



VIRTUAL PRODUCTION SKILLS REPORT 2023

StoryFutures

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EXECUTIVE SUMMARY

In our interim report *Virtual Production: A Global Innovation Opportunity for the UK* we provided a mapping of the skills needed across the film and television industry in order to capitalise on the opportunities presented by virtual production technologies and techniques. The report identified serious skills gaps and problems with communication between the workforce, talent and suppliers.

This 2023 report provides a detailed analysis of the results from our quantitative skills and R&D survey which was designed to gain an understanding of the dynamic, fast-changing development of virtual production (VP) in the UK. The resulting data provide insight into how UK companies can take steps to take advantage of the opportunity that VP presents.

Eight detailed case studies drawn from *VP Futures*, our SME training and R&D scheme, reveal that the challenges that SMEs are facing have in fact multiplied this year.

Despite new training initiatives becoming available, the demand for training continues to outstrip supply. Over one third of organisations surveyed reported less than 6 months of 'in house' experience with VP, and thus an urgent need to upskill. Two-thirds of all **VP-productive** organisations (those already using VP actively) reported that VP skills in the employment market are generally in weak, or very weak supply, reflected in their inability to find talent across the board.

A similar picture emerges in R&D. The survey tells us that VP techniques and workflows are being

supported by informal and unstructured approaches to R&D often through trial and error experimentation whilst on set. This adds unnecessary complexity and risk, with companies reporting that significant risks were being taken in order to complete productions to schedule and within budget. The added R&D pressure to learn tools and innovate during active projects is said to be a major barrier to successfully competing in the VP market. The need for R&D funding is clear. Our research demonstrates that de-risked R&D in non-commercial contexts, through schemes such as *VP Futures*, is vital to maintaining growth in the sector. This is particularly true for organisations that are **VP-ready** (ready to use VP in the next 6 months), or that are **VP-in-waiting** (planning to use it in a slightly longer time-frame). Especially pressing R&D requirements include the integration of workflows, coding and engineering, plugin design, VP-specific asset building and optimisation, as well as the supporting physical infrastructure and production design. Access to spaces and places where funded R&D can be undertaken is essential to tackling these areas of need.

As virtual production technology evolves and becomes more ubiquitous it is helping to shape the future of entertainment as a whole. The metaverse will increasingly shape our understanding of and interactions with not just film and broadcast TV, but also theatre, games, galleries, libraries, museums and other as yet nascent sectors. Our research takes the first steps in providing a road map to navigate this new territory.

INTRODUCTION

Virtual Production – often referred to simply as “VP” – is a radically new approach to filmmaking using real-time game engine technologies. It opens up a huge range of exciting creative and business opportunities as filmmakers and others around the world adopt new VP practices. In the face of severe skills shortages throughout the creative sector UK organisations aiming to capitalise upon these opportunities must overcome the challenge of finding and nourishing new talent for virtual productions.

Our StoryFutures *VP Skills Interim Report*, published in late 2021, provided a snapshot of the skills gaps, challenges and opportunities for the UK. It also signposted a way to meet these challenges, including the need to rapidly upskill current creative sector practitioners within the context of managing a live virtual production.

Our 2022-23 iteration of the VP Skills Report brings the industry skills picture up to date, drawing on a significant sector survey of 35 organisations, 41 interviews with practitioners and the learnings from *VP Futures*, a research and training in action programme delivered by StoryFutures, Future Screens Northern Ireland, ILM and Epic.

While *VP Futures* gives us an inside view of the challenges felt by smaller companies to adopt real-time virtual filmmaking, our Skills Survey 2022 provides us with a wider perspective on the sector. Importantly, the skills survey also shows us the most critical skills gaps and the current status of the skills pipeline. A new series of ethnographic interviews reveals the impact the skills gaps are having, not only on day-to-day management of VP projects, but also on R&D areas that are critical to maintaining the cutting edge of VP in the UK.

The picture that emerges is one of incredibly uneven access to talent and technology. Whilst a handful of companies at the cutting edge are beginning to treat virtual production as simply ‘production’, much of the wider film and television sector has barely encountered key technologies such as the LED wall or even games engines. As a result, there is a clear need to ensure leading players are incentivised to share knowledge and best practice whilst at the same time able to push the boundaries of new R&D challenges.



Uplands TV. Photo: Peter Richardson

METHODOLOGY

We adopt a mixed methods approach, drawing on both qualitative ethnographic research and quantitative survey-based research in order to understand the dynamic, fast-changing development of VP in the UK. Alongside this we were able to develop a research in action approach, which mapped theory and practice and skills research through the delivery of the *VP Futures* programme. Such an approach has allowed us to test how skills gaps might be best mapped and addressed in the sector.

This Report presents and analyses data from three primary sources:

- **Survey:** 35 companies working or planning to work in VP were surveyed. The sample included companies from UK Screen Alliance, Immerse UK, PACT, and UKIE, and covered information about the organisation, plus information about skills, VP training, experience of employees working in VP, roles and skills shortages and R&D in VP. All contributions were anonymous.
- **Interviews:** 41 interviews across two years, including 29 spoken to in 2021 for the *VP Skills Interim Report 2021*. The semi-structured interviews were remote (via Zoom) with interviewees offering feedback on iterations of the VP Skills Mandala. Interviews covered the background of interviewees, roles and responsibilities, how VP is changing the sector, changing relationships between departments, roles most in demand and where the gaps in VP skills are most felt. Interviewees were also asked where they thought VP would be in 5 years.
- **VP Futures case studies:** Covering all major areas of the creative sector, 8 companies participating in *VP Futures* received a programme of training and R&D support. Companies completed an audit of their skills on entry and on exit to/from the programme. Throughout their training they documented their creative and technical progress in extensive and richly illustrated *VP Playbooks*.

Data was analysed using MAXQDA 2022. The findings of the survey have been used to organise data collected via other methods, for example in the way that the case studies and ethnographic data has been presented. The survey shows how the skills gaps have been ranked in terms of importance and impact on the growth of VP, and this is a useful filter through which to analyse the provision of training that addresses these gaps. In a number of cases the survey and interview data overlap, since survey respondents were offered the opportunity to sign up for one-to-one interviews, and thus to express opinions and information about VP and skills not covered by the survey questions. Two participants took up this opportunity.

The design of data collection methodologies pivots on the concept of skills and skills gaps distributed across the non-linear workflows of VP. The focus of the interview questions, the survey questions, and *VP Futures* is on VP skills in the context of teams, rather than only on the skills of individuals. This is in part a response to the reports we have received of the currently unfixed nature of VP roles and the variable way in which VP job descriptions are written. For example, smaller companies may often have individual staff members operating across more than one role type, while larger companies may encourage ways of working across areas and expanding the repertoire of their employees through cross-training.



Photo: Juliet Brown. National Film and Television School

VP IN THE UK: THE STATE OF THE ART

Photo: Juliet Brown, National Film and Television School



2022 Overview

During 2022 virtual production in the UK has been developing rapidly in a fast-changing international context, characterised by ever-faster cycles of R&D, the release of new tools and the realisation of new creative possibilities for filmmaking. This has been signalled throughout by the arrival of flagship productions with wide appeal to streaming, cinema, and, with the release of *Abba: Voyage*, also to live music and theatre audiences.

The adoption of LED video wall technology has been seen across markets worldwide, and industry reports predict the continued rapid growth of VP. According to a recent estimate, the global VP sector will rise in value to USD \$ 3.1bn by 2026 (Infiniti Research Limited, 2022). Recent reports suggest the value of the sector will rise to USD \$ 5.1bn by 2027, from an estimated USD \$ 2.6bn in 2022, with leading technology players including NVIDIA Corporation, Sony Group, and Technicolor (Markets & Markets, 2022).

Following this trend, another estimate suggests the sector will continue to escalate in value to USD 6.79bn by 2030, expanding at a CAGR of 17.8% from 2022 to 2030, underpinned by what is described as the ability of streaming services such as Netflix to create content recommendations and commissioning of content based on extensive user data, and investing a reported USD 17bn in developing data-driven services

(Businesswire, 2022). This fits an industry trend to deploy artificial intelligence technologies to analyse data of this kind and devise new services on the back of this, and to use machine and deep learning to enhance the quality of visual effects and simplify 3D design processes (Grand View Research, 2022).

Against this is a rising awareness of the severity of shortages of the skills needed in the sector to maintain the growth of VP in the UK, as elsewhere. Crew shortages and retention issues at all levels and across all types of productions were reported in the BFI Skills Review 2022 (British Film Institute, 2022). In response to a call from the Department for Digital, Culture, Media and Sport (DCMS) for research and understanding of the challenges facing the scripted film and high-end television production sector, the BFI uncovered the extent of critical skills gaps. The report estimates that “the sector urgently needs to invest at least 1% of production budgets in training the future of our workforce” (p.2). The current situation raises risks such as “crew being promoted too early and without the necessary support, leading to increasing levels of stress on set” (p.2). The independent sector, in particular, faces a general struggle to attract and retain crew and the wider shortages have a noted impact on virtual production where skills in the new technologies are already in short supply. The authors of the BFI review comment on negative working practices in the film and TV sector at large:

“Working conditions and hours, recruitment practices, and poor work-life balance have an impact on crew retention and the diversity of the workforce. Unacceptable behaviours remain commonplace and our industry must change to become an attractive place to work.

BFI Skills Review 2022, British Film Institute, 2022, p.3

The Development of VP

Virtual production is an umbrella term, encompassing “a broad range of technical and creative frameworks utilising computer-generated imagery in real-time combined with extended reality — innovations of virtual reality, augmented reality, and mixed reality” (Hendricks, 2022). VP is a novel and, currently, often technically challenging combination of new and older technologies.

Despite the challenges, the rich creative and logistical incentives for using VP have led to the rapid inclusion of VP techniques into traditional production filmmaking frameworks (Bennett, 2020; Bennett & Kruse, 2015; Kadner, 2019).

Virtual production is increasingly being seen as a means of “unlocking creative vision and adding business value” to creative sector businesses (Deloitte, 2020). Since 2020 industry insiders have recognised this trend and noted that “new stages pop up once a week now, not only in Hollywood or London, but in locations everywhere” (David Morin, Industry Manager for Film & TV at, Epic Games, 2020a).

Guides and handbooks on VP have begun to proliferate as the spread of new studios continues, aimed at contributing to the stabilisation and standardisation of VP workflows. Two iterations of the Epic Games Virtual Production Field Guide have been published complete with interviews of professionals in VP and surveys of services (Kadner, 2019, 2020, 2021b), and Lighting for LED stages (Kadner, 2021a). A forthcoming third iteration of the Unreal Handbook is expected in 2023. In 2021 key VP player Netflix released a guide to in-camera visual effects, or ‘ICVFX’ (Netflix, 2021) and in 2022 the US-based Visual Effects Society (VES) published a handbook of Industry Standard VFX Practices and Procedures covering VP (Okun et al, 2020) and SMPTE published the on-set virtual production initiative (SMPTE, 2021).

The history of VP development is a long one, charting the technologies’ movement from Technology Readiness Levels (TRLs) 1-4 in the early 2010s through to widespread adoption in the early 2020s.

Overt descriptions of collaborative film production involving real-time engines to be found in academic and industry publications reach back to 2011. Early research includes ‘Touch driven communication for virtual moviemaking’ (Duff & Bolas, 2011), ‘Adopting virtual production for animated filmmaking’ (Bennett & Carter, 2014), and ‘Virtual production: Possibilities and limitations of virtual production environments optimization through implementation of innovative interfaces’ (Götz, 2015). Huebel (2015) described a system for physically-based virtual camera control using rotational motion capture. The term “virtual production” was used to describe a collaborative platform called ‘Dreamspace’ at SMPTE in 2017 (Grau et al, 2017).

In 2016 Bill Pope and Jon Favreau described the inception of the Digital Domain (or DD) platform, platform via the of the Photon game engine, as used on the *Lion King* (Goldman, 2016), and the cooperation between VR and filmmaking on *Jungle Book* (Goldman and Fish, 2019). Gary Roberts, VP supervisor from *Jungle Book*, built a virtual world named OASIS for the film *Ready Player One* (Roberston, 2018), and the filmmakers demonstrated the virtual cinematography tool used on the film at Siggraph in 2018 (Unity, Siggraph, 2018). SimulCam was created for the film *Avatar* in 2009, and is a term still widely used in VP (Unreal, Siggraph, 2019). For the feature film, *The Lion King*, director Jon Favreau remarked, “We’ve basically built a multiplayer VR filmmaking game just for the purposes of making this movie” (Snetiker, 2019).

Li et al (2022) surveyed the development of VP over ten years (Li et al, 2022), while Kavakli et al (2022) observe three major game-changing trends in the development of VP: globalisation, collaboration and industrialisation. They argue that:

“There is a need for an integrated VP studio (VPS) network through shared infrastructure and resources to foster high quality research and to solve industry-identified problems through industry-led collaborative research partnerships” (Kavakli et al, 2022).

Looking ahead, many believe the pace will continue. For example, based on industry consultation, Schultz forecasts that over the next 10-15 years, “we can predict that complex movie sets will be digitally created for actors to perform in them live and without reduced post-production” (Schultz et al, 2021).

VP SKILLS SURVEY 2022

The VP Skills Survey 2022 provides a snapshot of VP in the UK in 2022, firstly by gathering information about VP skills in organisations employing VP, and secondly by gathering information about how these organisations employ VP. Our analysis identifies the key VP skills gaps and their impact on company growth. The analysis also maps the sizes and types of organisations involved in VP, including levels of funding and investment. Finally, it addresses the status of internal and external training and sources of recruitment. The results show an industry in a variety of states of adoption and readiness for VP, with organisations classified into:

- **VP-productive:** *Those already using VP actively.*
- **VP-ready:** *Those ready to use VP in the next 6 months.*
- **VP-in-waiting:** *Those planning to use it in a longer time-frame.*

Our survey should be viewed as a snapshot based on the responses of approximately half of all of the active VP organisations in the UK. Of the 35 respondents, 19 organisations actively involved with VP responded to our survey, representing a cross-section of the sector, from larger enterprises using feature film LED stages through to smaller companies running or accessing smaller stages, and games companies. Respondents included companies working in film, the immersive/interactive sector, advertising and marketing. It also provides additional coverage of a further 16 organisations who are planning to join the VP sector. To put this in context, according to the Department for International Trade report on VP published in March 2022, “the UK has become the epicentre for large feature film level Virtual Production stages”, with 12 stages in the UK, 10 of which are in London, and with a total of 40 stages of all levels nationally (DIT, 2022; The Studio Map, 2022)*.

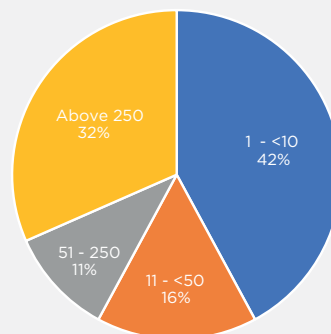
The data suggest that there are a limited number of companies in the UK who are prepared to describe themselves as VP specialists, preferring to see VP as part of a portfolio of services encompassing immersive filmmaking techniques more broadly. In a rapidly changing ecosystem hedged with uncertainty around the economy and rising costs of production, the expense of working with LED volumes may deter many from declaring a specialisation in VP at this time, despite an active interest in VP.

Businesses responding to our survey and active in VP are now only one part of a more complex picture that is emerging: an increasingly important and growing aspect is that of freelancer workers and micro-businesses who are utilising remote working to build and deploy low-end flexible VP solutions for clients. Epic’s ‘Work-from-home virtual production’ guide (Unreal, 2020a) and Matt Workman’s social media channel (Cinematographer Database, 2020), provide advice on how to deliver low budget VP, are evidence of this growing trend.

The Organisations

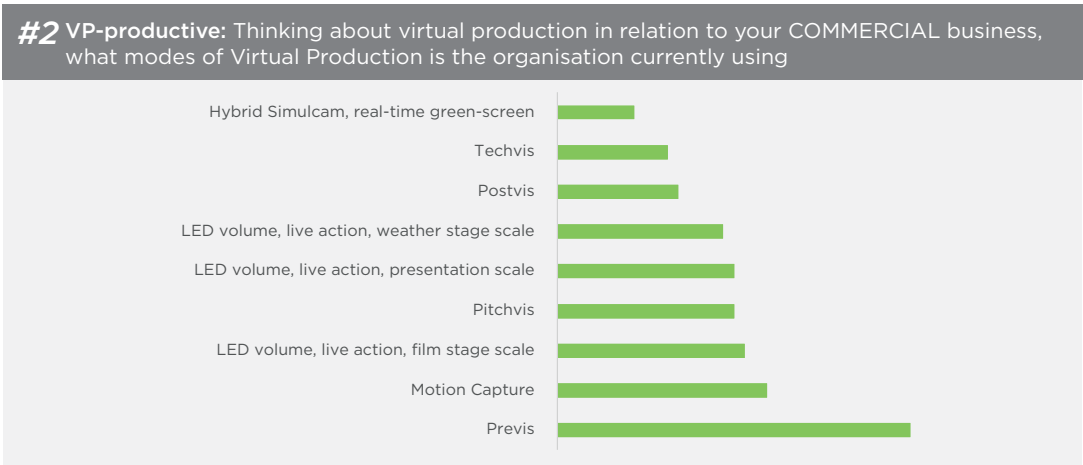
- **Of VP-productive organisations surveyed, 42% are micro-businesses, 27% can be described as an SME and 32% are large enterprises (see #1 below).**

#1 VP-productive: How many permanent employees (including directors) are in the organisation?



- **Across all the organisations surveyed, 60% are micro enterprises (1-10 employees), 25% are small-to-medium enterprises (SMEs) (up to 250 employees), and 15% are large enterprises (over 250 employees).**
- **The core business and focus of companies, across all of the organisations surveyed, is film (20%), immersive and interactive (14%), advertising/marketing (11%), television (11%) and broadcasting (9%).**
- **Less than half of VP-productive organisations have in-house VP-dedicated teams (42%).**
- **Previs and motion capture were the single biggest commercial use cases for VP-productive organisations, followed by LED film scale stages with live action.**

*In 2022 Pinewood and Leavesden studios reviewed their Virtual Production business model prompting both studios to discontinue their standing volume stages in favour of a more flexible and agile ‘pop up’ model. This was to accommodate a spike in demand for traditional stages.

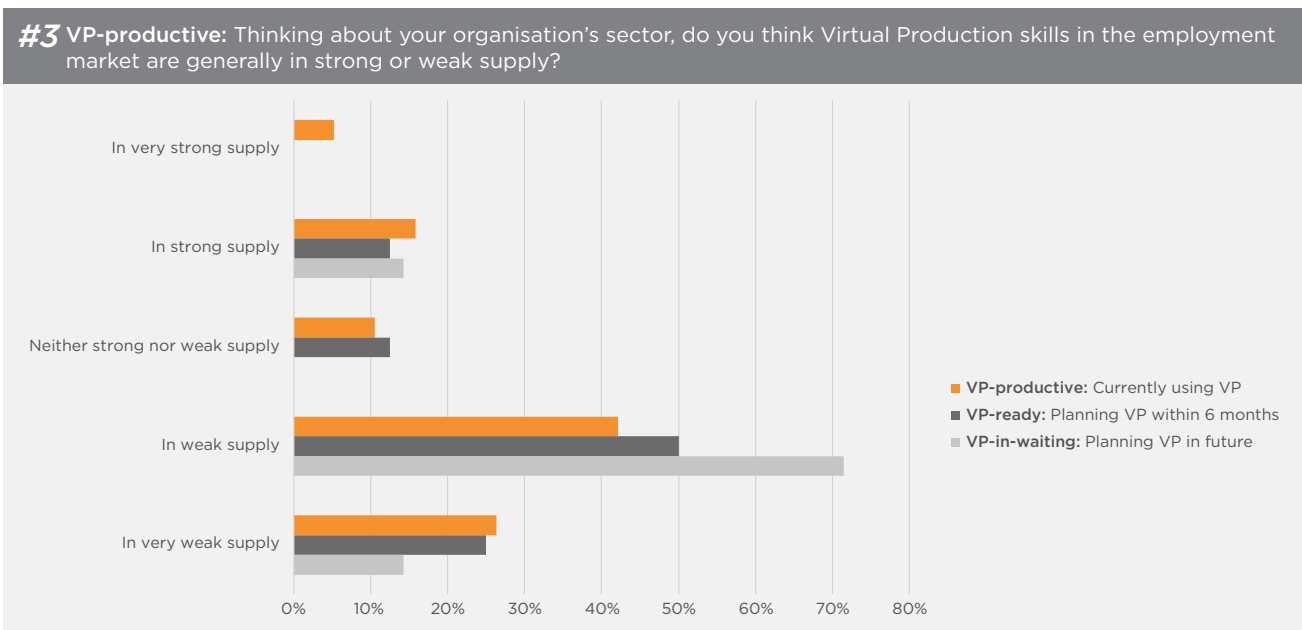


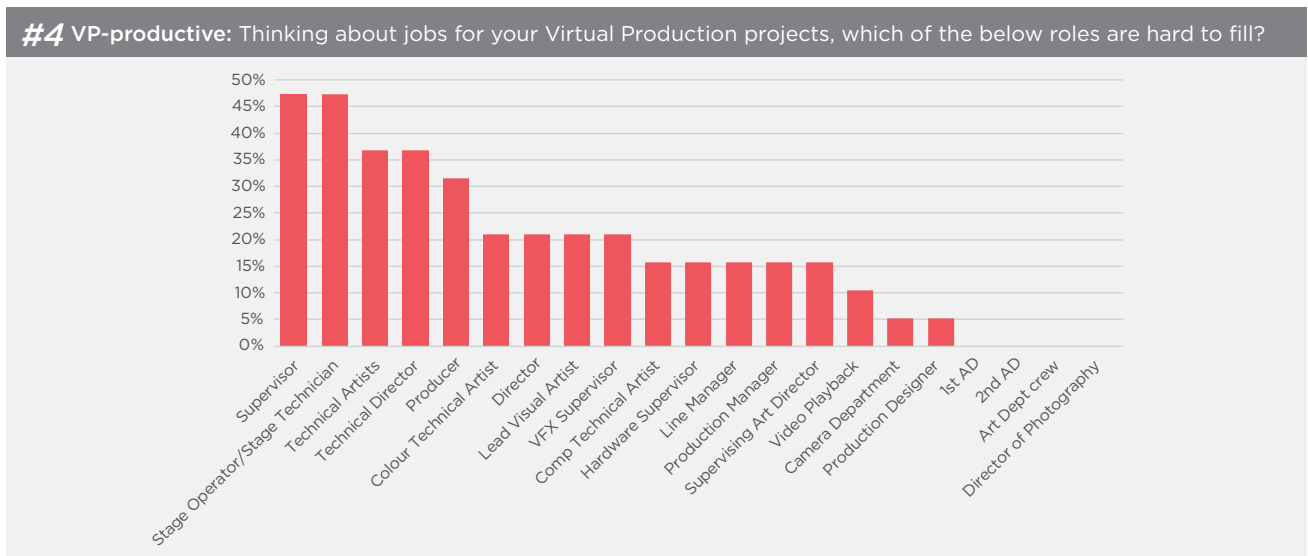
VP Skills Snapshot

Changing patterns of communication between traditional departments, and the creation of entirely new departments, such as the Virtual Art Department (VAD), require new approaches to collaboration. A crucial starting point for successful collaboration is a shared vocabulary. We are seeing companies maintain project-specific documentation, including listings of key terms, whilst the Visual Effects Society has begun a process of crowd-sourcing a full glossary of VP terms (VES, 2022). This lack of shared

understandings is, however, just one of a number of sector-wide barriers to growth and innovation. Added to this, our survey data implies that VP-ready and VP-in-waiting organisations may, as they finally enter into active practice in VP, find that they have underestimated the difficulty of finding employees with suitable VP skills.

- **Two-thirds of all VP-productive organisations thought that VP skills in the employment market are generally in weak or very weak supply (see #3 below).**





- For VP-productive organisations, the top 5 roles that companies find hardest to fill are (see #4 above):

VP Supervisor
Stage Operator (Game Engine) / Stage Technician (Hardware & Tracking)*
Technical Artist
Technical Director
Producers with experience of VP

- For VP-productive organisations, there are several broad skills areas that operate across roles that are in the greatest shortage at present.
- The top 5 of these cross-roles skills gaps are:
 - 1. Art Department and Games Engines:** This relates to the changing relationship between the Production Designer – who may or may not have experience of designing with game engines and with VP workflows – and the Virtual Art Department (VAD), which has deep expertise on game engines and VP technologies and is responsible for all content visualisation and creation.

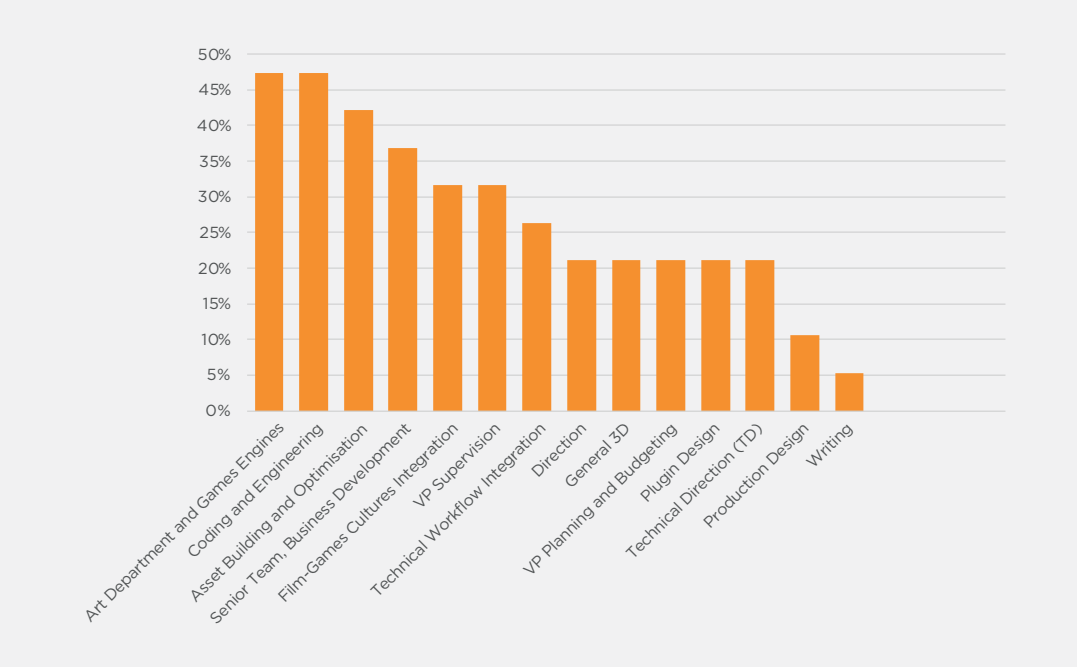
- 2. Coding and Engineering:** Covers areas such as Plugin Design, where specialist knowledge and skills are required to customise game-engine driven workflows. These skills are used across many roles including Stage Operators / Stage Technician, Technical Directors, and can extend to Production Design and creative roles.
- 3. Asset building and Optimisation:** This skills gap reflects the rising demand for high quality 3D content that is suitable for use in VP, optimised in such a way that it will not slow the computing of scenes in real-time. Technical Artists and others working in the VAD require these skills, and an awareness of this is also useful in the Art Department.
- 4. Senior Team and Business Development:** VP requires “front-loaded” production skills including planning, scheduling and budgeting of technically and creatively demanding non-linear VP projects. This skills area also covers fundamental financial and technical logistics, extending to the skills and knowledge required to set up and run a VP studio from a standing start (Seymour, 2020).

*A number of specific role names are used in the film and TV industry and include: UE Stage Operator, UE Technical Artist, Visualisation Technical Director, Brain Bar Technical Director.

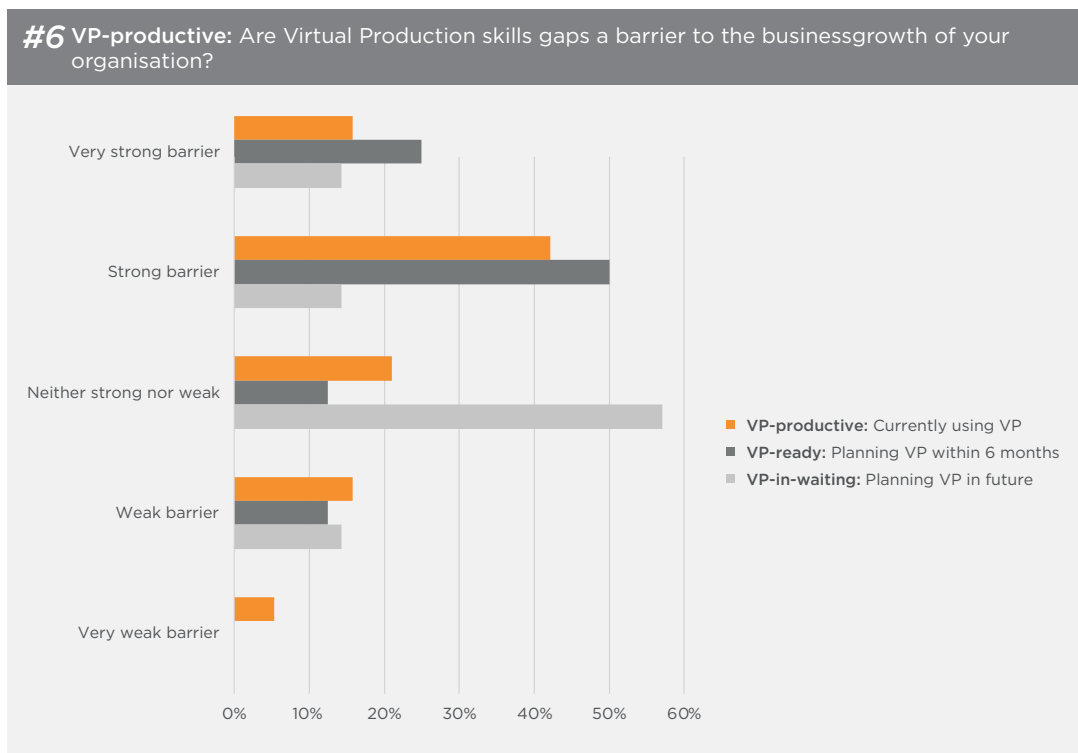
5. Film-Games Culture Integration: The integration of film and games cultures is key to making a success of VP. While this is a matter of reconciling different mindsets and production cultures, there are several skills areas that sit between filmmaking and game design and that are embedded in the working relationship between the two. Technical workflow integration is one such area; the VP Supervisor, Director and First AD have a prominent role in bridging these different approaches.

- **For VP-productive organisations, skills gaps are critical to growth, particularly in these five areas: Art Department and Games Engine; Coding and Engineering; Asset Building and Optimisation; Senior Team, Business Development; Film-Games Cultures Integration** (see #5 below).

#5 VP-productive: In which broad area/s does your organisation have the greatest skills gaps in terms of barriers to growth?



- In an emerging sector with many companies taking a portfolio approach to VP, skills may not always be seen as a barrier to growth. At the same time, there is a statistically significant group of companies planning to enter VP who find skills to be a strong barrier (see #6 below).



R&D Skills Gaps

Where VP is already in use, essential research and development is very often carried out in parallel or in advance of projects, since cutting-edge VP workflows have not been standardised, and there is no single dedicated proprietary or open source toolset that facilitates all aspects of VP. Effectively, this means that training, R&D and live production happen simultaneously, with companies taking significant risks to complete productions to schedule and within budget, whilst at the same time learning and innovating on an active project. Such an environment can place huge pressure on crews, underscoring the need for the appropriate cross-team collaboration and communication skills, supported by experienced producers wherever possible – who will be able to build planned safeguards, capacity and time into projects, in order to avoid potential project meltdown.

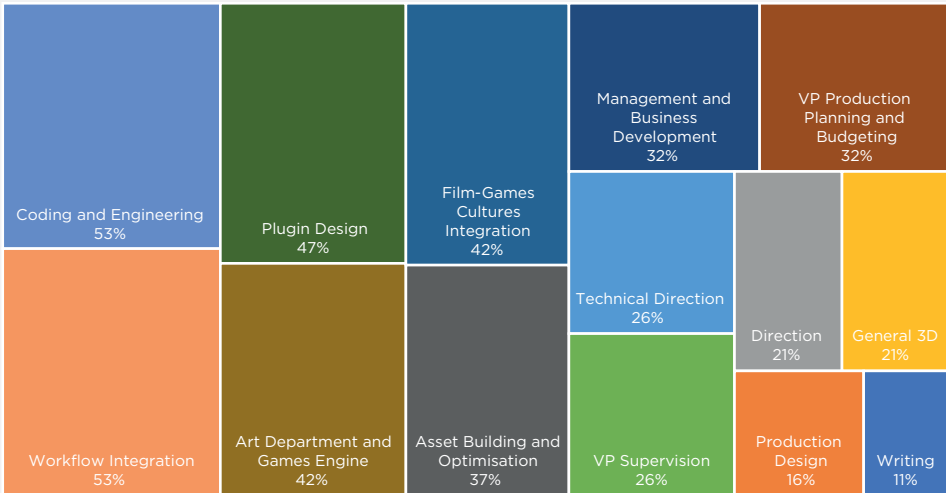
The survey asked organisations about which skills areas are needed for effective R&D in VP. A number of key R&D areas that were identified in the survey are closely related, and could be seen as contrasting dimensions of the same phenomenon: the convergence of real-time games-engines and filmmaking. Film-Games culture integration and workflow integration are two such overlapping areas. Yet it is unclear how (or even if) R&D is being conducted by organisations concerning the integration of contrasting mindsets.

Instead, it is likely that new VP workflows are being supported separately by informal and possibly unstructured approaches to R&D, through trial and error experimentation with the resources to hand. More systematic approaches to R&D are derived from Production Managers, Talent Directors and Producers, and their equivalents in smaller teams, looking to test specific techniques and achieve particular R&D goals, including team building and talent curation, with the aim of creating value for VP projects.

- **Most VP-productive organisations said that research and development was being actively carried out into VP (79%).**
- **As well as R&D into VP, a majority (67%) of all the organisations surveyed are carrying out R&D in immersive production more widely.**
- **Prioritised R&D areas include:**

Coding and Engineering
Workflow Integration
Plugin Design
Art Department and Game Engines
Film-Games Culture Integration

#7 VP-productive: What are the key R&D areas that you think need prioritising in VP to create innovative new products and services in VP?



Unless otherwise specified tables comprise responses from all companies

VP IN THE UK: THE STATE OF THE ART

- For VP-productive organisations the top 5 key R&D skills gaps are:

Coding and Engineering
 Plugin Design
 Asset Building and Optimisation
 Workflow Integration
 Film-Games Culture Integration

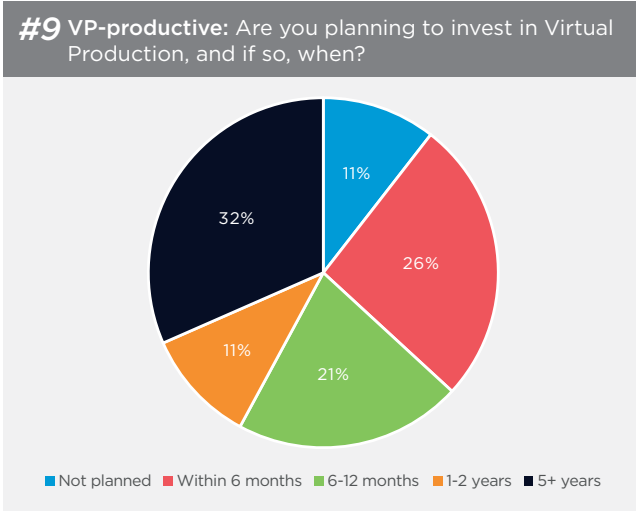
- The need for skills in Management and Business Development and VP Production Planning and Budgeting are recognised (16%) but not ranking high as R&D priorities, perhaps because they are understood as being acquired only through hands-on practice.



Funding and Investment

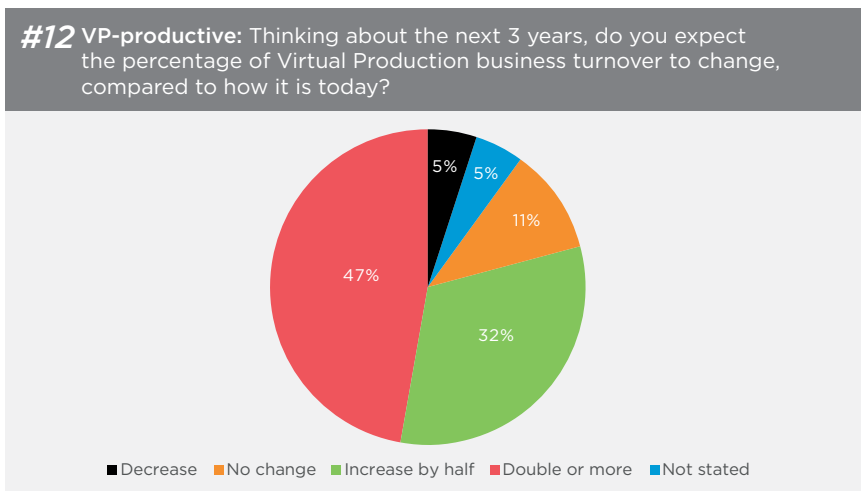
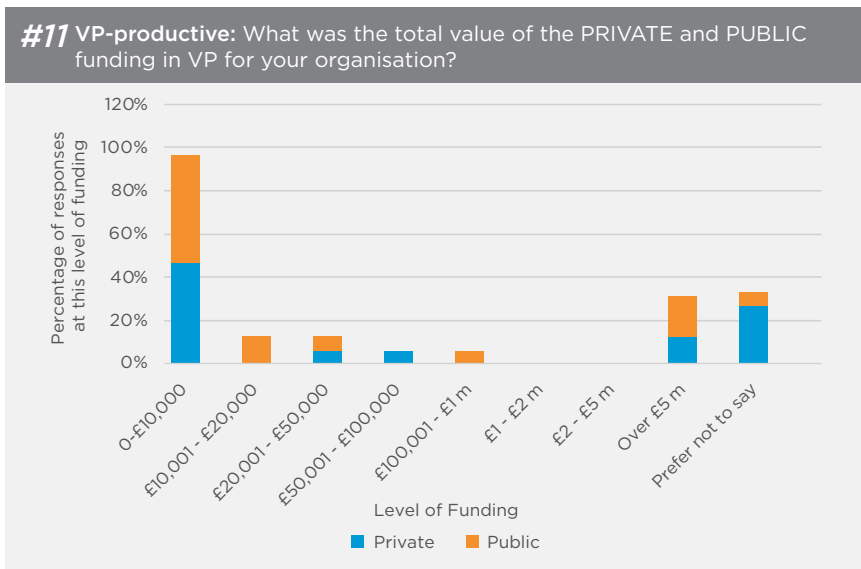
The securing of funding and investment is an important aspect of running VP and of planning for entry into VP. The survey asked organisations to share information about the extent of support received.

- **Nearly half of all VP-productive organisations have plans to invest in VP within the next 12 months (see #9 right).**
- **37% of VP-productive organisations have accessed public grant funding, and 26% had secured public match funding.**
- **In some cases over £5m funding for VP-productive organisations was received from private sources (13%), or from public sources (19%).**



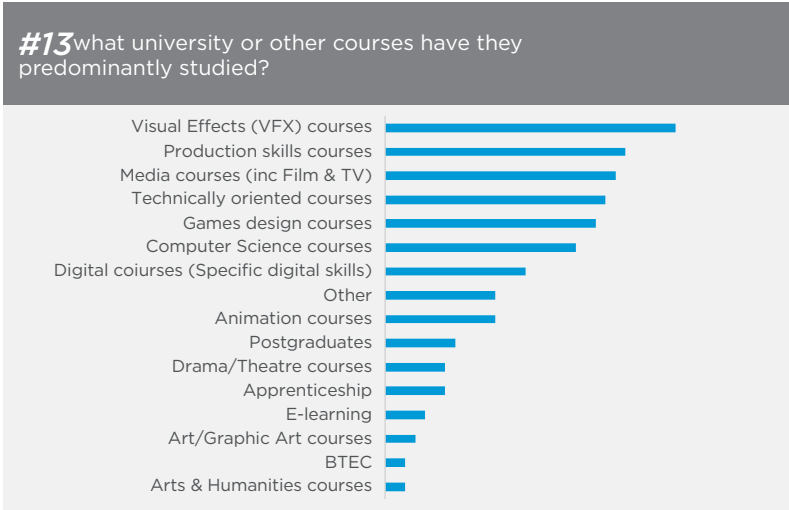
- **Half of VP-productive organisations thought that the percentage of VP business turnover would double or more over the next 3 years (see #12).**
- **42% of VP-productive organisations said that approximately 1-10% percent of current business turnover involved Virtual Production.**

Companies clearly anticipate that VP business will continue to grow. This outlook is perhaps based less on desire within individual companies to be at the cutting edge of this technology set, and more on the growing understanding that VP is seen as becoming an indispensable tool in studio-based production. Whilst advanced forms of virtual production may continue to push the limit of what is possible in blending real and virtual environments, including taking VP out of the traditional studio environment, for many companies the value of VP will be realised when it becomes ordinary business. This is the history of every successful media technology. We will know the success of the UK in adopting VP when we no longer need to report on the skills-needs separately from other skills mappings from the screen production sector as a whole.

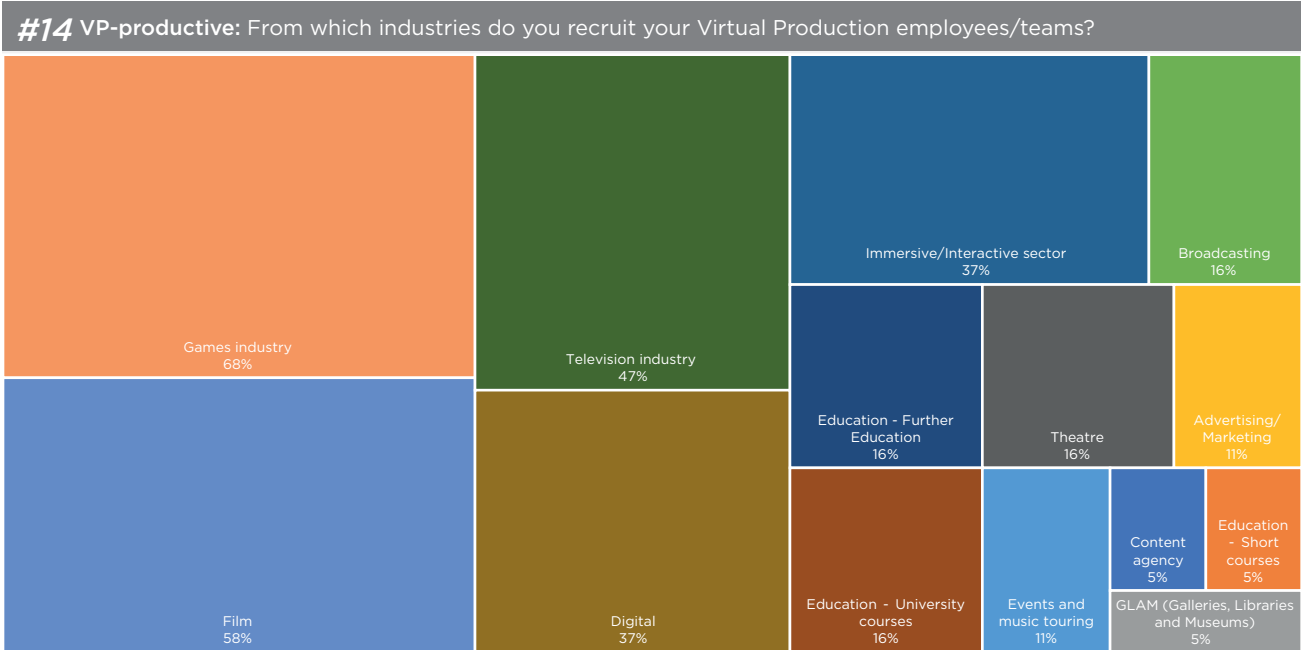


Training, Education and Recruitment

- **For VP-productive organisations:**
 - Most (84%) provided or encouraged staff to undertake external training, while a smaller proportion did not (11%).
 - Visual Effects and Production skills courses (including Virtual Production, Production Management) are the main sources of undergraduate recruitment (see #13 opposite).
 - Media arts courses (including Film & TV), Technically oriented courses (including Editing, Cinematography and others), Games design and Animation and Computer science courses are other significant sources of VP recruitment.
- **Across all organisations surveyed, a small number of employees have come from non-graduate training programmes including Extended Diplomas in Games, Animation and VFX Skills, Next Gen Skills Academy and AIM Awards.**
- **One respondent added a note that their organisation relied on the recruitment of “a lot of highly motivated self-taught crafts-persons.”**



- **The top 5 industries that have provided recruits to VP for VP-productive organisations are Games, Film, Television, Digital, and Immersive/Interactive. (see #14).**
- **The majority of VP-productive organisations received funding below £10k (see #11)**



THE VP SKILLS MANDALA

The 2021 VP Skills Mandala has been reiterated for this report. We highlight here the key skills gaps revealed by our 2023 surveys and interviews with industry experts. The Mandala draws attention to those skills and roles where there is most need to address shortages in the labour market, and to help focus and support training and education in this area.

This mapping locates story and directorial vision as the central pivot around which roles and departments orbit, as they draw upon an ever-changing array in a collective effort to complete a VP project. The mapping is not 'one-size-fits-all', and is not fixed, since VP workflows vary and change a great deal over time and across different productions. The non-linearity of VP production is made visible, for example where the Director of Photography (DoP) appears in early pre-production, consulting on the lighting design of virtual scenes, as well as during the production phase, as traditional. A similar pattern is seen with the VP Supervisor.

KEY:

- Creative and communicative
- Technical and logistical

Skills most in need:

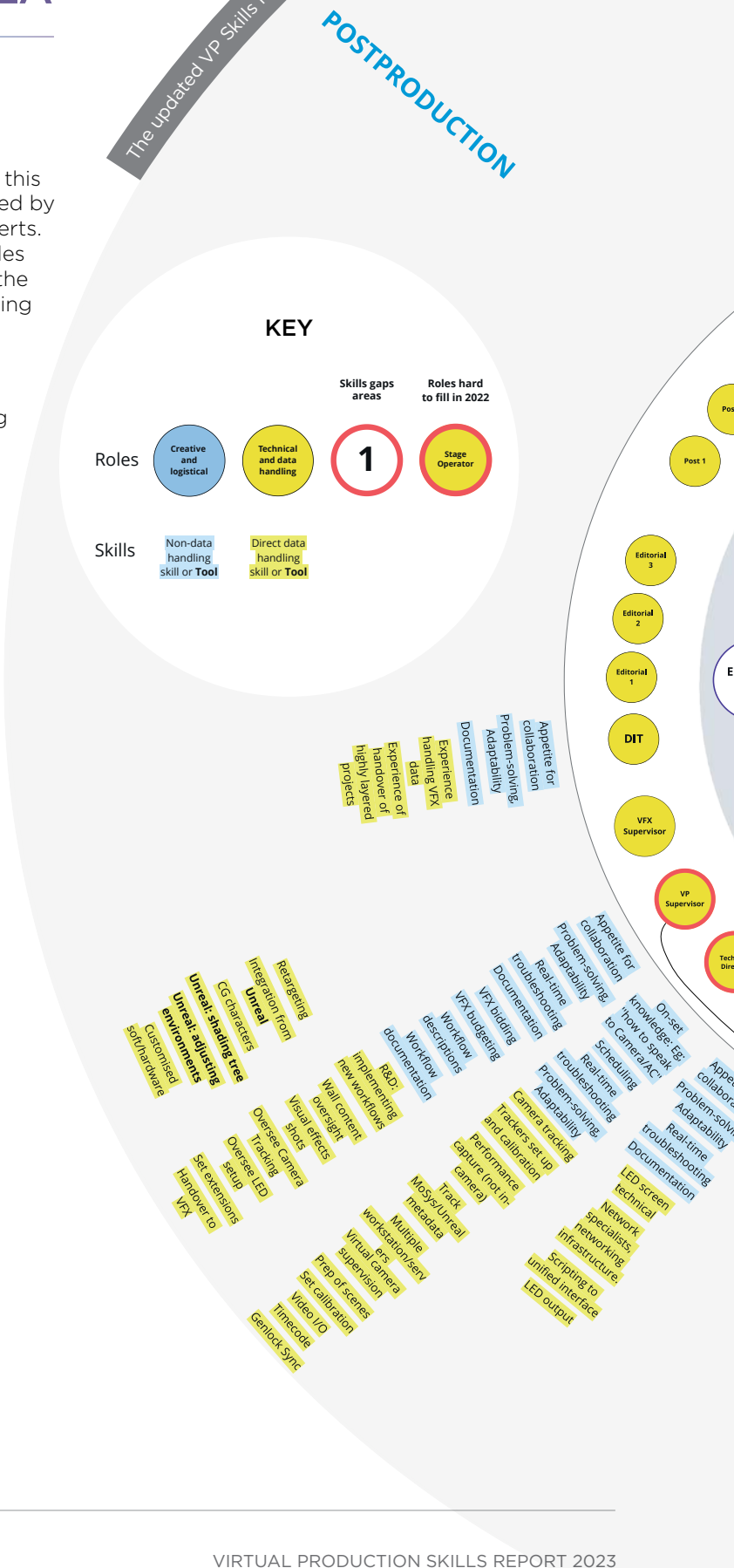
1. Art Department and Games Engines
2. Coding and Engineering
3. Asset building and Optimisation
4. Management - Senior Team and Business Development
5. Film-Games Culture Integration

Roles hardest to fill:

6. VP Supervisors
7. VP Stage Operator (Game Engine) / Stage Technician (Hardware & Tracking)
8. Technical Artists
9. Technical Directors
10. Producers with experience of VP

R&D skills gaps:

11. Coding and Engineering
12. Workflow Integration
13. Plugin Design
14. Art Department and Game Engines
15. Film-Games Culture Integration



DEVELOPMENT

Senior Team Business Development - budget, planning skills

4

- Unreal: Sequencer
- Digital storyboards
- Screenshots from VR
- Virtual Scouting
- Preproduction
- Story: response to technical possibilities
- Story crafted for VP
- Set - actors management
- Set - space management
- schedule management
- Understanding hidden R&D costs
- Sourcing VP skills
- Casting
- Early planning of workflows and interactions
- Interviewing HoDs
- Bidding
- Budgeting

PREPRODUCTION

1

- Digital Continuity: Knitting together of tools and metrics
- Digital Security
- Digital Networking
- Digital Admin
- Workflow integration
- Provision of cross-training: branching out from a home discipline
- Support for HR to understand new roles and interests
- Aptitude and profiling
- Technical talent casting
- Virtual set dressing
- 3D modelling and rendering
- Physical object placement
- Style guide
- Design principles
- Colour theory
- Hand-drawn storyboards
- Set - foreground design
- Physical/virtual prop doubling
- Location scouting
- Scene blocking
- Primary research into topic areas

5

Film-Games Culture Integration

3

Asset-building and Optimisation skills

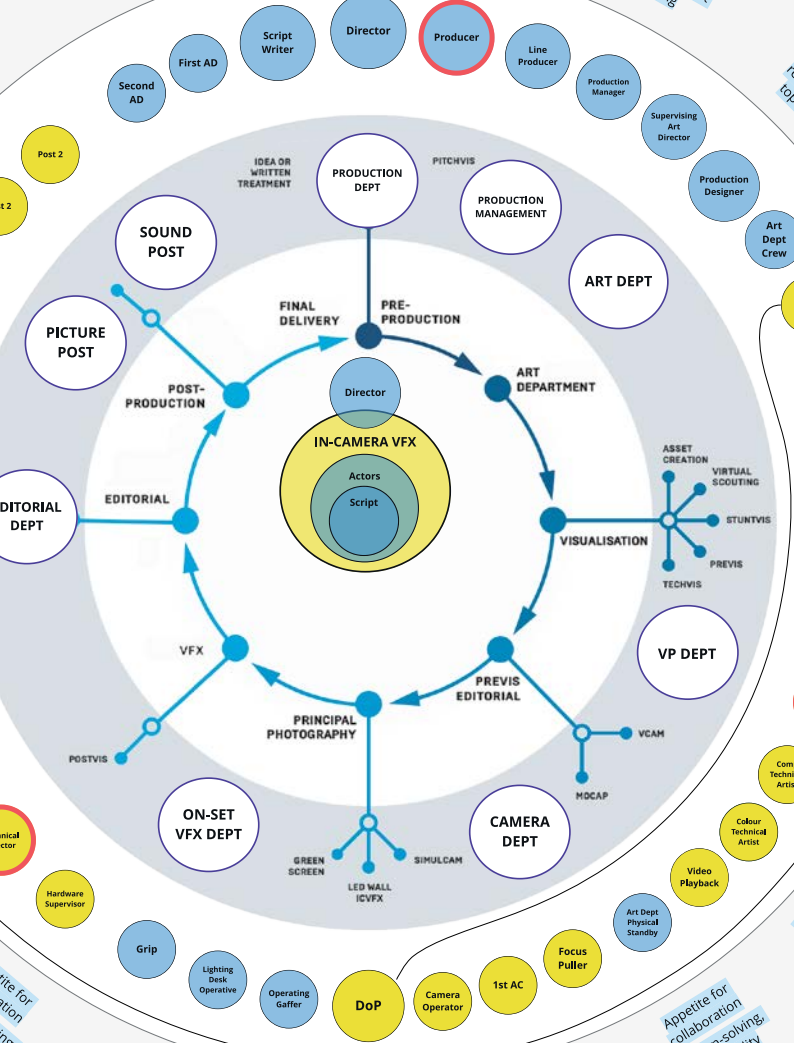
- Hybrid techniques: e.g. projection
- Video processing tests
- Display technologies tests
- VP Studios management
- LED wall design
- Tech R&D
- Appetite for collaboration
- Problem-solving
- Adaptability
- Real-time troubleshooting
- Documentation
- Knowledge of film and moving image
- On-set virtual Art Department and Gaffer standby
- Unreal - object placement
- Location
- photogrammetry
- 3D asset conversion
- assets
- content: real-time
- preparing 3d
- Creating and
- Preparing 3d
- Virtual cinematography
- Modeling in ZBrush and 3DMax and bringing into Unreal
- Shader code prototyping
- Plugin creation
- Final 3D asset creation
- Blocking virtual elements
- Shot design
- Previsualisation
- Versioning: Perforce, SVN, Github
- Custom tracking system
- Unreal
- Documentation
- Real-time troubleshooting
- Problem-solving
- Adaptability
- Appetite for collaboration
- Modelling
- Documentation
- Real-time troubleshooting
- Problem-solving
- Adaptability
- Appetite for collaboration
- Environment Optimisation
- Layout
- Physical simulation
- Lighting
- Colour
- Camera moves - procedural
- VR/AR authoring

2

Coding & Engineering Skills (see R&D)

- Appetite for collaboration
- Problem-solving
- Adaptability
- Real-time troubleshooting
- Real-time colour grading
- Virtual set color correction
- Content loading
- Calibrate lighting
- Virtual set dressing
- Costumes with sculpting and VR designs
- Set dressing and location enhancement
- MoSys, Ncam, OptiTrack
- Scripting MEL, Python, C#, Javascript and C++
- DeepMotion - markerless Mocap via iPhone
- Camera moves - keyframes
- Tracking systems
- Live compositing
- Environment Optimisation
- Layout
- Physical simulation
- Lighting
- Colour
- Camera moves - procedural
- VR/AR authoring

PRODUCTION



THE VP SKILLS MANDALA

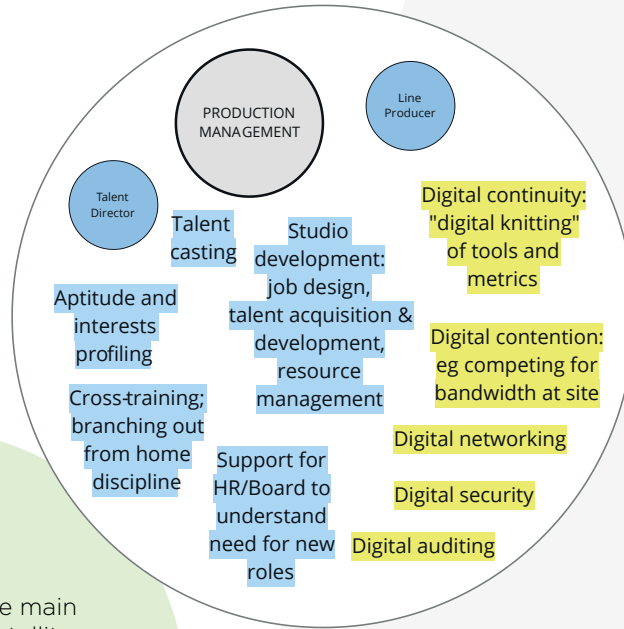
Colour is used in the Mandala to represent the predominant type of skills and roles. Creative, communicative and logistical roles and skills are denoted by blue, while technical roles and skills are highlighted in yellow. This is a visual aid to help with understanding the complexity of VP, and shows how all roles carry a mix of both technical and creative and communicational and logistical skills, and shows that there is no binary opposition between these skill types: for example, the predominantly blue Director may also employ some technical skills and thus the array of skills associated with them might be a mix of blue and yellow. The predominantly technical Technical Director role also has very important blue communicational skills associated with it: for example, “knowing who to speak to and how to speak to the Camera Department.” Without these “setiquette” skills (referring to the ways professionals behave on-set) it would not be possible to carry out this and other roles effectively.

Communicational or “soft” skills now feature across the entire Mandala: all of our data pointed to the fact that this is a key skills gap area for VP, making the difference between the success and failure of a VP project. Communication skills, including logistical know-how, can be broken down further, into personal attributes such as an appetite for collaboration, and having an adaptable approach to problem-solving in real-time workflows, documenting new workflow to help with on-boarding and preserving learnings in an evolving space.

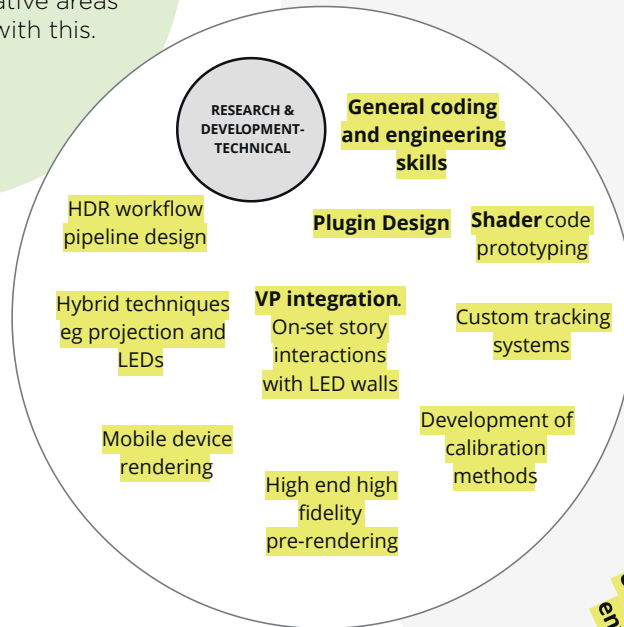
The VP Skills Mandala is a diagnostic and sense-making tool, allowing companies to better understand which roles and skills might be missing from their teams: for example, how to address these gaps by developing new technical and planning skills.



80six. Photo: Peter Richardson



Interlocking with the main VP Skills Map are satellite sub-maps for skills used in Production Management Talent Direction, and for technical areas of R&D for VP, and creative areas of R&D that overlap with this.



DEVELOPING A VP SKILLS PIPELINE

VP Training in the UK

A number of programmes in the UK are currently offering training pathways to those already working in the industry who wish to upskill and pursue work in VP. Commercial VP vendors have begun to supply short courses. These include: Mars Volume Academy with 'VP Scheduling and Financials for Producers', 'LED for Film Crews' and 'VFX on set'; Final Pixel Academy with VP Masterclasses for producers and advertising; and Screenskills with an 'Introduction to VP' short course, a 10-day foundation course and 'Operating virtual production systems' in partnership with the Mo-Sys Academy in east London, catering for 'Early, Experienced, Expert' practitioners. Notably, these courses focus on upskilling individuals rather than companies. An exception to this was 'Remote Control: Virtual Production for Film and TV Development', organised by the Screen Industries Growth Network (SIGN). This aimed to help companies finalise VP projects already in the later stages of the development or early pre-production phases, providing SMEs with three workshops that enabled them to benefit from specific on-set roles: was Showrunner/Writer, Director, Producer, Production Designer, Art Director or VFX Supervisor.

From VP-in-waiting to VP-ready

With the *VP Futures* programme StoryFutures and partners aimed to help companies transform from VP-in-waiting companies into VP-ready companies, ultimately preparing them for the post-programme journey towards becoming VP-productive. The growing number of VP-related skills training outlets evidences the demand for training in the sector. However, StoryFutures has identified two key principles that are central to shifting organisations' status to VP-ready:

- Training and R&D in VP are inseparable.
- Training should also be at company level to develop teams and accelerate adoption.

The *VP Futures* programme evolved as a targeted response to the critical shortage of virtual production skills that were documented in the 2021 VP Skills Interim Report. *VP Futures* was the result

Links

<https://marsvolume.com/academy/>

<https://finalpixelacademy.com/training-%26-opportunities>

<https://www.screenskills.com/bookings/introduction-to-virtual-production/>

<https://www.screenyorkshire.co.uk/remote-control/>

of a collaboration between StoryFutures (run by National Film and Television School (NFTS) and Royal Holloway, University of London, National Film and Television School (NFTS) and Future Screens Northern Ireland (FSNI), with the valuable expertise and mentorship of highly experienced staff at both Epic Games and Industrial Light & Magic (ILM). It is an innovative training and R&D programme for companies wishing to use VP.

Eight companies were selected from an open submission process – 4 from mainland UK and 4 from Northern Ireland. They were invited to enter the 'Development Zone' of the scheme and work towards a pitch day, at which point two companies would be offered entry to a funded 'Production Zone' where their projects would be realised either in part or in whole, and made ready for further funding and development as needed.

VP Futures is designed to be an iterative, agile and responsive process, with a modular structure capable of rapid adaptation to the needs of companies as these became apparent. In the 'Development Zone' introductory in-person workshops were held at the BFI at Southbank and at Epic Lab in London. These were followed up in stages, with remote masterclasses from ILM and other VP and motion capture experts, and bespoke mentorship with experts. Finally, test-shoots were arranged for each company, allowing them to enhance their creative and technical approach at critical stages of development.

In order to surface the innovative R&D that typically occurs in VP, the 8 companies were asked to record the evolution of their projects in a VP 'Playbook' covering the development of key creative and technical workflows, describing how new ideas were generated and obstacles of all kinds overcome. The VP Skills Mandala is a tool to help companies begin their approach to the complexities and terminologies of VP by building shared frames of reference and to establish a common language within and across teams. The Skills Mandala is not a one-size-fits-all tool but is designed to help identify where transferable skills and practices exist. This non-linear mapping of production needs to be adapted to different contexts, such as motion capture. "This essentially represents the Kubrick model of filmmaking, with all of the traditional departmental hierarchies" said Carl Grinter of Three Wise Monkeys, and there is scope for creating versions more suited to smaller productions where roles may be shared.

VP FUTURES: THE CASE STUDIES



Our case studies are based on a skills assessment of the 8 participating companies obtained from:

1. **VP Skills Mandala:** *self-assessment of skills using the VP Skills Mandala as a guide.*
2. **VP Playbooks:** *created by each organisation to record their progress through the programme.*

The case studies summarise how the companies reflect on their experience of VP, how the challenge of VP was met, and how it might add value and create opportunities for the company now and in the future. The case studies reflect the learning process and the journey undertaken by each company.

A snapshot of the skills that the companies brought to the scheme and of those that they have taken away with them is given in this section of the report. This broad snapshot of VP skills makes it possible to see the intersection of VP-related prior skills and the main focus of business interest. Presented in the form of a table, this summarises existing transferable skills on the one hand and newly acquired and redeveloped skills acquired through *VP Futures* on the other.

Each table links to the areas of the VP Skills Mandala which have the greatest impact on the growth of VP, as determined by our VP Skills Survey. These skills areas have been colour-coded to refer to their relative creative or technical slant, referring back to the Skills Mandala.

On starting the *VP Futures* programme all of the companies taking part already possessed a number of baseline skills on which to build a capacity for VP; these include important prerequisite communicational skills and essential transferable creative and technical skills developed on previous projects. As the VP Skills Mandala refers to an appetite for collaboration, the ability to work in an adaptable way, a disposition towards open-minded problem-solving, and a deep knowledge of film, moving-image and storytelling is also useful to bring to VP projects. These qualities help to attain a productive and healthy working environment for VP, and are soft skills much sought after by Directors of Talent, HR and recruitment personnel. These skills areas should not to be seen as desirable add-ons but as essential.

AURA DIGITAL STUDIOS - VP VENDOR | *A love story in VP*

Less than 10 employees - Start up 2021 - Indie end of market

Profile

Aura Digital is a micro studio founded during a university placement year in 2021. It currently operates as a B2B, working with different clients across the arts, education, film, and TV. With the launch of Studio Ulster in Belfast, the company expects to see an increase in demand for VP companies in NI. Aura Digital Studios are looking to position themselves to meet these new business opportunities as specialists in VP in Northern Ireland - working with LED volume screens, camera tracking set up, digital asset management, and Unreal Engine for film production.

Josh McAvoy - Director

Eva Robinson - VP Supervisor

Sinéad Burns - VP Producer

Project

Stone Hearts and Careless People is a supernatural romance that explores love, loneliness and the beautiful tragedy of living. Stone Hearts utilises core ICVFX methods, allowing the team to use the LED volume to portray a setting with fantastical elements and stylised lighting. They also utilised inertial motion capture for live compositing a CG character into the shoot.

VP Challenge

A key storyline point requires the taking of a photograph of a statue seen on the LED wall, live on camera, creating visual interest when the statue comes to life. A *VP Futures* Masterclass with ILM's Ian Millham described a scenario using water and LED walls, where the camera can either focus on the water or the reflection on the LED wall, but not on both simultaneously. With mentored support from ILM's Roel Coucke, a solution to this problem was found by utilising the reflections that are achievable in the virtual production pipeline, as both a way around this issue, and also as a narrative device to help reframe the storyline.

VP Opportunity

As LED technologies become more accessible for smaller studios, Aura Digital plans to demonstrate what is possible with indie-level budgets and prove the viability of smaller scale virtual production companies to larger vendors.

"Our Playbook... will be invaluable as we continue to grow as a company and onboard new staff into our virtual production pipelines."



Images courtesy Aura Digital Studios

Existing VP-Transferable Skills	
Production	Technical specs and limitations as part of pipeline building. Bidding and budgeting.
Preproduction	Techviz in Maya, moving from 3D to Unreal for level design in games. Specialising in creating pipelines including AR.
Art/VAD	Modelling, optimisation, environment, layout, pre-visualisation, shot design, final 3D asset creation, virtual cinematography, creating and preparing 3D content.

New VP Skills as a result of VP Futures	
VP Dept	Applied experience in pipeline design, technical specification and Unreal. <i>See Mandala:</i> 4. Management - Senior Team and Business Development 2. Coding and Engineering
VAD	Developed new expertise in Unreal Engine. <i>See Mandala:</i> 1. Art Department - Games Engines
On-Set VFX	Working with multi-user and sequencer animation; live compositing, managing LED output, camera tracking systems and extension of mocap skills. <i>See Mandala:</i> 6. VP Supervision



Key

- Blue = Creative and logistical, non-data handling.
- Yellow = Technical and data handling, direct data handling.

DRAW & CODE – GLAM SECTOR | *Animating museums of the future*

10+ employees – Formed 2014 – Museums, galleries and commercial

Profile

Draw & Code is an SME and immersive technology studio established in 2012 and based in Liverpool whose portfolio includes a mix of client work, partnerships, and in-house IP. The company is experienced in game engine development, event-tech and LED-based installations and real-time technology. Virtual production is new for the business and requires hands-on training for broadcast, filmmaking and integration of VP into existing workflows and pipelines.

Daniel Burns – Head of 3D

Nick Edwards – Producer

Lucy Mutlow – Unity Developer

Peter Woodbridge – Senior Creative Technologist

Project

The Enchanted Museum is a hybrid virtual and physical cultural experience taking visitors on a narrative adventure through museum collections. The concept will see a museum within a museum that uses virtual production techniques to display different objects, settings, and eras all within a relatively confined space within a single floor of The World Museum Liverpool.

VP Challenge

Understanding the design processes that go into creating seamless blends between the virtual and real elements on screen, the workflows used in a live virtual production environment and direction for performance were key challenges. One of the studio's strengths is the ability to work on complex R&D led innovation projects. The company has a number of projects in development which could exploit VP in the future, and critical to their learning was having access to a virtual production stage to test VP tools and technologies and new R&D in VP that could be applied to other projects in the business.

“It has really helped to give us time to experiment and gain new knowledge in the studio around production, creative and technical areas... Seeing all the nuances of Unreal in the context of VP has been gold dust to us.”

VP Opportunity

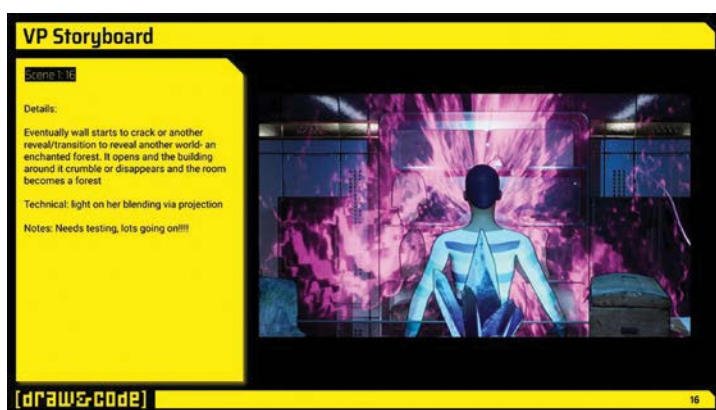
VP Futures has enabled Draw & Code to address skills-gaps, giving them the expertise to carry out new R&D in VP tools, techniques, and content creation. The team are now able to competently work with new VP skills to help them achieve their vision of making physical spaces more interactive and introducing playable places to the digital world.



Images courtesy Draw and Code

Existing VP-Transferable Skills	
Production	Existing well-defined production team, extensive creative direction experience and studio resources.
Preproduction	Previsualisation with Unity and other DCC packages.
Art/VAD	Unreal, Maya, materials editing, rigging, materials, Blueprints, shaders, sequencing.

New VP Skills as a result of VP Futures	
VP Dept	Developed template for future immersive experience projects and understanding of logistics and fit within the supply chain ecosystem. <i>See Mandala:</i> 4. Management – Senior Team and Business Development
On-Set VFX/VAD	Gained competence in set-up of N-Display multi-user system integrated with logic, and in other sensor systems and communication protocols (Midi, OSC, DMX). <i>See Mandala:</i> 2. Coding and Engineering
On-Set VFX/VAD	Experimented successfully with virtual lighting and projection mapping. <i>See Mandala:</i> 6. VP Supervision



ENGINE HOUSE – FILM AND TV | *Game Spaces in VR and VP*

Less than 10 employees - Formed 2014 - Preparing for long-form

Profile

Engine House is a VFX studio based in Cornwall, working in animation and advertising. As a small company, finding more efficient ways to work is a priority. The team has struggled to convince clients to work with VP instead of more established methods. The opportunity to get hands-on results with virtual production and create a VP project to show clients was seen as an chance to help the company expand their offer and elevate production plans for internal projects in development. Engine House's aim is to move into creating long-form content.

Jason Robbins – Director
Mike Richter – Director
Natasha Price – Producer

Project

The Race is a young adult sci-fi thriller set in near-future space. The audience follows Nova (they/them), aged 17 as they compete in a VR race which ultimately reveals that the world they were living in was entirely AI generated. The team used *VP Futures* to plan a short sequence from the film, using VP tools to create atmospheric set lighting.



Images courtesy Engine House

VP Challenge

The team required a better understanding of film production as well as the creative side of VP processes. Moving from creating 3D content to working on set with digital assets and live action was essential. Key learning points included preparing in advance for assets to be loaded on set and balancing script ambition with practical delivery: for example, avoiding full-body shots and placing actors in scenes without large set-builds. Lighting and colour have been their biggest learning curve, working to achieve the right contrast and colour in space environments.

VP Opportunity

Engine House plans to continue with their expansion into VP as an extension of their current offer to clients, building on what they have learned on *VP Futures* and using their new knowledge and skills to complement their inhouse capabilities.

“This has been a really valuable and exciting process for us, to find out not only how VP is used, but how it isn't. It was great to have the freedom (and even to be encouraged) to go through a process of trial and error in order to discover the process to create projects in VP that fit within our pipeline. VP can only be learnt by being hands on and essentially getting it wrong until you get it right, which is exactly what we did!”



Existing VP-Transferable Skills	
Production	Directing, Producing, budgeting and bidding.
Preproduction	Full-3D content creation, storyboarding, animatics, scene blocking and location scouting.
Art/VAD	Game engine design work in Unity and Unreal.
New VP Skills as a result of VP Futures	
Production	Understanding of up-front costs, production logistics and data capture management. <i>See Mandala:</i> 4. Management - Senior Team and Business Development
Preproduction	Developed approach to script execution, breakdown and assignment of methodologies.
On-Set VFX/VAD	Volume environment prep, volume stage testing, Simulcam, Blueprints. <i>See Mandala:</i> 1. Art Department - Games Engines 2. Coding and Engineering 6. VP Supervision 9. Technical Direction



LIMINAL STAGE PRODUCTIONS – IMMERSIVE THEATRE | *Exploring the boundaries between*

Less than 10 employees - Formed 2016 – immersive technologies

Profile

Liminal Stage Productions is a LGBTQ+ disabled female-led company, generating creative content at the intersection of live performance and emerging technologies. They are currently relaunching as an SME with the ambition to create globally competitive content using VP and immersive technologies.

The company sought in-house skills, training, and wider VP knowledge in order to plan, budget, and manage VP projects more effectively and to create a proof-of-concept sizzle reel to attract the funding and partnership support required to stage a full production.

Robyn Winfield-Smith – Artistic Director

Miranda MacKay – Producer

Myra Appannah – Technical Artist

Simon Wilkinson – Technical Artist

Project

FLEX is a semi-autobiographical stage show created by Robyn Winfield-Smith which explores the bio-psycho-social effects of Hypermobility Spectrum Disorder (HSD). It is a queer love story between an animator and a coder, presented as a one-person show supported by 4 camera-operating dancers. The ‘video’ element is created in Unreal Engine and presented on an LED volume, with the camera operators forming part of the story. This idea combines real-time motion-capture and virtual production technologies into a stage production that can be experienced live in an auditorium or digitally after the event through a 360-VR recording.

VP Challenge

Advice from the Epic mentors helped the team understand that optimisation is key in virtual production. What the audience sees on the surface may look normal, but if the programming underneath is not optimised or constructed in the most efficient way, then this can result in glitches or performance issues. The team felt this linked to the lead protagonist’s invisible disability, who

may present as an able-bodied person most of the time, but the way her ligaments are programmed underneath her skin and around her skeleton means that she comes up against glitches (physical injury) and reduced frame rate (chronic fatigue). Given that FLEX sets out to demystify VP tech for audiences and the live performance sector, the team thread this optimisation analogy into the storytelling, allowing the character to demonstrate the repetitive process of trial and error as she discovers more about her disability.

VP Opportunity

Liminal are planning to include an element of VP into all of their future productions and to offer consultancy and entry-level training in VP for live performance companies and freelancers. Liminal are currently pioneering the creation of a West Midlands XR Studio dedicated to XR performance and the training of artists in emerging XR tech:

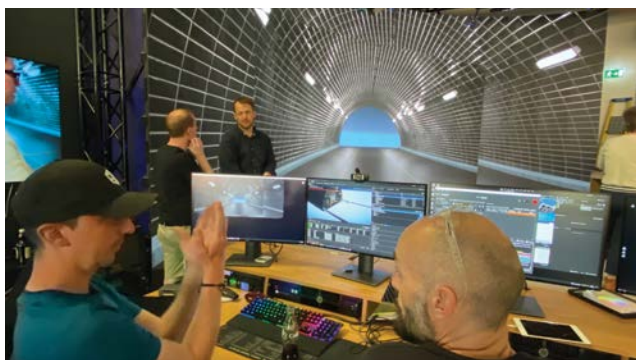
“VP Futures was the most responsively bespoke, meaningfully in-depth, and intensely stimulating training programme we’ve ever encountered. The quality and enthusiasm of trainers and mentors were second to none, and we have learned an extraordinary amount on the programme, across all areas of VP. We now feel so much better equipped to step confidently into the VP space to blaze a trail in the application of this technology to the live performance and cultural sectors.”



Images courtesy Liminal

en live performance, VR and VP

Existing VP-Transferable Skills	
Production	Independent production in subsidised theatre and commercial producing for screen and immersive.
Preproduction	Previsualisation in 3D (Maya).
Art/VAD	Technical Artist roles, working with Unity on immersive projects.
New VP Skills as a result of VP Futures	
VP Dept	Integration from Unreal Engine, CG characters in VP, Blueprints in UE5. See Mandala: 6. VP Supervision
On-Set VFX/VAD	Optimisation and rendering efficiencies for multi-camera setup for volume environment prep, volume load-in, volume stage test LED wall ICVFX, interactive lighting, Simulcam. See Mandala: 6. Stage Operator / Stage Technician
MoCap	Liminal created a Motion Capture Department workflow; Role for MoCap Director; Skills include Movement Design, and Directing MoCap Artists, and MoCap Technician; Specifying of MoCap Systems, and Operating Mocap systems in live performance. See Mandala: 5. Film-Games Culture Integration



RETINIZE - IMMERSIVE STUDIO | *Conversations between digital characters & humans*

10+ employees - Formed 2019 - AR, VR, multi-screen, film and TV

Profile

Retinize is an immersive tech studio and SME based in Belfast, working across AR, VR, multi-screen installations and software development, whose roots lie in high-end film and television. The company has developed Animotive, a VR SaaS (Software as a Service, defined as a method of software delivery and licensing in which software is accessed online via a subscription, rather than bought and installed on individual computers) for 3D animation pipelines which could be used as part of a Virtual Production workflow. Retinize are planning to develop a test piece that showcases how Animotive can be used with Unreal Engine to create broadcast quality content and, in turn, build their in-house Virtual Production capacity.

Jack Morrow - Technical Lead

John Connor - Unreal Technician

David Cosgrove - Production Lead

Alan Perry - 3D Assets

Project

The team will create a short proof of concept 'Newsbites' in the style of a nightly satirical comedy show, where a real-world host presents a segment alongside a 3D character, driven by real-time Mo-cap data within an LED Volume. The 3D character would be puppeted in real-time by a performer in

an Xsens Mo-cap suit and using a head-mounted iPhone. The Xsens suit would capture the skeletal performance while the iPhone would capture the facial performance. A real-time performance would be rendered for television broadcast from Unreal Engine.

VP Challenge

Real-time and remote performance is innovative within Virtual Production and proved to be the key area of investigation for the team within the programme, and there were a number of methods they had to experiment with for best results. Moiré and latency were the big challenges, true for their ILM Mentors. Seeing how their mentors and industry leaders had responded to these challenges enabled the testing of different methods and put the team in a strong position for the future development of the project.

VP Opportunity

VP Futures built upon and expanded the team's existing VP knowledge and highlighted areas where they had gaps in their skills and knowledge, such as how to reliably move assets between Unreal Engine and Animotive, developing best practices for remaining flexible whilst also retaining data integrity. They plan to continue develop their software, including integration of final pixel export for UE, and also work as a VP vendor.

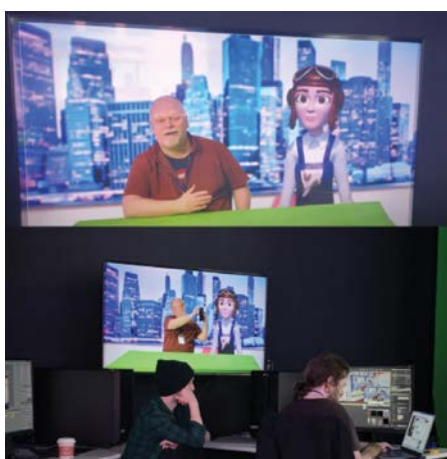
"This programme has been invaluable for evolving ideas we've had, for connecting us to key people and for levelling up our knowledge of VP."

"The skill set within and available to Retinize includes 3D artists, riggers, developers, camera technicians, producers, and writers. What we hoped to get from the Development Zone of this programme was to pivot these skills for use within VP workflows - ...not only has the programme done that, but it has opened the door to new skills."



Images courtesy Retinize

Existing VP-Transferable Skills	
Production	Agile workflow and sprints.
Preproduction	Proprietary software used for previsualisation.
Art/VAD	Unreal cinematics rendering, UE Sequencer. DCCs for 3D asset creation. 7 years R&D experience, with C++ skills.
New VP Skills as a result of VP Futures	
Production	Planning, budgeting and bidding for VP. See Mandala: 4. Management - Senior Team and Business Development
VP Dept	UE Cinematics for Final Pixel output. Workflow customisation and scripting, troubleshooting. See Mandala: 2. Coding and Engineering
On-Set VFX	Live compositing, LED output, volume load-in, brain bar operation. See Mandala: 7. Stage Operator / Stage Technician



SOLUIS - ARCH VIZ | *Bringing people in architecture to life*

10+ employees – 20+ years – Interactive architectural visualisation

Profile

Soluis is a large digital media, interactive experience and architectural visualisation studio based in Glasgow for over 20 years. Increasingly they are asked to embed a narrative into client briefs, and at the heart of the storytelling process and built environment are people. Current processes are too costly and the team has been limited by budget, time, and lack of tried-and-tested processes. Using VP technology, Soluis are planning to explore how to develop creative content that will allow them to bring spatial storytelling to virtual architectural environments created in Unreal Engine.

Claire McGarry – Studio Director

Raquel Resende – Senior 3D Artist

Robert McMillen – CTO Edify

Jonathon Knox – Creative Director

Project

The project is a journey through a built environment set in a futuristic and dystopian world. The team's knowledge in VP is in the advanced use of Unreal Engine using traditional animation and compositing techniques. In order to develop this project for VP adoption in the enterprise sectors, they require additional insight into the practical elements of implementing a suitable set of VP workflow processes, how best to prepare the virtual environments ahead of each shoot and what VP facilities are required.

VP Challenge

During *VP Futures* Session One, Solius' time on Epic Innovation Lab's LED Volume made clear that they were overly ambitious with their project scope. Their scene was heavy, lighting was not working, and appeared not to be to scale. Being able to transition from one scene to another in a seamless take and the movement between spaces was essential. The team focused their learnings on optimisation, animation and handling multiple levels within one scene. After some experimentation on the volume, 1-2-1 mentorship from ILM and Epic, they managed to create and test a scene incorporating live action for their project and were also successful in switching scenes on their test shoot.

VP Opportunity

Soluis is considering VP for new projects. They are looking to get wider company support for incorporating VP into their production pipeline. The team are hoping to collaborate with production companies to produce Unreal Art scenes, utilising the company's pre-build photorealistic assets, which could be incorporated into VP content creation pipelines.

“VP Futures has opened our eyes to opportunities we hadn't imagined and hope to develop within the AEC, design, and commercial visualisation industry to fill in the missing piece in bringing together beautiful looking visuals and the people that breathe life into it. After all, what is architecture without the people living, working, enjoying and just being in it.”

Existing VP-Transferable Skills	
Production	Production management skills.
Preproduction	Extensive experience in previsualisation, Creative Director role in-house. Spatial and narrative storyboarding and animatics. Established production teams.
Art/VAD	In-house Unreal art team building immersive environments, asset creation and library logging. Technical art experience in shading tree, materials. Some photogrammetry.

New VP Skills as a result of VP Futures	
On-Set VFX/VAD	Unreal Engine and Mocap. Live compositing, LED output, and NCam, Volume load-in. See Mandala: 8. Technical Artists
On-Set VFX/VAD	Metahuman/human interaction within VP. Developed capacity for UE shaders and coding. See Mandala: 1. Art Department - Games Engines 3. Asset building and Optimisation



Images courtesy Soluis



SUNNYSIDE – PRODUCTION | *Art documentary and narrative*

Team of 2 – Formed 2012 – Focused on high-end TV market

Profile

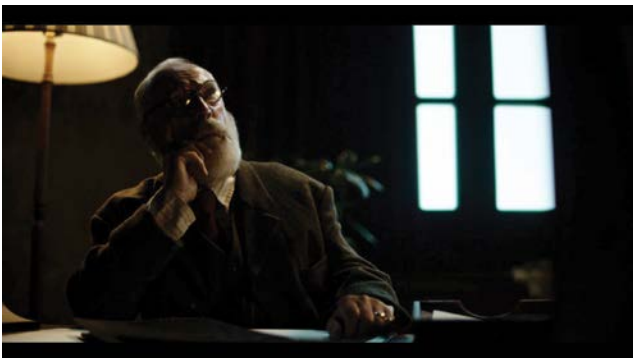
Sunnyside Productions is an independent television production company formed in Scotland by filmmaker Andrea Miller. Sunnyside had been developing factual entertainment for the international market but more recently has pivoted toward the development of feature documentaries and the exploration of new ways to bring factual stories vividly to life on screen. New skills and expertise in VP will be a significant contribution to the company's capability and growth in the future.

Andrea Miller – Executive Producer

John Gilbert – Writer

Project

The *Surreal Life* is a 4 part high-end drama series set in the 1920s and, 30s at the height of the Surrealist moments in Paris, London and New York. The project consists of several scenes that are visually very rich. The team prototyped a scene to demonstrate the effect of using VP on the way the story is told to pitch to funders and commissioners. The project creates an opportunity to introduce the writer as an integral part of the early development process, learning the possibilities and limitations of VP as writer/producer team.



Images © *The Surreal Life*, Sunnyside Productions

VP Challenge

Sunnyside is a small creative team with no previous VP knowledge or skills. The biggest challenge for this company was understanding VP processes and the skills required to deliver VP, from the ground upwards. After completing the *VP Futures* Development Zone, the team were able to make a more accurate assessment of their production needs, such as how to use UE for previs and techvis; acquire accurate language and costings; how to manage the creation of assets and delivery to the wall; how to adapt a writing/development process to VP's capability; and how to prep a VP shoot.

VP Opportunity

During *VP Futures*, the team were introduced to the idea of creating a series treating several artists with the same format, each involving the recreation of artistic works in virtual production. This creates a new opportunity to use VP to tell documentary stories in a novel way for the production company. The writer, Jon Gilbert, is now much more likely to explore alternative genres and ways of writing that expand his writing toolkit. The team feel they can now talk with practical authority about how to shoot on the volume and how to write for it.

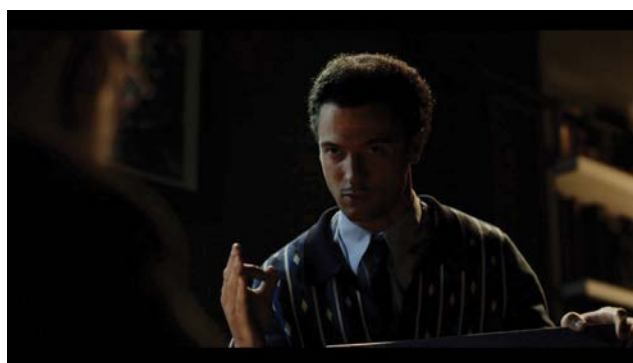
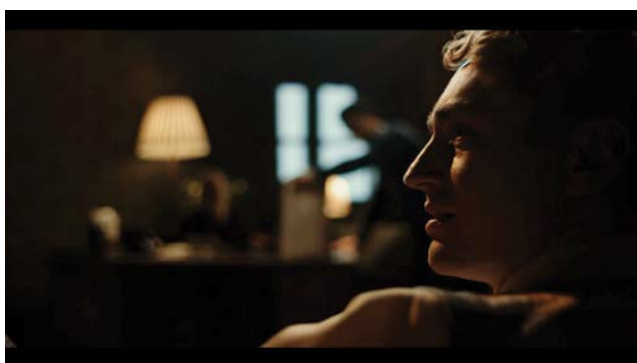
“VP Future was an incredible opportunity to go from almost zero knowledge about filming for Virtual Production to a really solid grounding in the terminology, techniques and potential of a VP shoot. The mentorship was exceptional. We were supported at all times and the learning curve was phenomenal; we went from being near-total novices to (not quite) experts in six weeks! As a crash course in VP, it was both intensive and highly rewarding and has left us feeling confident and inspired to continue our journeys into shooting with VP.”

Existing VP-Transferable Skills

Production	Extensive producing experience in documentary arts programming, studio, live performance and drama.
Preproduction	Experience of screenwriting, rewrites, note-taking, storyboarding and 2D previz. Research skills in story development.
On-set	Line Producing and project management experience.

New VP Skills as a result of VP Futures

VP Dept	Business case development and sourcing VP talent. Grounding in planning and budgeting of VP. See Mandala: 10. Producers with experience of VP 4. Management - Senior Team and Business Development
Preproduction	Unreal Sequencer and digital storyboarding.
On-Set VFX	Gained understanding of VP terminology and on-set communications, Directing and with DOP. See Mandala: 7. VP Supervision



TAUNT – ANIMATION | *Real time pipelines in real world sets*

Less than 10 employees – Formed 2017 – Animation for film, TV and online

Profile

Taunt is an independent animation studio, who create their own IP, character animation and VFX for film, TV and online. Character animation and VFX has become a large part of this small team's established profile and they believe virtual production will be essential to this toolkit in the future. The team has experimented with creating VP environments and started to develop new and valuable VP skills. They anticipated that *VP Futures* will help the team incorporate what they have learnt into their existing animation workflow and take on bigger projects as animation vendors.

Ryan Loughran – VP Visual Artist

Fiona McLaughlin – Director

Tom Getty – VP Supervisor

Project

'Róise & Jupiter' follows a young girl 'Róise who finds herself exploring the walls of a large Victorian manor with her sassy Robot Dog, Jupiter, brought to life through integration of lighting, CG character development and live-action talent with full CG environments in a VP pipeline.

VP Challenge

New learning for Taunt has centred around colour management, optimisation, ray tracing and how VP data management fits in with traditional compositing. A challenge for the team was 'shooting with a sharp focus on the wall' as their project involves CG characters on the LED wall interacting with live action cast members. Their initial intention was to shoot with the CG characters in focus, however testing confirmed that this will cause issues that they were able to modify through the support of mentorship and testing to allow them to incorporate compositing and other solutions into the VP pipeline.

VP Opportunity

Taunt's experience on *VP Futures* has been to incorporate what they've learnt into their existing animation workflow and build VP capabilities to work with larger clients. *VP Futures* has helped them solidify where they want to go in the industry, introducing them to the possibilities of VP technologies across multiple industries.



Images courtesy TAUNT

Existing VP-Transferable Skills

Production	Wide experience of animation production in full CG.
Preproduction	Previsualisation for animation and VFX.
Art/VAD	Character animation and VFX, integrate Maya to Unreal Engine.

New VP Skills as a result of *VP Futures*

Preproduction	Building collaborative VP workflow and pipelines. See Mandala: 10. Producers with experience of VP
VP Dept	Volume Environment Prep and Testing for Green Screen, Interactive lighting, Simulcam. See Mandala: 7. VP Supervision
On-Set VFX/VAD	Colour spaces calibration and colour management. LED Wall ICVFX, Colour management, Optimisation, Ray tracing, VP data management in Compositing. See Mandala: 6. Stage Operator / Stage Technician



CONCLUSION

Having reviewed the quantitative data it is now important to return to the question “What does it feel like on the ground, to be working in VP?” Our interviewees have repeatedly claimed that communication is a key skill necessary to the practice of virtual production, a skill that goes a long way towards avoiding a particularly stubborn but critical stumbling block: **how to reconcile the “two worlds” that converge, or collide, in VP.** By necessity the filmmaking mindset and the games-design mindset must converge in VP, by working together to form a new tradition out of this meeting.

‘Film and games culture integration’, as we have called it, is not very easily pinpointed within the VP Skills Mandala, as this integration or convergence only comes into play through highly synchronised and collaborative workflows, and is felt whenever the creative vision of the project has to be materialised in visible or audible form via game engine technologies.

Successfully integrating physical and virtual sets created by different departments is a balancing act for practitioners. VP requires soft skills in communication to help achieve a balanced relationship between the varied roles, minimising any potential “disconnect” involved in bringing together filmmaking aesthetics on the one hand and games-based real-time interaction design on the other.

We see the definition of virtual production as much broader than the film industry does. We see it as the entire game engine stack from art and environment creation cameras and lighting right through to green-screen and the LED volume.

Benjamin Lavery, Studio Head, The Trailer Farm, a Keywords Studio.

‘Gameplay capture’ is not considered to be ‘Production’ in games, nor is ‘in-engine cinematics’, and editing is not equivalent to ‘Post’. **The language and terminology of VP** might be left to ‘evolve’, but interviewees often expressed the need to agree on and be able to access a baseline language and thus a shared way of communicating:

“Our clients are very comfortable in being on a traditional set, but now we’ve introduced a new paradigm that requires everyone to think about production from a slightly different perspective, so it’s about trying to minimise confusion and help focus on growing the business, and the uptake of the new technology, which I think has a real benefit for the industry. From the client’s perspective, I think that there are a number of aspects that need to be standardised, for example how these new roles should be referenced, the nomenclature for being on-set, and how we talk about the Virtual Art Department, versus content creation, versus when you’re shooting on a stage”

Sue Lyster, Executive in Charge, ILM London.



National Film and Television School

Production Designers need to hand their design ideas over to the Technical Artists of the Virtual Art Department, while also mediating the relationship with clients much earlier on than would be the case in traditional linear filmmaking. Until the merging of PD and VAD departments becomes the norm, a process of translation and negotiation is needed for this type of handover to be successful. At Production level, the practice of developing creative and technical talent capable of working together is itself a rare strategic skill, and encourages creative and technical talent to learn from other experts and fold this learning into their 'home' discipline.

“Communication and maybe slightly more open mindedness, and film is very hierarchical. Whereas games, are a bit more 'flat'... VP only really works if there's an open layer of communication between the departments... First ADs, I think, would make good VP Supervisors, because they're used to that cross-wise departmental communication and they understand people from Production.”

David Levy, Director Business Development, Global Solutions, ARRI.

Communication is not just a matter of, for instance, addressing DoPs or VP Supervisors in the most appropriate way and times, or of using channels such as Slack and Trello to keep the lines of communication open, but is also concerned with how VP is disseminated and explicated to different audiences. Finding a common language and sensibility that operates across the two differing approaches to design and collaboration is difficult, however with an appropriate approach to this problem it may be possible to reverse the order of things and to turn this challenge into an opportunity. Currently VP is in the unique position of having very low initial barriers to entry, by virtue of free-to-access tools such as Unreal Engine and a multitude of online educational resources and forums in which to pick up knowledge and tips about how to practise VP. Free-to-access tools and resources can drive skills development in specific parts of the VP pipeline but cannot on their own support the development of **VP-ready** organisations to take their place in the VP ecosystem.

“Rather than each individual studio creating an academy... if you can improve accessibility, democratise things the way that Unreal Engine to a degree is democratised, I still think you shouldn't need two-to-three thousand pounds in the bank

to buy a machine that can run the software... it all boils down to information sharing, accessibility, democratisation of these technologies, and if you can do that, then the talent will flourish and then the talent will be diverse”

Monika Chowdhary Kuczynski, VFX/VP Producer.

By promoting **the democratisation of VP** and by being open about the potential for opportunity and access, it should be possible to grow new talent to meet the demand for VP, and in the process, educate clients in the ways of VP. There is also the need to deal with the problem of diversity, as despite the relatively low technological barriers, there still remain many economic, social and gendered barriers to entry. Research and education has a responsibility in this as well, to use language that is right for the sector as it is developing, rather than inadvertently perpetuating a traditional view of filmmaking and creativity.

On the ground, 'Film-Games Culture Integration' equates to different approaches to collaboration.

Negative practices on set, as identified by the British Film Institute (BFI Skills Review, 2022) and confirmed by our own research, only deters new creative and technical talent from entering VP. An interviewee with a background in both TV and games working as a motion capture Director and consultant says, that these two contrasting production cultures are showing promising signs of convergence, but this is threatened by negative practices:

“People who work in linear storytelling have started using the tools, but there still isn't the respect from film and TV, in fact there's still a certain amount of snobbery. It's not helped by the fact that the games industry... don't pay or recognise the talent in the same way. ... But, if we need to understand how to create good motion capture performance for our virtual production backgrounds and environments, then we are going to need to start to understand each other more.”

John Dower, Co-Founder, The Mocap Vaults.

The notion of “set etiquette” – the rules and customs dictating how to behave while on set – might be seen as necessary for the pressured efficiency of a production, but might also be seen as a barrier to entry for those who are coming from a differently organised discipline, and thus becomes a challenge to VP rather than an opportunity for VP. In at least one case, set etiquette and games-film culture

CONCLUSION

integration was counter-intuitively supported by separation: “On the Pinewood set-up for StageCraft you’ve got this balcony where the Brain Bar* lives, so they will not be coming down onto the set, and people from the set are not going to be going up; it creates a bit of a barrier, and I think that was a happy accident,” says VFX/VP Producer, Monika Chowdhary Kuczynski. Looking ahead, the path for VP-ready SMEs is far from straight-forward:

“The biggest challenge for the future will be collaboration versus consolidation. While there are lots of exciting things happening all at once, it all feels a bit fragmented at the moment in terms of pipelines, tools, hardware and so on, which makes it difficult to find seamlessly integrated solutions. Meanwhile, the bigger players are becoming more proprietary and territorial, so it’s about finding a middle ground.”

Sue Dhaliwal, Executive Producer, Territory Studios.

The **theoretical implications** of virtual production are still being explored. A recent attempt to address film theory in relation to VP addresses the assemblage of digital and physical components asks what impact this has on cinematic space: “This arrangement differs from seeing a digital image as it is a representational surface, delivering an illusion of a spatial world... where bodily changes lead to the forming of space-related mental images that precede the narrative” (Ilmaranta, 2020). In this technologically inflected view, VP is like an elaborate interactive trompe l’oeil painting, a digital tableau designed to allow people and cameras to move around within the physical space and to act against the backdrop of the technical and physical constraints of the VP stage.

Future research in this area can look more closely at how other creative disciplines intersect with VP, along with the practical and theoretical implications of this. **Writing and acting for VP**, for example, are quickly becoming specific skills areas, shaped by the need to adapt to a creative assemblage of virtual real-time tools and techniques, physical infrastructure and sets. Joel Bennett finds that there are three types of immersion available to an actor working in VP, bodily, spatial and perceptual, and he finds that the actors’ sense of immersion is especially improved through real-time control of virtual environment lighting (Bennett, 2020). In contrast with working in

a green-screen environment, a performer can directly see and respond to digital elements, atmospheres, and beings in ‘unreal’ environments depicted in the animated tableau, and can alter their performance as a result. The ability of the VP team to change lighting interactively and to manipulate virtual objects to help improve performances, including architecture elements within the scene, creates the opportunity for interplay between “space-related mental images” and the embodied narrative described by Ilmaranta – playing with the way that the illusion is created and sharpening the effect of the technique on audiences.

Once technical workflows are established for a filmmaking project, Directors can find that VP offers a sense of immersion and creative fluidity. In one anecdotal example related by an interviewee, when shooting scenes for the feature film ‘Pistol’ Danny Boyle was able to exploit the adaptability of the digital medium:

“It was a fantastic moment, he was head over the monitor, and I could hear him just giggling to himself because he was enjoying what he was seeing. He was like, ‘Yes, this is what I want!’ Then he said, ‘Ah, I don’t suppose you’ve got something of driving down the road at night in a forest?’ And we said, ‘Let’s check the database, because trees aren’t indigenous to the scene.’ He said, ‘Doesn’t matter, put it up... Okay, go for it, shoot.’ It was amazing to watch.”

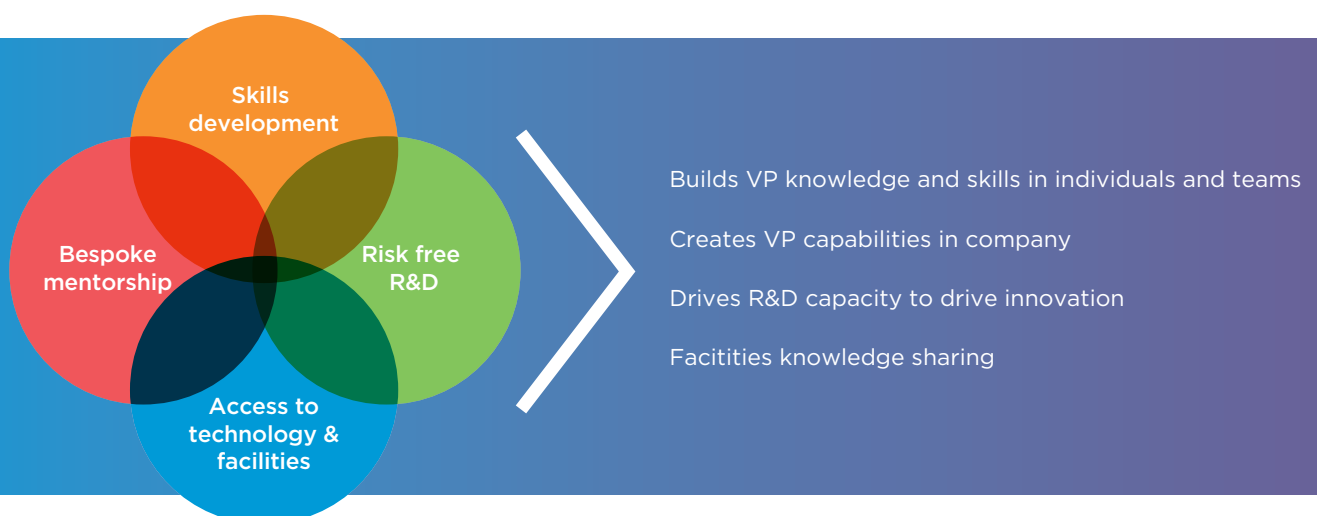
David Levy, Director Business Development, Global Solutions, ARRI.

Through painstaking R&D many technical and logistical processes can be de-risked in an effort to support the efficiency of a production, but creative risk is a form of friction that should not always be ironed out. Certain projects, says Sue Lyster of ILM, “can be hugely painful but can push you to new places”, resulting in huge productive and creative gains. Of the many productive “pain points” in VP, the largest at the moment in the UK is the inability to find talent across the board, a situation created by extreme movements in the labour market, difficulties sourcing European talent, the working-from-home phenomenon, and exacerbated by the current cost of living crisis. In 2021, said ILM’s London-based Director of Talent Rebecca Barbour, “It felt like it was on fire... I think we still have the same problems, but they don’t seem as on fire as they were the previous year.”

*Brain Bar is a contentious name for the assembled Stage Operators, managing the Game Engine, and Stage Technicians, managing motion capture and tracking technologies.

TAKEAWAYS

- Most VP-productive organisations are R&D intensive, that is, are actively carrying out research and development on live VP projects (79%).
- At the same time, the vast majority of VP-productive organisations surveyed received funding below £10k making it difficult to sustain intensive R&D cultures in these organisations - 42% of which are micro-businesses, and 27% SMEs. This is underlined by the fact that less than half of VP-productive organisations have 'in-house' VP-dedicated teams (42%), staff who may be suited to the pursuit of R&D.
- Micro-businesses and SMEs are in particular need of increased R&D funding from the public sector, to help them become VP-ready businesses and thus be able to sustain growth in this sector. 37% of VP-productive organisations have accessed public grant funding, and 26% have secured public match funding.
- Communication skills are key, which can only be honed by time working on set in VP-productive organisations, gaining valuable experience in the practice of VP. Applied learning opportunities on set are thus critical, providing access to role-based learnings that are extremely hard to find in the sector.
- There is an urgent need to rapidly develop new skills, and grow new talent and capacity in VP-ready and VP-in-waiting organisations in order to meet rising demand. Training gained in isolation is not as valuable as training gained while working within a VP ecosystem that supports training, R&D and high level mentorship. Access to infrastructure for applied learning will drive innovation through R&D and this in turn will drive organisational growth in the sector.
- Despite the availability of new training initiatives during 2023, the demand for training continues to outstrip supply, and there is an urgent need to upskill, as illustrated by the fact that over one third of organisations surveyed reported that staff have less than 6 months experience of VP. Even for VP-productive organisations who are beginning to establish a presence in the sector, two-thirds of these reported that VP skills in the employment market are generally in weak, or very weak supply.



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