AutoPano. However, some 360 cameras are now able to capture and stitch using proprietary software.
- Volumetric capture and photogrammetry enable the production of photorealistic performances and models. They allow a user to walk around a space that has been created using 3D graphics or photogrammetry and interact with a character/actor in motion whose form has been fully captured by multiple cameras from every angle.

CHALLENGES:

Technical; The nature of shooting 360° video (capturing and stitching together footage from myriad cameras and angles) creates many challenges in the editing process. Continuity between shots, visible seams and blurring on the edges and mismatched colour and exposure across cameras can result in an unrealistic viewing experience.

- Technical; Due to the time it takes to stitch images, previewing content can be a challenge on set, so a director may often only be able to see how a scene has been captured hours or days after filming.

- Technical; The files produced by multiple cameras or the volumetric studios are huge in number and size. This makes media management an absolute requirement and means that files have to be compressed and optimised for download and playback on low-end devices or broadcast destinations (such as YouTube or Facebook).

- Commercial; Without a known and established broadcast route to viewers and with highly variable audience sizes, it is difficult to follow existing business models for content production.

- Creative; Film and TV directors have years of experience directing player attention via camera angles, transitions and other techniques all of which fall apart when the viewer is able to look anywhere and is forced into a single viewpoint.

- Creative: Fixed wide angle lenses and limited manual exposure and shutter controls limits the scope and quality of a 360° camera image.

- Creative; In general a shoot will have multiple people behind the camera, however 360° cameras do not offer the production team anywhere to hide.

OPPORTUNITIES / WHERE ARE THE GAPS?

There is a great deal of innovation happening in the 360° camera market, supporting hardware and software space, allowing for increased resolution, improved battery function, rig overheating, improved stitching and six degrees of freedom.

Volumetric capture and laser scanning is successfully being used to create high definition assets that can be used in a highly controllable and repeatable manner. If these are rigged and animated like 3D models it will be possible to use and re-use a single scene or character as desired.

Suitable devices and platforms that can play out large, high resolution files with interactivity that are non-glitchy or don't crash a device or platform.

Spatial audio has a powerful effect on the design of an experience. New 3D sound hardware and software such as the Sennheiser Ambeo VR mic partnered with four track recorder and RODE VideoMic Soundfield will make this aspect of production easier to capture and post produce.

Large file sizes in VR place higher demands on existing network infrastructure; for example as yet there is no streaming format for VR that can scale to large numbers of viewers on desktop or mobile, so content needs to be downloaded to a device prior to playback, which many viewers find inconvenient. This is partially due to streaming challenges, traditional broadcasters who have yet to identify the route by which to create and grow audiences for VR content or the technology that will underpin this. In general, broadcasters are watching to understand how the market will develop. However, new entrants such as Netflix, who have deep pockets and an ability to deliver high bandwidth demands, may well capture the market.


REWIND • HERE BE DRAGONS
GHOST IN THE SHELL
THE VIRTUAL REALITY EXPERIENCE

VFX AND ANIMATION - CREATING STORIES IN VIRTUAL REALITY

Animation producers create linear, predominantly story-led make-believe worlds and characters while VFX producers generally create imagery as part of a larger piece of content. Because they work using a variety of 3D software applications like Maya, they are naturally well positioned to create and produce CGI for immersive and interactive experiences and have readily taken up the challenges and opportunities offered by the immersive industry including creating their own immersive content, self-distributing and selling direct to the consumer in a similar way to games studios.

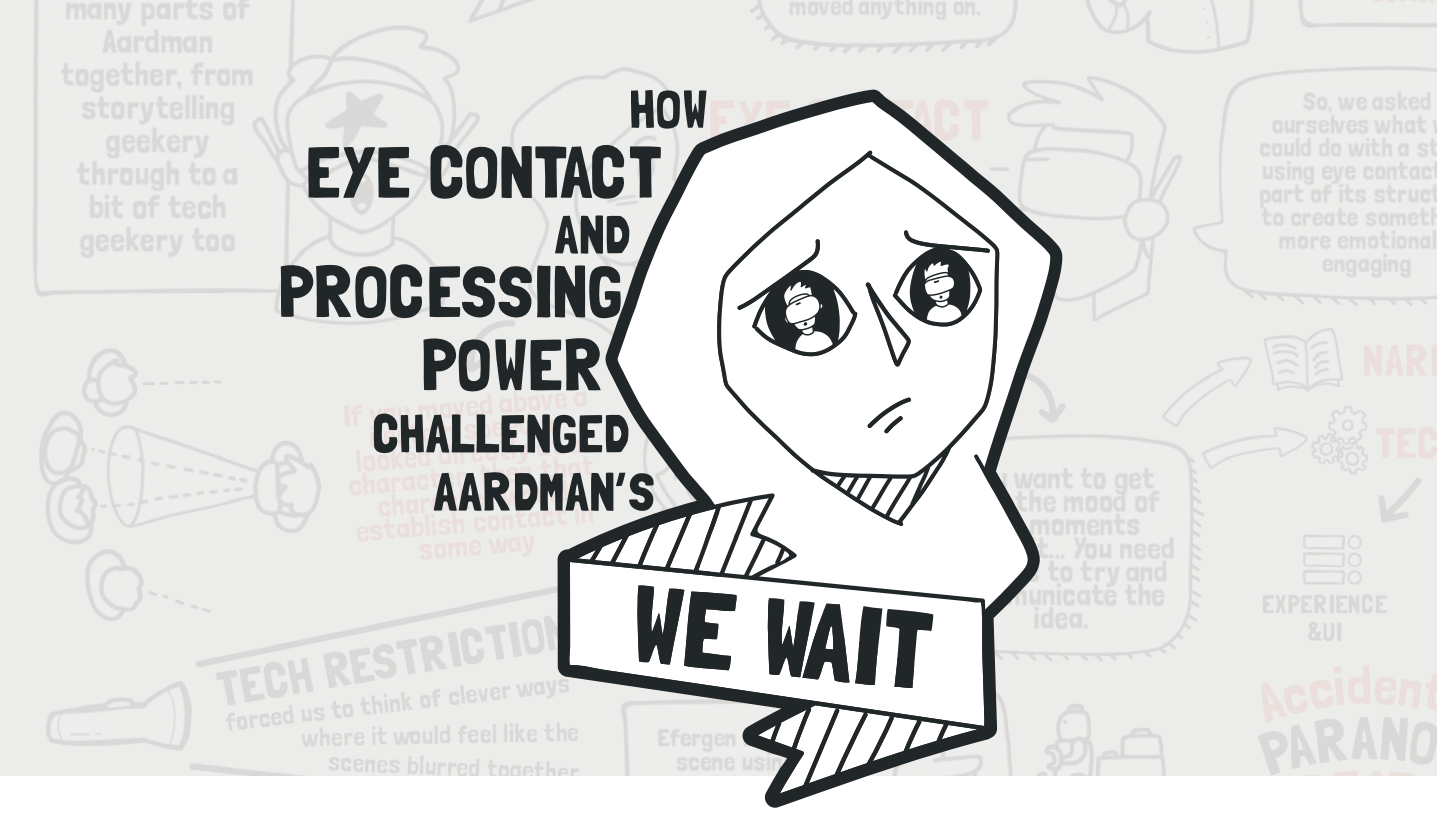
As creative users of technology, there is a great desire to understand how new stories can be created using immersive technologies and to explore the potential for empathy by placing the viewer in the scene in a way that has never been possible before VR. At the same time, there are challenges. Similar to TV and film, animators are having to surrender control of the viewer's attention and rely upon a more viewer-centric camera position. In addition, animators have generally not had to contend with player interaction, and while the new medium of VR does not require it, players placed in a world and potentially taking on a role in the story, may feel strange if they can only passively watch, so animators are now facing challenges of incorporating viewer actions into the narrative.

The workflow for an animation or VFX immersive project, regardless of scale, can vary based on how the project was conceived and developed. Projects of this nature are likely to combine CGI with captured elements like motion capture, photogrammetry and volumetric capture. In many cases a VFX project may be commissioned by a client/platform and produced by an independent, medium-sized company, and the project would start with an existing concept or IP that had already been researched and pitched, most likely utilizing pre-vis technology. The delivery platform and Head Mounted Display (HMD) technology would be considered prior to the pitch. Once the project is commissioned and funding is in place, the delivery platform and HMD technology are confirmed. The core team are hired including a producer, Creative Director, VFX artist(s) and possibly coder at this stage. The concept for the project is fleshed out and sometimes requires additional resources such as a storyboard artist, researcher and script consultant.

Once the editorial structure and script have been approved the project enters the production phase. Prior to any creation and capture, further storyboarding/previs, modelling, prototyping, and grey-boxing are carried out and 3D animation software decided on to create a "look". Once the project is ready to go into production, specialist suppliers are engaged such as photogrammetry, volumetric capture and motion control. All captured and created elements are carried out through the production phase and sound design begins.

Editing, compositing, music composition or track sourcing, picture correction, grading, narration, sound design and final mix are all carried out during post-production, as well as continued app build and testing against the structure of the experience's content and interactivity. Once all elements are finalised the app is tested, tweaked and fixed. The app is delivered to a client or platform. Post-release, the app is patched and upgraded.

The following interviews highlight workflows, challenges and opportunities encountered during the production of immersive content by an animation company and two VFX studios one of which, REWIND, now also specialises in capture techniques aligned with immersive content production, such as 360° filming and motion control.



Dan Efergan, Group Creative Director of Digital, Aardman Animations

Project:
We Wait

View Project

AARDMAN ANIMATIONS

BACKGROUND

We Wait is an immersive story for the Oculus Rift, about a Syrian family making the perilous journey from Turkey to Greece on a smugglers' boats. Commissioned by the BBC and launched in 2016, it took six months to produce.

TEAM

The project consisted of one CG artist for model creation, one developer, a narrative director, an interactive director, a producer and one part-time sound person. The team was purposefully kept small, due to budget but also in order to keep the workflow tight.

WORKFLOW AND TOOLS

They started with concept art to convey the idea, then split into designing the narrative and designing the technology, including scenes, characters and front-end user experience.

We've changed our VR production process every time we've made something because it's always different. Every project has a certain uniqueness to it. There's no cookie cutter creative process to construct stuff.

ANIMATION

In order for objects and characters to move about in VR scenes, they need to be animated. This can be achieved by coders using simple or complex methods, or by using motion capture technology, but commonly in VR applications it is the responsibility of animators or 3D artists. In order for any object to be animated, it is usual for the 3D Artist to rig it with an artificial skeleton, to which the 'skin' of the 3D model will be tied. From there the skeleton can be recorded in various poses over time, which when played in sequence form the basic animation loop. There are also a number of techniques to make animations behave dynamically, for example using a physics engine and attaching weights to certain parts of the model to enable characters to fall down stairs like a rag-doll. Animation engines have become highly advanced in Unity and particularly Unreal, and due to being able to render in real-time, have encouraged many animation studios to explore using them.

Unity and Unreal proved capable at not just VR but also all real time animation, which is feeding back to the wider animation projects.

Asset stores like Mixamo provided working rigs that were used as placeholders for experimentation.

Use of physical tools like Lego and plasticine characters helped with view angles and placement.

Use of motion tracking capture suits such as Perception Neuron allowed faster creation of animation sequences from human actors.

They trialled design software such as Twine and Adventure Creator as fast prototyping tools, but they were not yet able to manage the complexity of large projects. Tools such as Tiltbrush, where spaces can be created quickly in VR, and AnimVR, where animation can be quickly prototype, are proving very powerful.

CHALLENGES

One hundred and fifty years of linear storytelling from film and TV does not immediately translate to immersive; this will take years more experimentation. Use of eye contact in the experience is highly emotionally engaging.

While expecting to use skills learnt from cinema, the closest analogy to VR direction is theatrical, the scene is better managed as a play with the viewer taking a part - with similar problems conveying emotion and narrative.

Processing power on mobile devices limits visual effects that can be relied upon in traditional animation, as well as loading between complex scenes.

With projects telling real world stories, other stakeholders (for We Wait including BBC correspondents, United Nations staff and two refugee families) need to be brought into the development at an earlier stage. Coordination requires communication tools that can allow collaboration on scripts and flow diagrams.

Staff familiar with animation production methods and tools like Maya, find Unreal the most natural tool for interactive as it has a great animation interface. However staff with the ability to code Unreal applications are hard to find in comparison to Unity developers.

"We've changed our VR production process every time we've made something because it's always different. Every project has a certain uniqueness to it. There's no cookie cutter creative process to construct stuff. We've now started using tools like Tiltbrush to sketch out spaces quickly because then the world you are designing in is the same as the one you are experiencing it in, which helps the process. We're also testing AnimVR, a draw animation system in 3D so the artist can flick from frame to frame easily."

Dan Efergan Aardman Animations

ASSET STORE

There are now a large number of online stores where 3D models, code, audio, textures or even complete scenes can be purchased, either provided by tool makers such as Unity or by third parties like Turbosquid. In some cases this will allow demonstration scenes to be put together very quickly at minimal cost or background objects to be put into environments.

HOW EYE CONTACT AND PROCESSING POWER CHALLENGED AARDMAN'S

A joint production with BBC Research and Development, We Wait is an immersive story for the Oculus Rift, about a Syrian family making the perilous journey from Turkey to Greece on a smugglers' boats.

We have a linear story telling industry which is 150 years old, and they're really good at creating **EMOTION**

I was frustrated with VR when it first came out because storytelling on interactive platforms hadn't moved anything on.

We have not worked hard enough to get better at it...

VR brings many parts of Aardman together, from storytelling geekery through to a bit of tech geekery too

EYE CONTACT

is quite a deep and fundamental human and animalistic connection

So, we asked ourselves what we could do with a story using eye contact as part of its structure to create something more emotionally engaging

If you moved above a certain speed or looked directly at a character, then that character would establish contact in some way

CONCEPT ART

You want to get into the mood of the moments within it... You need visuals to try and communicate the idea.

NARRATIVE

TECHNOLOGY

EXPERIENCE &UI

CHARACTERS & SCENES

TECH RESTRICTION

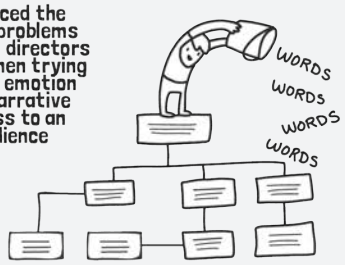
forced us to think of clever ways where it would feel like the scenes blurred together

Efergen built his own scene using Lego, complete with crude plasticine characters

Accidental PARANOIA CREATOR

It's THEATRICAL

We faced the same problems theatre directors have when trying to get emotion and narrative across to an audience



We poured all the words we had into a giant flow diagram and worked out how they all joined up with each other

During these experiments, someone would be staring at you only to look away when you look at them.

UNITY OR UNREAL?

Our animation teams find it easier to into Unreal but our coders find it easier to be in Unity.

We've started using tools like Tiltbrush to sketch out spaces quickly because then the world you are designing in is the same as the one you are experiencing it in.

We've changed our VR production process every time we've made something because it's always different

It's important to approach VR productions with space to experiment and research alongside what you are actually developing

John Durrant, Creative Director, BDH Immersive

Project:
Wonderful You

View Project

BDH IMMERSIVE

BACKGROUND

Launched in Nov 2017, Wonderful You is a twenty-minute experience about the womb and how senses develop within a foetus. The project took nine months to develop.

TEAM

The team consisted of 12 people, including a writer/director, producer, narrator, designer, 3D artist, texture artist, art director (directing each individual scene to generate the right atmospheres), VFX artist (to generate effects around liquids, light etc), UI developer (interface and interactivity), musician/composer, sound designer, sound recordist, script consultant, scientific advisor and an executive producer.

WORKFLOW & TOOLS

The project workflow starting point followed the VFX process used for BDH's other productions for film and TV.

You have to plan out how the intersection of all those different techniques will work - looking at the script and emphasising where you need the different techniques. It's important for workflow for everyone to join and see what the director wants and see how their work is being used in context, just like film production.

A four minute script was drafted, including a storyboard around each environment in the experience. From this point user interface, interactions, user journey and sound storyboarding were discussed and formalised.

The project was then set up in Unity using wireframe models. From here 3D models were created using Autodesk Maya, wrapped in textures produced in Photoshop with effects and other designs created using After Effects. As models and effects were created they were brought in to Unity to replace the wireframes. Each scene was continuously reviewed using VR headsets.

360° images were used as backgrounds to 3D objects in the foreground, which required careful intersection, but provided performance improvement.

Objects were brought in from online asset stores, but more often than not updated by artists to make them more realistic and to fit in the project style.

Photoshop and After Effects were used to pre-render effects for mobile, based upon generative particle effects built in Unity on a PC.

CHALLENGES

Developing for multiple headsets is a challenge, as mobile headsets such as Samsung Gear do not have the processing power of PC based headsets like the Oculus Rift. This led to complex fluid effects being rendered in real-time as generative particles on the Oculus, and pre-rendered using After Effects and Photoshop as animated sequences on mobile headsets.

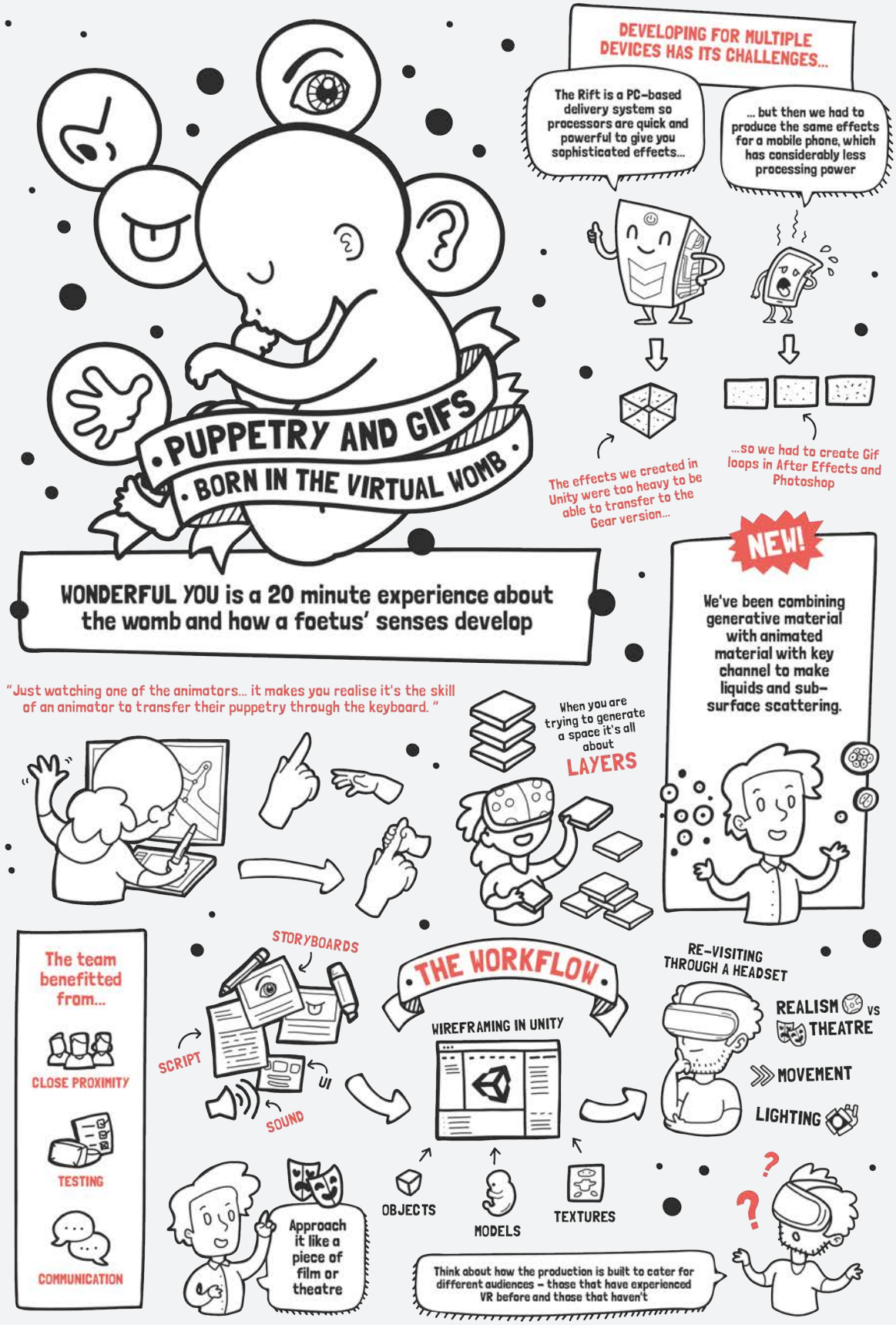
Generating something that looks realistic in a VR headset is a constant creative and quality control challenge, to avoid scenes looking flat or out of character, but also maintaining high frame rates.

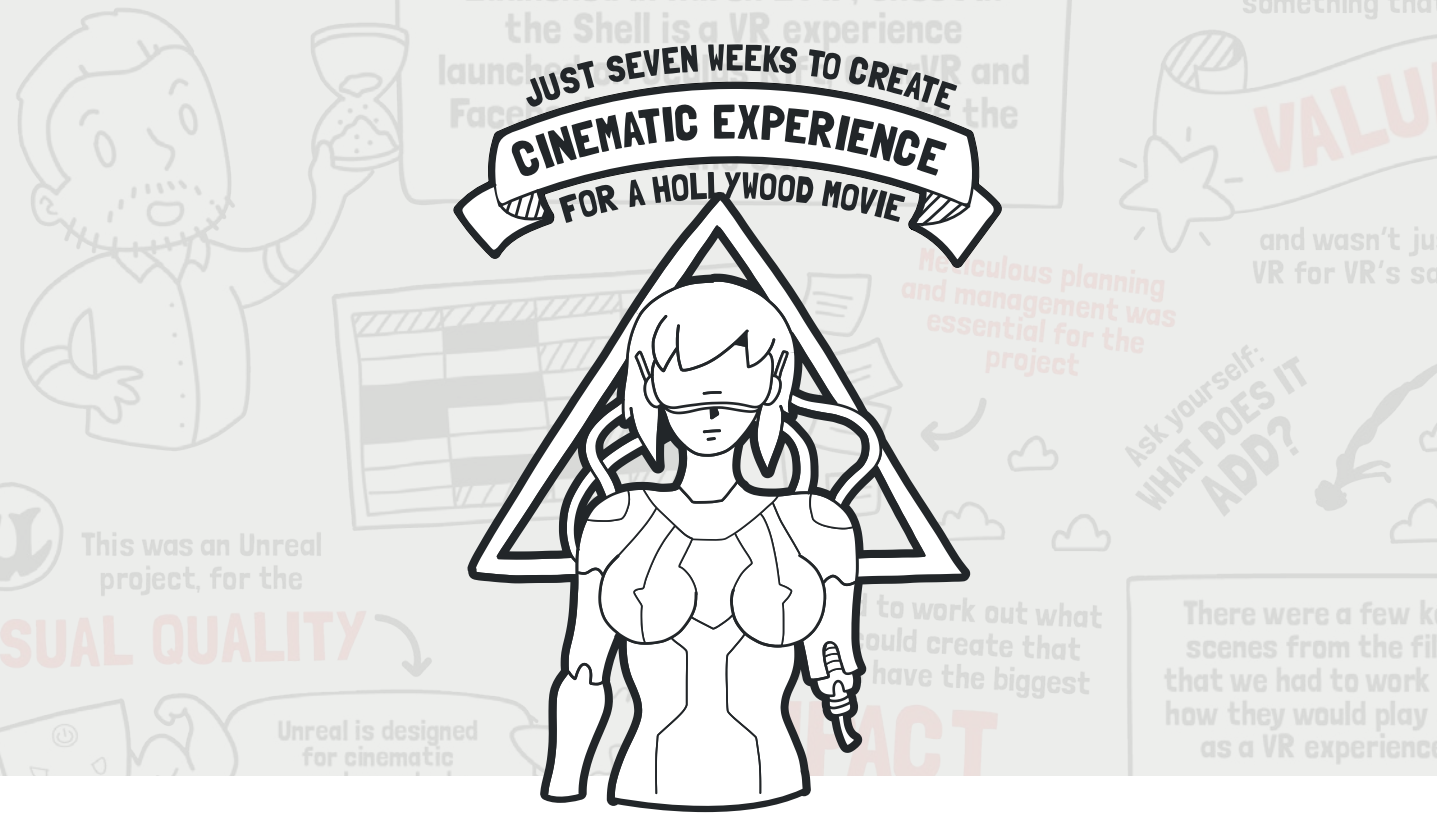
Similar to film production, it is critical for the Director and everyone in the team to review the project regularly to see how it is coming together. Problems can arise quickly which can throw a project off schedule, having people working together in the same space greatly increases the problem solving ability.

"We wireframe in Unity, then start generating 3D objects using Adobe After Effects for animation and design and Autodesk's Maya for creating the high-end models, skinning those models in Photoshop. It's also a combination of generating worlds, 360° images, which are flat, with 3D objects in the foreground. You have to plan out how the intersection of all those different techniques will work - looking at the script and emphasising where you need the different techniques. It's important for workflow for everyone to join and see what the Director wants and see how their work is being used in context, just like film production."

3D ARTIST

A 3D Artist is responsible for creating 3D models of environments, objects and characters, and often creating the textures, lighting and overall layout of a virtual reality scene. They may also take charge of the direction of animation and the events that happen within a scene, where these are not required to be controlled by code, and so in a small team the 3D Artist may end up taking a directorial role in certain types of VR application.


PUPPETRY AND GIFS
BORN IN THE VIRTUAL WOMB
DEVELOPING FOR MULTIPLE DEVICES HAS ITS CHALLENGES...
The Rift is a PC-based delivery system so processors are quick and powerful to give you sophisticated effects...
... but then we had to produce the same effects for a mobile phone, which has considerably less processing power
The effects we created in Unity were too heavy to be able to transfer to the Gear version...
...so we had to create Gif loops in After Effects and Photoshop
WONDERFUL YOU is a 20 minute experience about the womb and how a foetus' senses develop
NEW!
We've been combining generative material with animated material with key channel to make liquids and sub-surface scattering.
"Just watching one of the animators... it makes you realise it's the skill of an animator to transfer their puppetry through the keyboard. "
When you are trying to generate a space it's all about LAYERS
The team benefitted from...
CLOSE PROXIMITY
TESTING
COMMUNICATION
THE WORKFLOW
STORYBOARDS
SCRIPT
UI
SOUND
WIREFRAMING IN UNITY
OBJECTS
MODELS
TEXTURES
RE-VISITING THROUGH A HEADSET
REALISM VS THEATRE
MOVEMENT
LIGHTING
Approach it like a piece of film or theatre
Think about how the production is built to cater for different audiences – those that have experienced VR before and those that haven't



Greg Furber, VR Director, REWIND

Project:
Ghost In The Shell

View Project

REWIND

BACKGROUND

Launched in March 2017, Ghost in the Shell is a VR experience launched on Oculus Rift, Gear VR and Facebook 360 to help promote the movie of the same name. The project was developed in just seven weeks.

TEAM

Due to tight timescales the project took up the majority of the studio, as well as working with external companies for motion capture specialist skills.

WORKFLOW AND TOOLS

Unreal was picked over Unity due to superior graphical power and visual quality.

The content path indicated the narrative and the scenes which needed to be recreated in VR. From this point the scenes were created using grey-box models, which were replaced with the full 3D models as they were delivered.

This was an Unreal project, for the visual quality, it can achieve some amazing visual things and it can be harder to get Unity to that place. Unreal is designed for cinematic gameplay and when you're running it on a PC where you've got the grunt behind it, then it's possible to do some stuff that looks fantastic in the engine relatively painlessly.

Assets were created either from the ground up by the REWIND team using 3DS Max and Maya, or adapted from models and assets available on asset stores. Animation was created using motion control capture of actors.

Workflow and techniques are very much specific to each production with the changing product requirements meaning that it is difficult to create a single process for all. Some elements are common, and the use of skilled and experienced staff can ascertain the most efficient way to achieve the right results.

CHALLENGES

Developing a high quality VR experience for an iconic property required an experienced team and a high level of project planning.

Developing initially for mobile VR (Gear) then upscaling to PC VR (Oculus) for a higher quality experience can present challenges in asset design.

Staff skilled at real-time VR with project experience are hard to find, and there is a need to keep hold of good individuals and teams.

"This was an Unreal project, for the visual quality, it can achieve some amazing visual things and it can be harder to get Unity to that place. Unreal is designed for cinematic gameplay and when you're running it on a PC where you've got the grunt behind it, then it's possible to do some stuff that looks fantastic in the engine relatively painlessly."

Greg Furber REWIND

MOTION CAPTURE

Motion capture (also known as Mo-cap) uses sensors positioned on a performer's body to record actions. That digital information is then used to animate digital character models in 2D or 3D computer animation. The purpose of motion capture is to record only the movements of the actor, not his or her visual appearance. This animation data is mapped to a 3D model so that the model performs the same actions as the actor.

PROCEDURAL CONTENT GENERATION

As an alternative to hand creating 3D models, textures, animations and environments, it is possible to generate these programmatically, which means that hundreds of variants can be created very rapidly. An algorithm or code model is designed that either mirrors the process a designer would take or creates a shortcut to creating similar content. For example, to create an environment a mathematical model can be used to generate a number of hills and valleys which are then filled with water to a certain level to create lakes. On top of this, a variety of plants are placed which are grown artificially using the concept of a root, branches and leaves of various types. Within this world, houses can be placed that randomly vary a few template models and some underground passages created by programming an artificial miner that randomly decides in which direction to mine.

JUST SEVEN WEEKS TO CREATE CINEMATIC EXPERIENCE FOR A HOLLYWOOD MOVIE

Launched in March 2017, Ghost in the Shell is a VR experience launched on Oculus Rift, GearVR and Facebook 360 to help promote the movie of the same name

Getting the project planning right and ensuring the right tools and skills were immediately at their disposal was crucial

We wanted to do something that had a **VALUE** and wasn't just VR for VR's sake

Meticulous planning and management was essential for the project

Ask yourself: **WHAT DOES IT ADD?**

This was an Unreal project, for the **VISUAL QUALITY**

Unreal is designed for cinematic gameplay and when you're running it on a PC it's possible to do some stuff that looks fantastic in the engine.

We had to work out what we could create that would have the biggest **IMPACT** within that time.

There were a few key scenes from the film that we had to work out how they would play out as a VR experience

Anyone that does real-time VR are hard to come by and we desperately want to keep them in-house for as long as possible

3+M

ADAPTED ASSETS

INTERNAL ASSETS

MOTION CAPTURE

It's about understanding what the end product needs to be and what is essential to make it happen

Knowing when to **BORROW** from previous workflows and when you need to come up with something **NEW**

Everything was being **REFRESHED & TESTED** as we went along

Gear VR

We are working at the bleeding edge of what's possible at the moment, and that's really exciting. But it does mean every project has unique challenges

The big challenge was that we were creating three different experiences, each optimised for the different platform

The consensus is that AI isn't as clever as people think it is. AI would help on the outward facing stuff more than the internal processes

KEY FINDINGS: VFX & ANIMATION

The VFX and animation community are ideally placed to work with the new medium of VR, having grown accustomed to enlisting new technologies for the purposes of storytelling since the use of hand draw cartoons and through years of experience using the latest animation technology.

WORKFLOW HIGHLIGHTS:

- Production tools used by animation teams remain largely suitable for creating assets and there is a growing use of Unity and Unreal for working with these in real-time for VR productions.
- Traditional concepting and script-writing techniques are being used to design the experiences prior to production, however these are being added to with experimental physical or virtual set design that are required for immersive stories and new camera positions.
- Scenes are trialled using a combination of gray box models in VR, using new tools such as Tiltbrush that allow scenes to be created in VR, and using physical models of Lego or other materials prior to full development.
- Online asset stores are being used to provide template models that are then replaced or upgraded with custom created versions.
- Both 360° filming techniques and computer generated graphics are combined to create scenes that are interactive and optimised for lower power devices.

CHALLENGES:

- Commercial; sourcing experienced and talented teams can be difficult, in particular finding staff that can use Unity and Unreal requires looking outside the traditional resource pool for VFX and animation.
- Technical; developing for multiple platforms and distribution routes, each with different rendering power and control methods, requires large amounts of rework and support.
- Creative; directing the viewer, when they can control where they look, is a challenge that needs creative solutions, as is bringing interactivity into the experience that will add to rather than break the immersion or narrative.
- Technical: creating high quality and high resolution content with VFX and image capture elements with complex interactivity that won't cause app issues or generate glitches in delivery (platform and hardware).
- Commercial: funding and commissioning partners can be difficult to obtain in a market that is still very experimental and expensive.

OPPORTUNITIES / WHERE ARE THE GAPS?

Producers are investigating new ways to prototype and communicate how scenes should be constructed, however these are not simple to digitise into a project. There is an opportunity for applications that allow fast construction and communication of scenes, and which do not require specialist technical experience, which would enable more people to create VR content. This would reduce the reliance upon skilled developers to do elementary scene construction.

There is an opportunity for a tool that can automate the process of porting an experience designed for one platform (e.g. Oculus Rift) to another (e.g. mobile). Such a tool would need to be able to both optimise content, increase resolution (using AI or procedural content techniques) as well as accommodate for different user interface methods available on each platform. An alternative would be a further acceptance and use of an open standard for all platforms, such as OpenXR from Khronos.

As with games, film and TV, files for animation driven VR are very large, and as yet need to be downloaded prior to playback on a user's device. As well as limiting consumer uptake, the opportunity for streamed VR will rely on both higher network speeds as well as optimisation of content delivery.


VRWC
AMD

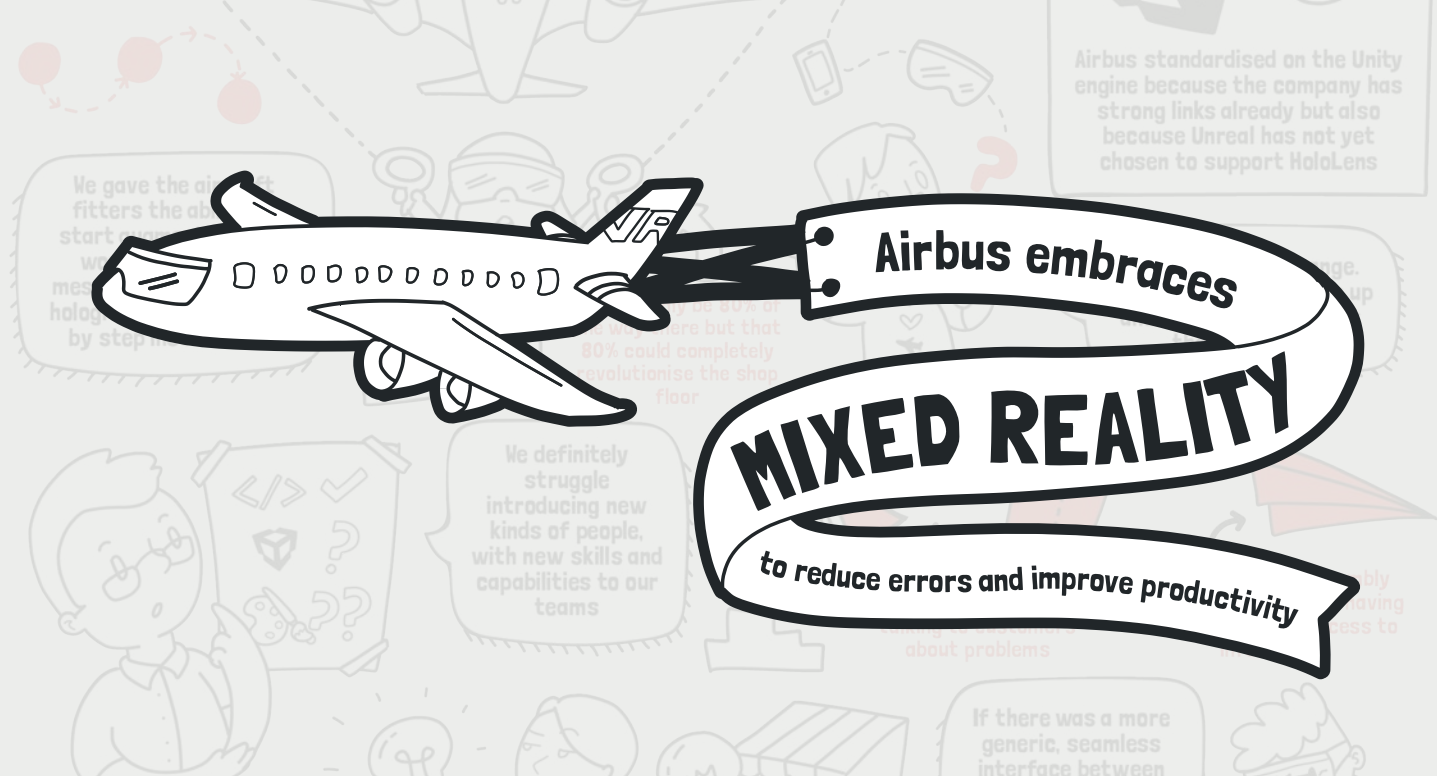
ENTERPRISE - DELIVERING COST SAVINGS WITH VISUALISATION

Enterprises are experimenting with VR as much as the creative industries, with applications including marketing, training, design and engineering and visualisation of complex datasets and processes. In these industries the low rate of consumer take-up of VR headsets is not so much of an issue, with businesses generally considering the reduction in costs or increase in impact and retention in comparison to traditional methods.

Typical software development for a business would start with a business case for the application or project. This could include a statement of the problem to be solved, constraints around the project including timeline, budget and resources available, a creative brief or set of design guidelines, and an indication of who can be consulted on the project to make sure it fulfils the user requirements.

A business may then decide to either invest in an internal team to develop the product, which means that they retain skills and experience gained, or use external experts to provide such skills, which will often provide faster and more immediate results. The development of software for a business will traditionally follow a waterfall method, where software is designed in full on paper, then fully developed, then tested. Each stage only starting when the previous ends. Alternatively an agile methodology may be used, where the product is broken down into areas of functionality which are each designed, developed and tested in a number of sprints.

While enterprises have had many years of developing or utilising software for computers, web browsers and mobile, the major difference with immersive projects is the introduction of the third dimension. This means that traditional roles of user experience expert, user interface designer, developer and tester are added to by 3D artists, animators, 360° camera operators and interaction developers, largely drawn from the games, TV, film, VFX and animation industries.



John Arundell, Digital Transformation Leader, ESW Digital Wing, Airbus UK

AIRBUS

BACKGROUND

Airbus has been using a variety of forms of visualisation including VR for many years to develop higher quality components with less chance of design error. In 2016 it achieved productivity increases of at least 5% across various projects utilising AR devices (such as Hololens), saving millions of pounds across processes and leading to the formation of the Airbus Holographic Academy.

TEAM

Development teams traditionally include a user experience designer, a software developer and a customer. However as Unity has become more widely used game designers, 3D and 2D artists are now employed bringing new skills and capabilities from the games industry.

We have an advanced manufacturing facility that does a lot of proof of concepts. We will come up with an idea, try to work out the biggest issues and use the advanced facility to replicate the process and test the software. You design software next to the issue you are trying to solve.

WORKFLOW AND TOOLS

Initial concepts are born from users, either customers or manufacturing operators, considering everyday problems or where improvement is desired. Development is iterative and tested regularly for effectiveness against the challenge.

Aerospace projects include a number of project and technical communication tools, in particular a lot of CAD data. All of this is imported into Unity via specialist tools provided by PiXYZ. This is backed up with coding in Visual Studio and Blender for asset-design.

Hololens is integrated with other software and allows warning messages, text, videos, holograms and step by step instructions, offering massive gains over paper based solutions.

Teams use regular hack-a-thons and collaborate with Unity, Microsoft and Deutsche Telekom on development projects.

CHALLENGES

Legacy projects and products can be difficult to extract digital information from, which requires building of data processing modules that can convert information into Unity friendly data.

Hardware innovation is very fast - by the time processes have adapted to one set of hardware, the next generation is offering better immersion levels.

"We have an advanced manufacturing facility that does a lot of proof of concepts. We will come up with an idea, try to work out the biggest issues and use the advanced facility to replicate the process and test the software. You design software next to the issue you are trying to solve."

John Arundell Airbus

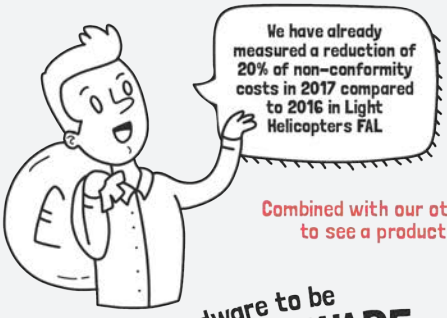
3D LASER SCANNING

3D laser scanning digitally captures the shape of physical objects using a line of laser light. 3D laser scanners create "point clouds" of data from the surface of an object, capturing a physical object's exact size and shape and turning it into a three-dimensional digital representation that can be manipulated and used as an asset in VR applications.

Airbus embraces MIXED REALITY

to reduce errors and improve productivity

Airbus is the largest aeronautics and space company in Europe. It develops applications in VR, AR and MR internally through its Holographic Academies and advanced manufacturing facilities

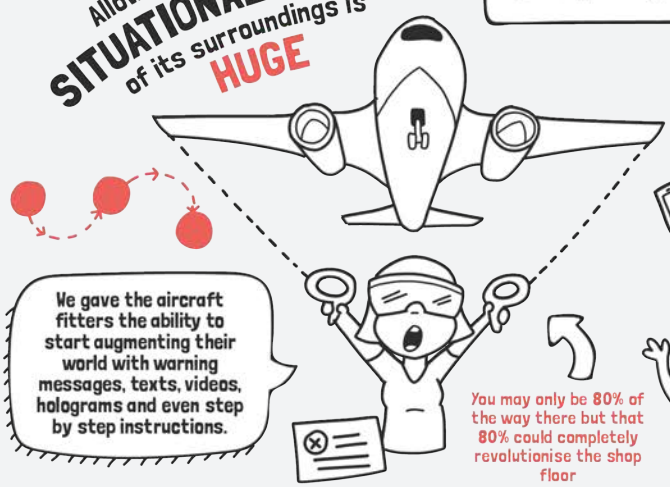


The benefits from MR have already gone into the millions of pounds

Combined with our other initiatives, we are expecting to see a productivity increase of at least 5%

This kind of return on investment is why Airbus is no stranger to trialling leading edge technologies

Allowing hardware to be SITUATIONALLY AWARE of its surroundings is HUGE



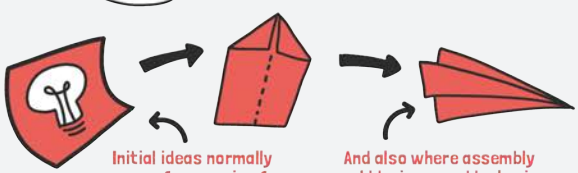
Airbus standardised on the Unity engine because the company has strong links already but also because Unreal has not yet chosen to support HoloLens

We gave the aircraft fitters the ability to start augmenting their world with warning messages, texts, videos, holograms and even step by step instructions.

You may only be 80% of the way there but that 80% could completely revolutionise the shop floor

Tech will always change. It's about how you keep up and make the most of it that matters

We definitely struggle introducing new kinds of people, with new skills and capabilities to our teams



Initial ideas normally come from a mix of talking to customers about problems

And also where assembly could be improved by having more immediate access to information

There is a danger that because tech is moving so quickly, by the time get something to market something else has come along

If there was a more generic, seamless interface between the different bits of hardware – that would be incredibly useful


VIVE

BRANDS - ATTRACTING NEW AUDIENCES

Technologies such as VR and AR are almost a perfect match for brand marketing; almost by definition they immerse a viewer or player in a story or narrative, and brands are able to provide a high impact and high engagement experience that builds recognition and emotional attachment with complete control over what the user sees.

There are challenges, with the relatively low pickup rate of consumer headsets meaning audience volumes are limited, but also opportunities that include very low cost cardboard and Daydream headsets that can practically be given away and the thirst for conference and trade show visitors to try out the best experiences on offer.

For web and mobile content, brands usually work with external agencies and partners to deliver marketing campaigns, and given the complexities of immersive development, this strategy continues with VR and AR. This means that brands can access the best skills for the campaign they have in mind, although some of the larger brands do manage internal teams once they feel a technology has proven itself. As such they are now making contact with games, TV, Film, VFX and animation companies to understand the various methods of producing VR and AR and working out how to use these techniques in their campaigns.

One such example is McDonalds who worked with Make Real, a VR development studio with a background in creating video games.

Sam Watts, Director of Immersive Technologies, Make Real

Project:
Top of the Crop
VR game

View Project

MAKE REAL

BACKGROUND

'Top of the Crop' is a two-player 'Hero VR' realistic potato harvesting game on the Oculus Rift, with participants competing against each other to harvest the most quality potatoes. The project was developed by Make Real for McDonalds as a marketing tool, and includes a mixture of 360° video, computer generated VR and touch screen interactions.

TEAM

The project was built by a small team consisting of a designer, a developer and producer. Each member of the team takes on multiple additional roles and the team have worked together for many years.

WORKFLOW AND TOOLS

While the studio has a professional gaming background, as this was a client project, Make Real started the project using their successful template of Four D's - Discovery, Design, Development and Deployment. Part of this included visiting the environment being portrayed, picking up noise, sensations and viewpoints which had to be replicated.

We grey-box a lot of stuff.
We have very simple primitives.
We'll get the actual sensation and mechanics feeling right without actually doing the final modelling assets, so we'll be driving around rough blocky, polygonal shapes across a field which we can make and look and feel bumpy - and then fine tune how bumpy to maintain comfort levels.

All requirements were evaluated to ensure they aligned with project objectives, to ensure that they contribute to what the customer was trying to achieve. Google's Design Sprint was used to record ideas and allow multiple users to vote, select and focus on the best, throwing out anything that didn't work. Initial designs were drawn on paper then the team modelled layouts within VR using Quill, Google Blocks and Tiltbrush.

Unity was the primary tool used from prototyping through to final production. Scenes were rebuilt from layouts using grey-boxes or wireframes to work out the dynamics of the game before complex assets were built.

As well as the team continually checking how the project worked in VR headsets, the customer was invited to regularly review the developing project to ensure it delivered to expectations.

Asset store content was only used in prototyping, with all final game assets produced from scratch.

CHALLENGES

In order to be successful, VR projects require careful management of budget, time and expectations. Unity and Unreal have their own specialisms that a team need to understand in order to get the best results.

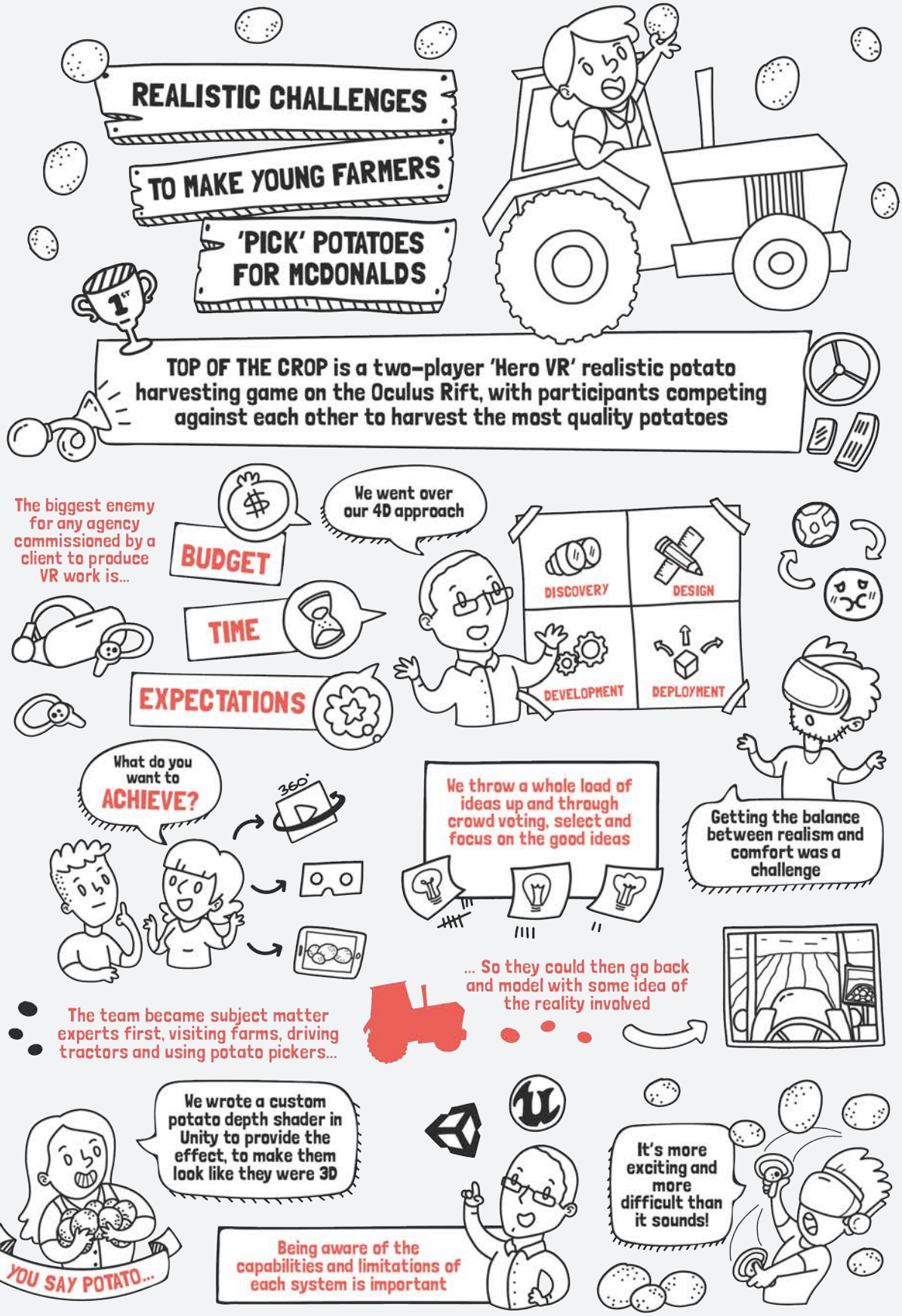
Processing power, overheating graphics chips and battery life on mobile devices limit the complexity of the experience that can be created.

"Creating a VR experience is simple in that you have a 3D scene - we use Unity – and once you have that scene you can drop VR camera assets into it and it will work immediately in VR. The skill and craft aspects come from designing the interactions and the overall design mechanics, so that's it's comfortable but also engaging."

Sam Watts Make Real

DEVELOPER/CODER

In a game development context, where an application needs to provide any sort of interaction (such as allowing a player to open a door), integration of hardware (e.g. motion capture suits), or other data sources (e.g. a developer is needed to write and test code for high score tables). Coders are also often called upon to integrate the various assets that are produced by other team members into a single application, submit applications to app stores, to write or set up servers for multiplayer or common resources, and even create tools to automatically generate content. Developers also look for ways to create re-usable solutions, which speeds up the workflow for a studio for repeatable tasks.


REALISTIC CHALLENGES
TO MAKE YOUNG FARMERS
'PICK' POTATOES
FOR MCDONALDS
1st
TOP OF THE CROP is a two-player 'Hero VR' realistic potato harvesting game on the Oculus Rift, with participants competing against each other to harvest the most quality potatoes
The biggest enemy for any agency commissioned by a client to produce VR work is...
BUDGET
TIME
EXPECTATIONS
We went over our 4D approach
DISCOVERY
DESIGN
DEVELOPMENT
DEPLOYMENT
What do you want to ACHIEVE?
360°
We throw a whole load of ideas up and through crowd voting, select and focus on the good ideas
Getting the balance between realism and comfort was a challenge
... So they could then go back and model with some idea of the reality involved
The team became subject matter experts first, visiting farms, driving tractors and using potato pickers...
We wrote a custom potato depth shader in Unity to provide the effect, to make them look like they were 3D
YOU SAY POTATO...
Being aware of the capabilities and limitations of each system is important
It's more exciting and more difficult than it sounds!

SKILLS, TRAINING AND EDUCATION

In order to create an immersive experience, a number of different skills are required. Job titles vary across industries, however a team will usually include a project lead such as a director, producer, creative director or product manager, who will delegate aspects of the creative, narrative, technical design or user requirements gathering to others.

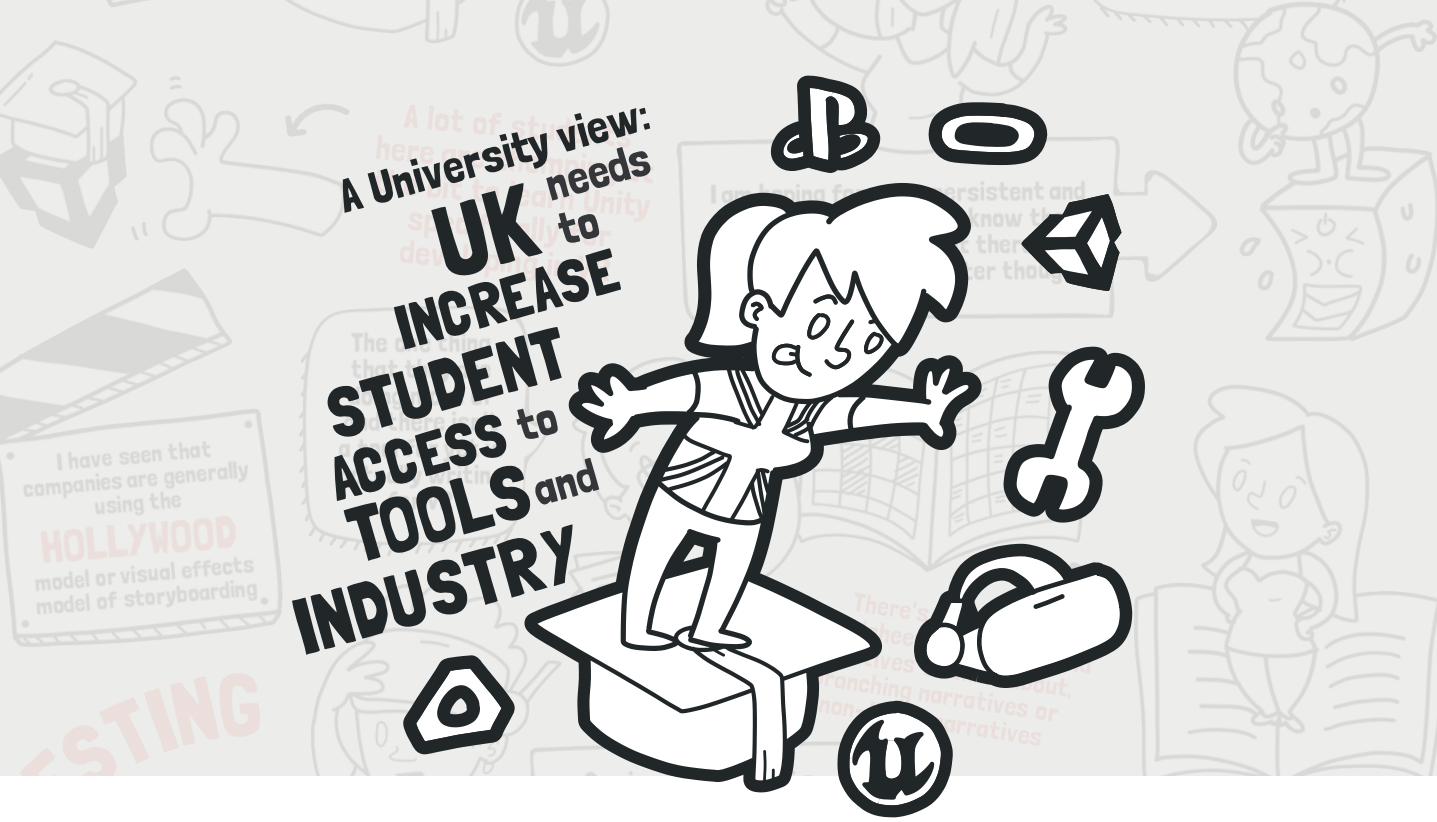
For interactive and computer graphics driven projects, a team will then include coders to create interactivity and development tools, and 3D artists and animators to create the scenes, characters and models in the projects. For projects making use of 360° cameras, roles will include cameraperson, footage stitcher, media manager and editor. For both project types, audio engineers and designers will provide an extra level of immersion and ensure the product works on the delivery headsets.

Teams working in immersive are largely self taught at this stage, and are adapting experience from the games, TV, film, VFX and animation creative industries, with businesses and brands drawing upon these groups to assist in engineering and marketing apps.

With no formal and widespread training programmes, learning is largely restricted to project based experimentation and discovery, and with a limited number of opportunities to work on VR and AR projects, skills availability has been restricted to date, leading to a premium placed on people with immersive development experience. The number of hardware options and development tools means that skills coverage is also patchy, with the availability of skills for a project often dictating how it gets designed and produced.

As immersive technologies become more established, there will be a greater need for further training delivered formally via professional training and within colleges and universities. It should be noted that game jams and hack events have traditionally been an excellent way for people to learn new technology and team skills, and could be employed further in the immersive fields.

Colleges and universities are adapting to the requirement from employers, researchers and students to provide formal training, including opportunities for project practice. One of these is the University of the West of England (UWE), where Jen Stein is part of the team developing a Masters in VR.



Jen Stein PhD, Watershed
Professor of Design Futures, Digital Cultures Research Centre, University of the West of England

View Project

UWE

BACKGROUND

The DCRC is a space for researchers working in the areas of media theory and practice to share their work. Part of the University of the West of England, Bristol, and a strategic research partner of the Pervasive Media Studio, DCRC brings together researchers and commercial producers in the field of wireless applications, social gaming and Alternate Reality Games.

TEAM

Within tertiary education, there are different approaches to research within creative and technological fields, ranging from hands on lab work, through to working with external companies and organisations.

WORKFLOW AND TOOLS

Across the spectrum of VR development, while people are gravitating towards game development production methodologies, right now the film/VFX model of storyboarding with a focus on the narrative is dominating the VR world.

The challenge in the UK is to increase the access and exposure to cutting-edge technologies as well as getting industry and education to work together on new applications. The US is a good role model for this kind of collaboration.

Unity and Unreal are the main tools being used for development, with Unity being the preferred tool from a student's point of view.

New platforms such as ARKit and AR Core from Apple and Google respectively, Hololens from Microsoft and MetaAR provide new opportunities for Augmented and Mixed Reality applications, which are being taught by colleges and universities.

There is a growing interest in light-field capture and volumetric technologies, which are beginning to be implemented in colleges and universities.

CHALLENGES

Current tools, from software development kits to the GPU and network capabilities of VR devices, are not enough to create highly persistent and emerging worlds.

Tools for designing VR experiences are generally based on a linear model of storytelling, however much of VR is becoming non-linear and dynamic, meaning these design tools are being stretched beyond their ability to deliver.

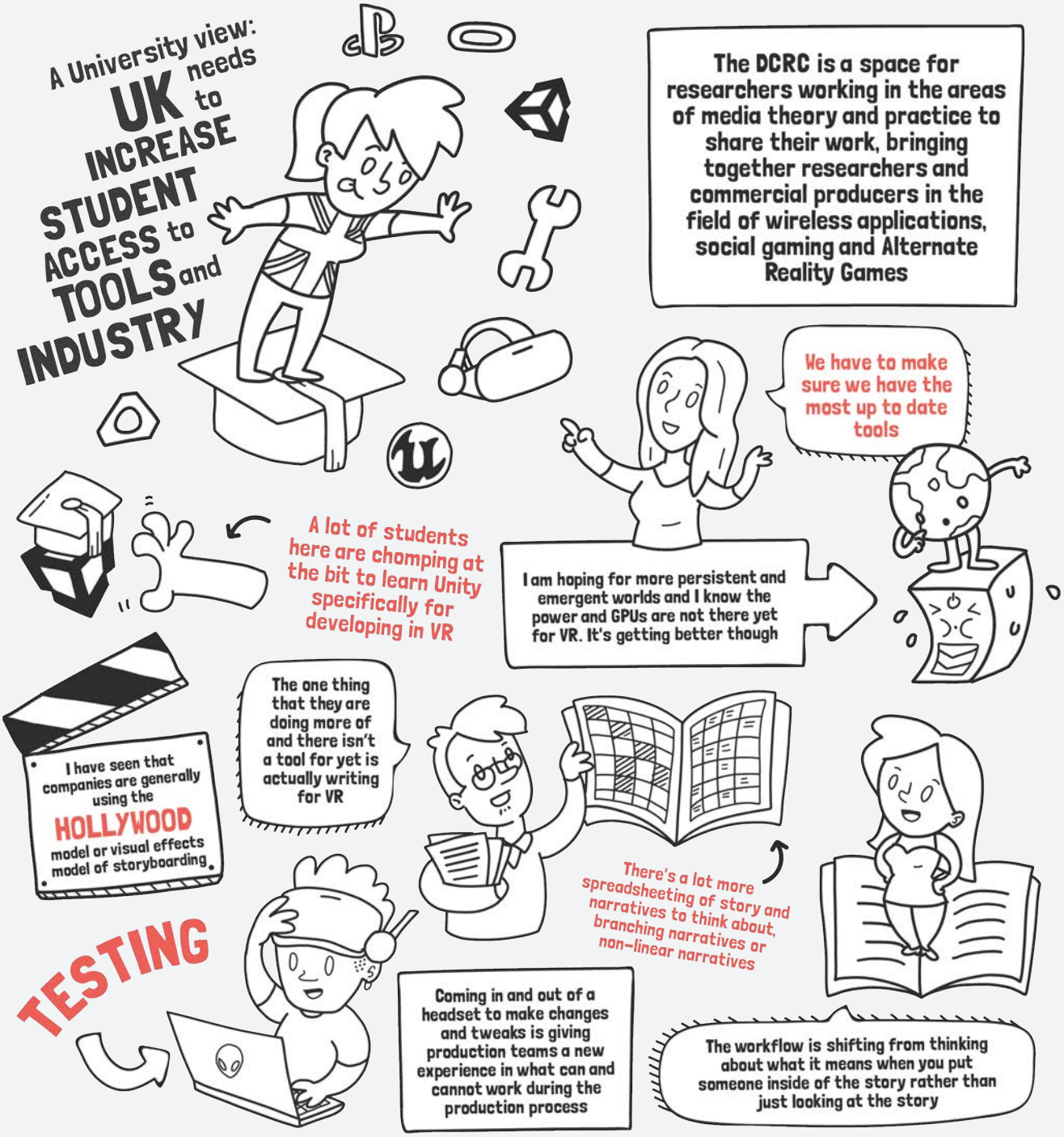
This extends to most of the development tools, which are designed for 2D screen based direction, and do not necessarily support visualising 3D space or how a VR experience will move dynamically in reaction to the player.

Access to local organisations plays a large role in the opportunities available, for example Silicon Valley and Hollywood influence the types of VR studio in each of those regions. VR companies need to identify how their local landscape can give them advantage in the emerging immersive industry.

The challenge in the UK is to increase the access and exposure to cutting-edge technologies as well as getting industry and education to work together on new applications. The US is a good role model for this kind of collaboration.

LIGHT FIELD CAPTURE

Light field capture is based on the idea of a light field, or the amount of light traveling in every direction in every point in space. While a conventional camera captures just a 2D image of the light as it enters the camera, a light-field camera also captures the direction that the light was coming from. With an array of these cameras, capturing nodal images, a 360° image with six degrees of freedom can be created.


A University view: UK needs to INCREASE STUDENT ACCESS to TOOLS and INDUSTRY
The DCRC is a space for researchers working in the areas of media theory and practice to share their work, bringing together researchers and commercial producers in the field of wireless applications, social gaming and Alternate Reality Games
We have to make sure we have the most up to date tools
I am hoping for more persistent and emergent worlds and I know the power and GPUs are not there yet for VR. It's getting better though
A lot of students here are chomping at the bit to learn Unity specifically for developing in VR
I have seen that companies are generally using the HOLLYWOOD model or visual effects model of storyboarding
The one thing that they are doing more of and there isn't a tool for yet is actually writing for VR
There's a lot more spreadsheeting of story and narratives to think about, branching narratives or non-linear narratives
TESTING
Coming in and out of a headset to make changes and tweaks is giving production teams a new experience in what can and cannot work during the production process
The workflow is shifting from thinking about what it means when you put someone inside of the story rather than just looking at the story


Opposable Group
TH-02

CONCLUSIONS AND WHAT'S NEXT

Each industry has taken its own route to develop immersive content and each are exploring new techniques, often by collaborating with new partners or by bringing in outside perspectives. This means that techniques merge, and from an outside perspective, appear to borrow from each other in terms of some of the solutions and new techniques being explored.

There are many challenges in the early days of a new content medium and industry, as well as many discoveries and opportunities as highlighted by this report. Below are some of the key points:

Technique (Area of Origination)	Challenges	Being explored or in development
Use of scripts, storyboards and other design documents to explain the concept. (All Industries)	Difficult to precisely define, control and communicate how the scene will look to a viewer. Difficult to describe interactions.	Tools to enable fast construction of VR centric viewpoints and attach narratives to objects.
Use of grey-boxing to rapidly create scenes, and use of physical models. (All Industries)	Need to be constructed by people skilled in Unity or Unreal, who are often difficult to find and should be working on more specialist code.	Tools that allow quick construction of scenes in VR, similar to Tiltbrush and Quill, and the ability to import scenes produced into working projects.

(Continued overleaf)

Technique (Area of Origination)	Challenges	Being explored or in development
Use of 360° cameras. (Film and TV)	New approaches to directing and capturing images, sound and action are required as well as editing the content to create narrative. The technology behind 360° camera systems is still in its infancy and many are sub standard for a professional delivery. Restricted to scenes that can be captured in the real world, requiring expensive set design in some cases. Difficulty in previewing footage as it is created, raising the risk of re-shoots if not correct. Lack of interactivity in captured footage. Multiple lenses and large file sizes require media to be closely managed. It can be difficult to direct player gaze.	Volumetric capture studios and photogrammetry techniques that allow actors and environments to be captured and manipulated in 3D. More mature 360° camera and editing solutions that provide media management and storage facilities. Combining 360° imagery with hand drawn or 3D CGI to construct 3D scenes. Advances to hardware and software to allow live preview of 360° filming, as well as separation of items for later editing. Importing 360° content into tools like Unity to add interactive content. Tools to automate the storage and retrieval of files produced by 360° cameras. Post processing to direct viewer attention.
Directing where the viewer should look, and custom design of interactions for each project and each device. (All Industries)	Expensive testing and re-work and custom code required for each platform. Different code required to interface with each headset requires rework for each platform.	Automated tools to optimise for different headset capabilities and interaction methods. Automated testing and distribution to remote testers. Open standards such as OpenXR (Khronos) will allow developers to write once and deploy on multiple platforms.
Optimising highly complex scenes for low-end headsets. (Games, Film & TV, VFX & Animation)	Expensive re-work required to rebuild models for lower end headsets.	Baking down complex scenes into 360° images. Tools to automatically lower resolution of complex objects, using procedural content or AI techniques.

Technique (Area of Origination)	Challenges	Being explored or in development
Distribution for download via app stores. (All Industries)	Audiences would prefer to stream content on demand, rather than download large files which take time and device space.	Improvements to network speed and bandwidth, as well as image compression techniques, to provide on-demand streaming of VR.
Use of online asset stores to provide placeholder models. (Games, VFX & Animation)	Asset store models often have to be replaced as not quite right for the project, or do not provide enough control.	Asset stores that provide highly customisable models that can be used for main productions, at a fraction of the cost of creating from scratch.
Managing collaboration on a project via code merging tools. (Games, VFX & Animation)	All team roles contributing on a project need to be trained in source code control. Mistakes can be expensive to correct when a team member makes a mistake.	Development of VR project creation and collaboration tools that allow developers to work together on scenes in real-time.
Data files need to be imported from various enterprise applications. (Enterprise)	Many software tools do not provide export options for 3D visualisations, full data sets need to be exported and manipulated, often including human cleaning of data.	Software vendors are updating data systems to provide VR or VR ready exportable data.
Hardware innovation can be faster than project teams can react. (All Industries)	Projects are often built for the last generation and need to be re-worked and retested for newer devices.	Automated tools to port pre-existing content from older devices to new hardware, or emulators that can be included in new devices.
Training, finding partners and project teams. (All Industries)	Limited formal training programmes. Limited project based learning opportunities Difficult to find partners and project teams.	Universities and professional bodies to offer training programmes for VR, AR and MR. Organisation of immersive hack events and community development activities. A greater number of locations and events where industries can meet and work on challenges.
Despite being very powerful, current tools are limited in ability to provide highly complex, persistent and player influenced worlds. (All Industries)	VR can only be delivered as a emulation of its potential at this stage, which means designers are limited in what they can deliver to audiences.	Future design & production tools, as well as network and cloud infrastructure, will in the next 10 years, deliver applications with highly social, highly complex VR environments.

WHAT WILL CHANGE OVER THE NEXT 10 YEARS?

Despite being very powerful, current tools are limited in their ability to provide highly complex, persistent and player influenced worlds, which will provide step changes for VR, AR and MR experiences. Immersive experiences can only be delivered as an emulation of its potential at this stage and therefore creators are limited in what they can deliver to audiences.

Over the next decade design and production tools will evolve, as well as network and cloud infrastructure. This will enable the creation of highly complex immersive environments as well as social applications.

This is likely to happen as a series of small steps as the ecosystem develops, however judging by the speed of current development in immersive and associated technologies, we can expect to see in the near future:

- New asset production and capture tools in both hardware and software.
- Pre-designed online assets which are simpler to use for specific use cases, have more capability, and allow the production of more realistic and detailed 3D assets and experiences.
- New AR experiences that make use of location and object mapping techniques to merge the virtual with the real, making use of location and object mapping techniques.
- New software production tools that provide template projects and drag and drop interactions, that will reduce the need for skilled developers and allow more people to develop immersive experiences and applications.
- Collaborative production tools that enable multiple people to engage in immersive software design and production in real time from multiple locations, some using immersive technology, others using more traditional design tools.
- Increasingly powerful networks services that allow the streaming of VR and AR in real-time from servers, removing the need to download software prior to play.
- New software architectures that spread processing across a number of servers rather than single devices, enabling a step change in experience complexity.

Ultimately these developments will drive further market growth and the take-up of VR and AR headsets amongst consumers and businesses, increasing audience size and commercial models available to developers. We look forward to watching these developments as they emerge, and to the exciting projects that will be created along the journey.

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CATAPULT Digital

Digital Catapult is the UK's leading advanced digital technology innovation Centre, driving early adoption of technologies to make UK businesses more competitive and productive to grow the country's economy.

We connect large established companies, startup and scaleup businesses and researchers to discover new ways to solve big challenges in the manufacturing and creative industries. Through this collaboration businesses are supported to develop the right technologies to solve problems, increase productivity and open up new markets faster.

Digital Catapult provides physical and digital facilities for experimentation and testing that would otherwise not be accessible for smaller companies.

As well as breaking down barriers to technology adoption for startups and scaleups, our work de-risks innovation for large enterprises and uncovers new commercial applications in immersive, future networks, and artificial intelligence technologies.

Opposable Group

Opposable Group are a technology company that specialise in the development of VR and games, and are co-founders of the Bristol Games Hub, VR World Congress and the Bristol VR Lab.

Tech SPARK

TechSpark is the information hub for all things tech, connecting, informing and preparing market insight for companies that work in in Bristol, Bath and the West of England region.

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