Deliverable

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D5.1 Market analysis report

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Abstract

This report provides a Market Opportunity Analysis of ImmersiaTV. To do so, it analyses ImmersiaTV's Value Chain, with 6 main categories of stakeholders identified. In particular it analyses in a detailed manner the businesss model features of three potentially close competitors for ImmersiaTV. Then it provides a description of the main market trends for audiovisual immersive products. Finally, based on these analyses, it provides a set of recommendations regarding ImmersiaTV's positioning in its Value Chain.

REVISION HISTORY

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EXECUTIVE SUMMARY

The main goal of ImmersiaTV is to demonstrate a novel approach for the recording, broadcast and display of omnidirectional video. In ImmersiaTV we fully embrace the need for high-quality omnidirectional video, but we recognize the need to create a novel AV language addressing the specifics of immersive displays, within the contemporary, and multi-display, living room.

Following the steps of the value chain that are directly crucial in ImmersiaTV's activity, the report identifies 6 main categories of stakeholders in the market for AV immersive products:

(i) Omnidirectional camera producers and/or processing software providers;
(ii) Providers of editing software for omnidirectional video;
(iii) Producers of immersive AV content;
(iv) Distributors;
(v) Providers of devices allowing to display immersive content;
(vi) End-to-end platforms.

The report provides a general overview of market trends for Virtual Reality and raises important questions concerning how the sector could evolve in the coming years, thus informing the ImmersiaTV consortium partners of potential threats and opportunities. Main trends are:

- VR is a fast-growing market;
- Next to games, video will drive the adoption of VR technology;
- Shipments and sales of display devices are the most visible feature of the market;
- Displays vary greatly in terms of price and quality, the underlying trade-off is the one between quality and accessibility;
- Consumers will adopt VR only if relevant, innovative content is developed.

Finally, based on the analysis of three potential competitors of ImmersiaTV, the report recommends:

(i) To assess whether ImmersiaTV should follow the strategic business choices followed by the three cases (vertical integration, direct customer ownership, indirect revenue model and high involvement of professional users);
(ii) To further address the following strategic questions
   a. Should ImmersiaTV provide separated components or an integrated suite of tools?
   b. Is it important for ImmersiaTV to innovate in terms of format/content?
   c. Is it important for ImmersiaTV to be available on several platforms?
   d. Is enabling live streaming crucial?
(iii) To develop the consequences of each choice for the project, from an exploitation (but also technological) point of view.

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LIST OF ACRONYMS

Acronym	Description
AR	Augmented Reality
AV	Audiovisual
BM	Business Model
HMD	Head-Mounted Display
MOA	Market Opportunity Analysis
TV	Television
VR	Virtual Reality
WP	Work Package

1. INTRODUCTION

1.1. Market analysis in the context of ImmersiaTV

1.1.1. ImmersiaTV

The main goal of this project is to demonstrate a novel approach for the recording, broadcast and display of omnidirectional video. In ImmersiaTV we fully embrace the need for high-quality omnidirectional video, but we recognize the need to create a novel audiovisual language addressing the specifics of immersive displays, within the contemporary, and multi-display, living room.

1.1.2. WP5 and T5.1

The overall objective of WP5 is to ensure that project results – to be understood as the creation of an end-to-end system for novel immersive audiovisual experiences and its components – have a determining impact on the audiovisual market. To reach this objective, this WP will:

- Determine overall conditions for successful exploitation of the proposed solutions, such as productization, standardization, additional stakeholder involvement etc. and identify optimal go-to-market strategies for each of the stakeholders, to be translated in feasible and viable exploitation plans.
- Organise maximal visibility to the proposed solutions through presence at major relevant events and set up direct contacts with potential clients of the developed solutions.
- Implement a communication strategy aligned with the exploitation strategies of the consortium partners.

Within WP5, T5.1 performs an analysis of the current and expected future market for immersive audiovisual products by:

1) Shedding light on changing behaviours and associated expectations in audiovisual consumption;
2) Assessing the market potential of the solutions developed within ImmersiaTV both in terms of enhancing existing formats and in creating new types of content;
3) Identifying technological trends, potential competing platforms and solutions as well as complementary stakeholders.

This analysis will lead to a set of recommendations which will steer both the use cases to be prioritized by the project as well as the exploitation and innovation transfer activities developed further in this WP.

1.2. Objective

This second iteration of the report describes the market for audiovisual immersive products and provides a set of recommendations as input for the use cases and the exploitation and innovation transfer activities in T.5.2.

This reports **follows the steps of the value chain** where ImmersiaTV is active or that are directly crucial in the project's activity. It analyses each step, with a focus on some of ImmersiaTV's potential competitors. This in-depth analysis of competitors' business model together with the analysis of market trends leads to intermediate business recommendations regarding ImmersiaTV's activities.

1.3. Overview of deliverable

Next section provides an overview of the methodology used in the report: Market Opportunity Analysis. It then briefly explains how data were gathered, which constitute the basis of the report.

Section 3 follows the steps of the Market Opportunity Analysis, providing (i) a definition of the relevant market(s); (ii) an analysis of ImmersiaTV's Value Network; (iii) a description of stakeholders in each step of the Value Network; (iv) an in-depth analysis of business model features of a few potential competitors; and (v) an analysis of main market trends.

Section 4 concludes and provides recommendations.

2. METHODOLOGY

2.1. Market Opportunity Analysis

Market Opportunity Analysis (MOA) is a step-wise method to assess the market potential of a product or service and to provide scenarios that can lead to market strategies. It consists of four steps: value network analysis, competitive analysis, market segmentation, and scenario development. It is a methodology designed to be a guide in a mostly qualitative research into the market potential(s) of a product or service. It describes the markets or ecosystem(s) in which the product or service can be placed, while providing insight into strategic choices that need to be made.

2.1.1. Value Chain/Value Network

Value networks correspond to the organization of actors in the provision of a product or a service, i.e. how roles, resources and capabilities are distributed among them and the relationships between them. Every value network will consist of the following building blocks:

a) the business roles,
b) the business actors that can potentially adopt these roles,
c) the basic services that are exchanged between the actors

Value networks are described using the following codes:

- White boxes indicate roles;
- Light grey boxes indicate an actor that may have one or more role;
- Arrows indicate a flow of service (e.g. providing a software) or content (e.g. stitched content)

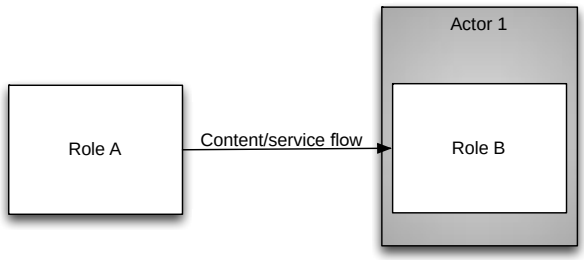

Figure 1: Illustration of the portrayal of Value networks

This report provides a simple description of ImmersiaTV's Value Network, used mainly to identify potential competitors, and position ImmersiaTV in comparison to them.

2.1.2. Competitive Analysis

Competitive analysis is inspired by the *competitive-forces model* by Porter.[1] This consists of following sub-analyses:

- *Current competitors*. This is in particular analysed by considering in detail 3 of ImmersiaTV's potentially most direct competitors: Jaunt, NextVR and Immersive Media. The analysis relies on the Business Model Matrix (see 2.2)
- *Complements and substitutes.* While this analysis is suitable for new entrants in developed markets, immersive experience is still in its infancy: important players have emerged but market positions are far from stable (to start with consumer adoption). Thus, it cannot always be divided rigorously whether other providers are current or

[1] *How Competitive Forces Shape Strategy* (Harvard Business Review, 1979).

future competitors or whether their offers will be complements or substitutes, etc. A related question is whether the immersive solutions developed within ImmersiaTV are complementary or substitute to current user practices, and therefore to standard media products. For example, are ImmersiaTV services competing with what broadcasters are currently proposing?

- *Positioning*. This is analysed in particular in terms of the innovative aspects of ImmersiaTV. ImmersiaTV's objectives are to innovate at various levels (cf. [2]:
    - Content (inner form or core). ImmersiaTV aims to come up with innovative formats for e.g. documentaries and live events
    - Consumption & Media. ImmersiaTV aims at changing the user's experience to AV content, e.g. in relation to the use of 2nd screen. The specificity for creative content is that at the level of consumption it may prove difficult to disentangle what relates to product innovation and what relates to process innovation [3].
    - Production & Distribution. ImmersiaTV aims at proposing new ways of producing and distributing immersive AV content
    - Business Models. ImmersiaTV aims a defining the relevant business models associated to the solutions developed in the project

  Furthermore, the innovative solutions developed within ImmersiaTV are based on previous innovations, and the combination thereof within an end-to-end solution. Therefore, some aspects of it can be innovative, others will be more about imitating the current state-of-the-art while being able to integrate with others functionalities. For example, ImmersiaTV benefits from the arrival of the smartphone, a device that has helped proliferate and optimize vital VR components like sensors, gyroscopes, and small screens [4].
- *Future competitors*.

The report identifies the main types of actors being active in the VR industry, briefly qualifies them, and provides structured, non-exhaustive lists of companies (see 2.3). The competitive analysis follows the stages in the value network, to identify competing products or services at each step (and end-to-end solutions). A mapping is provided for each stage in the value network, with specific angle. Thus:

- In the capture & processing stage, a distinction is made between the most important and other players.

2.1.3. Market segmentation

The market segmentation gives insights on the adoption potential of the innovation. The purpose of this exercise is to extend the competitive analysis and get certain indications on the possible market size.

[2] Valérie-Anne Bleyen et al., "A Typology of Media Innovations: Insights from an Exploratory Study," *The Journal of Media Innovations* 1, no. 1 (2014): 28–51.
[3] Ibid.
[4] Winter Wright, "A Brief History of VR," *WinWin*, 2015.

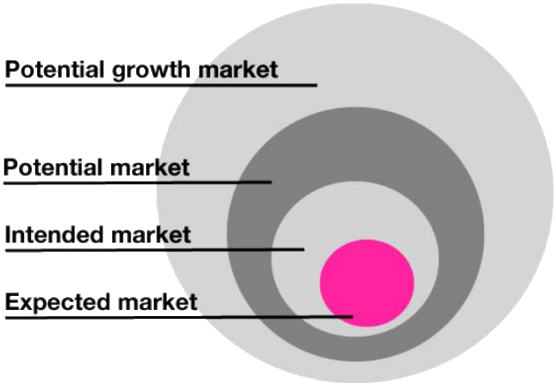

Figure 2: Market segmentation

The market segmentation is an established method in marketing [5], although many variations exist. A segment can be calculated or assessed by narrowing down the market to segments that constitute realistic target groups for the purchase/adoption of a good or service. This can be done as shown in Figure 2.

Due to the lack of consistent data on this rapidly evolving market, the aim of market segmentation is mainly to provide **a general overview of market trends** for Virtual Reality and to raise important questions concerning how the sector could evolve in the coming years, thus informing the ImmersiaTV consortium partners of potential threats and opportunities. Next iterations may provide a more detailed analysis, but only if relevant data are available.

2.2. Business Model Matrix

The business perspective relies on the business modelling framework provided by Ballon[6], which is summarized in the following Business Model Matrix (see Table 1). It has been used in various past projects, in particular applied to the media and telecom industries. It is here applied **to analyse the business models of three potentially direct competitors of ImmersiaTV: Jaunt, NextVR and Immersive Media**.

CONTROL PARAMETERS		VALUE PARAMETERS	
Value Network Parameters	Functional Architecture Parameters	Financial Model Parameters	Value Proposition Parameters
Combination of Assets	Modularity	Cost (Sharing) Model	Positioning
Vertical Integration	Distribution of Intelligence	Revenue Model	User Involvement
Customer Ownership	Interoperability	Revenue Sharing Model	Intended Value

Table 1: Business Model Matrix (Source: Ibid., 10.)

This approach emphasizes roles and relationships between different actors within one ecosystem, rather than confining on processes within single businesses. Within ImmersiaTV, it

[5] See e.g. Philip Kotler et al., *Principles of Marketing*, 2nd European (London: Prentice Hall Europe, 1999).

[6] Pieter Ballon, "Business Modelling Revisited: The Configuration of Control and Value," *Info: The Journal of Policy, Regulation and Strategy for Telecommunications, Information and Media* 9, no. 5 (2007): 14, doi:10.1108/14636690710816417.

should help to respond the following questions: how should business roles be distributed among different actors in potential business models? How is control over the technological architecture distributed over the network? etc.

The matrix figures four parameters of business models: (1) the organizational design or way in which the value network is assembled; showing how actors and roles, resources and capabilities are distributed in the value network, (2) the functional architecture respectively the technical design and how elements thereof contribute to the value creation process, (3) the financial construction containing revenue streams and revenue sharing models, and (4) the value proposition referring to the product or service offered to the end user. Each parameter consists in three sub-parameters; they are described below.

This deliverable adheres to the framework and its parameters, as they provide convenient means of orientation and structuring. Nonetheless, not all elements of the matrix are of equal relevance for the exercise at hand. In addition, information on some parameters may be more impossible to find. We therefore focus on a subset of parameters, which are further defined.

2.2.1. Value Network

- *Level of vertical integration:* Vertical integration relates to the scope of tasks one firm takes over in the value creation process. The higher the level of ownership and control over successive stages of the value chain, the higher the vertical integration.
- *Customer ownership:* This aspect relates to the relationship with the end customer, examining, amongst others, the access to key information of the customer, the type of contact (direct or intermediated), the level of intensity and proximity to the customer.

2.2.2. Functional Architecture

- *Interoperability:* Interoperability refers to the ability of technological systems to directly exchange information and services with other systems, and to the interworking of services and products originating from different sources.

2.2.3. Financial Model

- *Revenue model:* The main specification of this aspect is to examine the business model in question of income stream (direct/indirect).

2.2.4. Value Proposition

- *Positioning:* This aspect deals with the question whether to position a product or service as a complement to a particular set of existing products and services, or rather as a substitute to them. It is not least a question of marketing issues including branding, identifying market segments, establishing consumer trust, detecting competing products or services, and identifying the most relevant attributes of the product or service in question.
- *Customer involvement:* Customer involvement refers to the role of users in the business model and the scope of their integration possibilities. 'Prosumers' are enabled to produce and consume content and services in parallel in the network.

2.3. Data gathering

This deliverable combines insights provided by consortium partners and literature review.

ImmersiaTV consortium partners have been asked to fill a list of stakeholders that were contacted or should be contacted. Based on their main domains of activities, they have been asked to ensure the main stakeholders had been correctly identified.

On 24th November 2016, a Business Model workshop was organised in Porto, which involved all ImmersiaTV stakeholders. The aim was to discuss ImmersiaTV's strategic choices, during and after the project, and how to ensure its sustainability. Three cases of strong potential competitors to ImmersiaTV were analysed in-depth, following the Business Model Matrix methodology (see 2.2). A number of key strategic questions were derived, and for each a consensus regarding ImmersiaTV's positioning was discussed among the consortium partners. The results of the discussions are used in this deliverable and in the next iteration of D5.3.

More generally consortium partners are supposed to provide information about market trends and latest industry developments.

Literature review was mainly performed online. It has relied mainly on:

- Recent reports, e.g.:
    - Goldman Sachs, 2016. Virtual & Augmented Reality. Understanding the race for the next computing platform, Equity Research.
    - Hwang, R., 2015. Enable Your Virtual Reality & Augmented Reality Technology on ARM. ARM.
    - Pitchbook, 2015. Virtual Reality. 2015 Analyst Report.
    - Russell, A., 2015. The Enterprise Applications of Virtual Reality Emerging Technologies and Applications of Virtual Reality for Business. Center for Digital Strategies Fellow.
    - Wright, W., 2015. A Brief History of VR. WinWin.
    - Fonds des médias du Canada, 2016. Rapport sur les tendances. L'ère de l'expérience, Janvier.
    - Net Insight, 2015. Solving sync. Synchronized Live OTT, Solution Paper.
    - Gannett Co., 2015. Bringing you into the news: the state of virtual reality in journalism, October.
    - Vectorform, 2015. Virtual Reality. A learning curve for marketers, October.
    - The Farm 51, 2015. Report on the current state of the VR market.
- Data and information provided by the following websites/companies, e.g.:
    - Kzero (on kzero.co.uk)
    - Wareable (on wareable.com)
    - CCS Insight (on ccsinsight.com)
    - Digi-Capital (on digi-capital.com)
    - Digital Media Update (on digitalmediaupdate.blogspot.be)
    - Business Innovation Centre
    - Manatt digital media
    - Road to VR (on roadtovr.com)
    - Strategy Analytics
    - TBI Vision
    - The Virtual Report (on thevirtualreport.biz)
    - The VR Fund 2016 VR industry landscape[7]
    - Virtual Reality Reporter
- Information available on the analysed VR companies' (see 3.4) official websites

[7] https://trello.com/b/srhdQF14/virtual-reality-industry-2016

3. IMMERSIATV'S MARKET POSITIONING

3.1. Relevant markets

ImmersiaTV aims at innovating for technologies producing immersive AV content, and this way to propose new forms of AV content. Therefore, it touches upon three related fields: Virtual Reality (VR), interactive video and orchestration apps offering content for second screens.

Simulating one's physical presence as if one were in a remote place has been a challenging issue in the **Virtual Reality** field. [8]. Hence the challenge with VR is to immerse the user in another experience. With the emergence of VR, we have seen a simultaneous surge into the development of augmented reality (AR) experiences.[9] AR experiences focus on providing computer-generated artificial overlays into a user's real-world environment. Some AR platforms and devices can provide a more immersive experience than others, but the basic premise is that AR experiences do not block out the real environment[10] – contrarily to VR. Therefore, while ImmersiaTV touches slightly upon AR technologies (e.g. for the portals), AR and VR remain different. Regarding AR, the report will only evoke it. The focus will remain on VR, and in particular on 360 video.

Interactive video refers to all forms of audiovisual content that include some of interaction on behalf of viewers with the content. Therefore, it blends interaction with linear video. Interactions include:[11]

- Annotation (e.g. annotations in YouTube videos);
- Content Browsing (e.g., through keyframes) when there are means for undirected search;
- Collaborative Use when it is possible to perform the interaction together with other users in a synchronized way;
- Direct Content Manipulation when users have the option to interact with individual objects in the video;
- Content Navigation (e.g., fast forward/rewind, random access, etc.).
- Querying and Filtering when video content can be filtered for different features (e.g., color, faces, etc.).
- Content Summarization/Abstraction when the system supports generation of a digested or summarized view of the content.

Second screen denotes the use of handheld devices such as smartphones and tablets in close connection with TV watching.[12] While still a new behaviour among television audiences,[13] they offer promising perspectives, notably in the field of advertising.[14] Second screen applications require synchronisation between the first (TV) and the second screens.

[8] Daisuke Ochi et al., "Dive into Remote Events: Omnidirectional Video Streaming with Acoustic Immersion" (ACM Press, 2015), 737–38, doi:10.1145/2733373.2807963.
[9] Pitchbook, "Virtual Reality. 2015 Analyst Report," 2015.
[10] Ibid.
[11] Klaus Schoeffmann, Marco A. Hudelist, and Jochen Huber, "Video Interaction Tools: A Survey of Recent Work," *ACM Computing Surveys* 48, no. 1 (September 29, 2015): 1–34, doi:10.1145/2808796.
[12] Technologia, "Assessing the Impact of Second Screen" (Ofcom, March 4, 2014).
[13] http://www.bbc.co.uk/rd/projects/companion-screens
[14] http://wywy.com/research/second-screen-study/

3.2. Value Network

This section provides a description of ImmersiaTV's Value Network. Three main Value Chains can be distinguished: Components, Hardware & Software, and Content. Immersive AV content production is first captured. Captured content needs to be stitched and produced. The outcome is distributed before being displayed. Every step of this content chain relies on hardware and software:

- Cameras for capture
- Software to ensure the processing (i.e. stitching) of the captured content
- Software allowing to edit the processed content (e.g. by adding subtitles)
- Content delivery networks to ensure distribution
- Various devices for display and control the experience

Each of these hardware or software rely on components, some of which being specifically designed for producing and displaying immersive AV content. In this report, **we will *not* focus on component producers** (e.g. motion sensor, CPU)[15] since ImmersiaTV partners are no component producers.

The focus is on the production and distribution of immersive content, including the hardware and software needed to produce and distribute such content, hence the following figure:

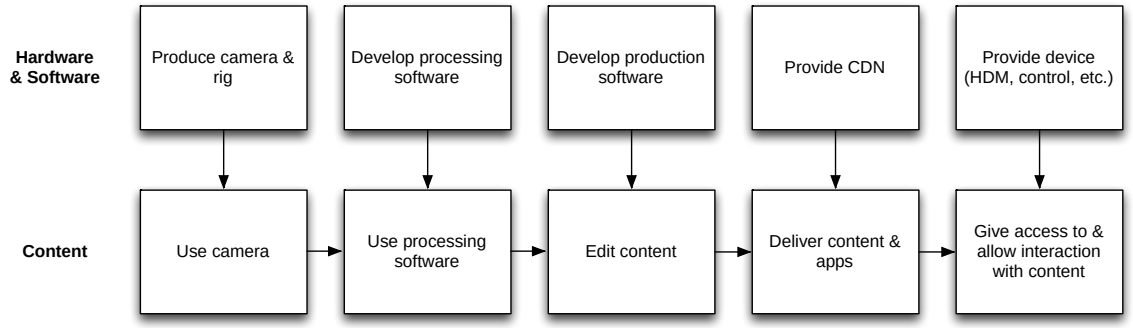

Figure 3: ImmersiaTV – Value Network

We have identified 6 main categories of stakeholders (sometimes with subcategories), in relation to their situation in the Value Chain and names for each type.

[15] It can be also softwares, e.g. the Opera TV Browser (source: http://www.operasoftware.com/products/tv/tv-browser).

3.3. ImmersiaTV's Competitors

3.3.1. Capture & Processing

At capture level, **(omnidirectional) camera producers** are producers of 360 cameras and/or rigs for multiple cameras.[16] Cameras are aimed at professional and/or amateur users. Thus, in an overview by Sjöblom of 17 such cameras, 7 are aimed at amateurs, 7 at professionals and 3 at prosumers. The split is done in accordance with their offering, by using certain parameters, for example price levels (consumer devices cost approximately from $300 to $1500), as well as the desired target segments and end uses.[17]

At pre-production level, **processing software providers** propose software solutions that notably allow to stitch audiovisual content that has been captured by omnidirectional cameras.[18] They need to ensure encoding of omnidirectional video sequences, which represent time-varying 360° environments.[19]

Both categories are presented together because of the **strong trend towards the integration of both activities**. [20] Cameras not only capture but also captured content is directly stitched (and sometimes edited although this seems to remain quite basic). For example, in 2015 GoPro, a famous camera provider, acquired **Kolor**, a provider of software products to stitch static pictures and videos.[21]

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[16] There are three basic types of omnidirectional cameras on the market (source: ImmersiaTV. Immersive Experiences around TV, an integrated toolset for the production and distribution of immersive and interactive content across devices. Part B, technical annex. Project proposal.):

- There are several relatively inexpensive single-lens 360° camera devices, which are able to produce omnidirectional video for consumer and stream it over wireless network interfaces. The quality of video coming from such compact devices is usually sufficient for mobile applications, but cameras are not able of producing high resolution or high frame rate video for more demanding users and immersive entertainment.
- Custom rigs for multiple (inexpensive) cameras. They provide high resolution and a good frame rate, in a light-weight, compact, untethered and affordable package, but they lack inter-camera synchronisation and central exposure and white balancing control. More advanced rigs are usually still custom-build rigs, with high end cinema cameras or based on machine vision cameras, high end to very low cost board level depending on budget, skills and desired image quality.
- Some companies are working on more advanced, professional omnidirectional camera systems constructed using multiple high-resolution cameras places on specialized rigs. Cameras are perfectly synchronised and sensors are consistently controlled, but often frame rate and/or resolution are not adequate.

[17] Sami Sjöblom, "Competitive Intelligence–Conducting an Analysis of a Business Environment," 2015, http://dspace.cc.tut.fi/dpub/handle/123456789/23507.

[18] These softwares might also help users to set up a 360 world or to add interactions that will enable different storytellings (e.g. concerning transitions).

[19] ImmersiaTV. Immersive Experiences around TV, an integrated toolset for the production and distribution of immersive and interactive content across devices. Part B, technical annex. Project proposal.

[20] Sjöblom, "Competitive Intelligence–Conducting an Analysis of a Business Environment."

[21] http://www.kolor.com/about-us/

Furthermore, there is an **integration towards the role of displaying**. Just like with standard cameras, it is possible to visualise what has just been captured. However not all display devices allow to capture, hence display remains a separate role (see after).

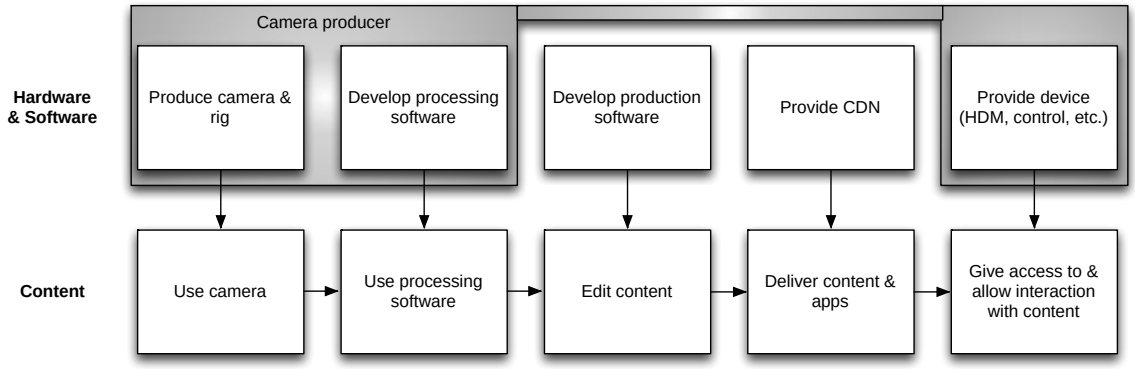


Figure 4: Camera producer – Value Network

A list of players in this sector is provided in Annex (see 6.1).

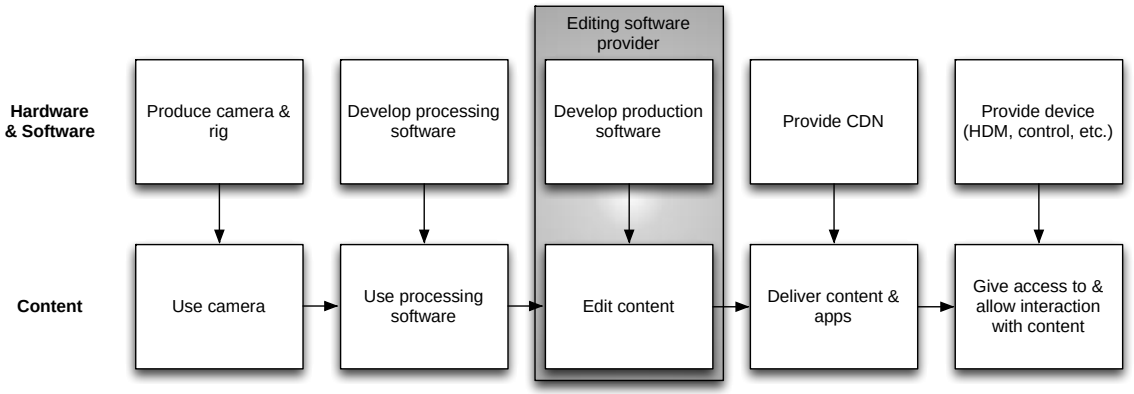
ImmersiaTV will not focus on building its own rigs, or stitching algorithms, but rather on developing a video capture, replay and processing distributed architecture that is ground up designed for omni-directional video.[22] **Therefore, the players active in providing hardware and software for capture and/or processing should not be considered as competitors. Their products are complementary to what ImmersiaTV is developing.**

However, several companies active here are also developing hardware of software in other steps of the Value Network, which makes them more likely competitors for ImmersiaTV (see also section 3.3.6. on end-to-end platforms).

Finally, the mapping (see 6.1) shows that **several important players are present in this stage including players that are strong in other stages** (e.g. HMD for Samsung or Facebook) or traditional players in the camera sector (e;g. Nikon, Kodak).

3.3.2. Production

At production level are **editing software providers for omnidirectional video**. For a list of market players, see 6.2.



[22] ImmersiaTV. Immersive Experiences around TV, an integrated toolset for the production and distribution of immersive and interactive content across devices. Part B, technical annex. Project proposal.

Figure 5: Editing software provider – Value Network

The creative editing of omnidirectional video is still a quite challenging undertaking. Off the shelf software to edit offline video, such as Adobe Premiere, or Final Cut X, offer limited support for these although plug-ins exist (e.g. Mettle Skybox, see after). It is possible to edit omnidirectional video through post-production software suites but this process remains very time-consuming, and unpractical to use.[23]

It is **crucial for ImmersiaTV** to follow the latest developments regarding edition of omnidirectional AV content, and in particular **to propose something different from what competitors are currently developing**, notably Mettle. This in a context of a particularly innovative market. In a next iteration of this report, we may check target users for production tools (e.g. professionals vs amateurs), or sound production tools.

3.3.3. Content production

At the level of content production are **producers of immersive audiovisual content**, i.e. compatible with immersive displays.

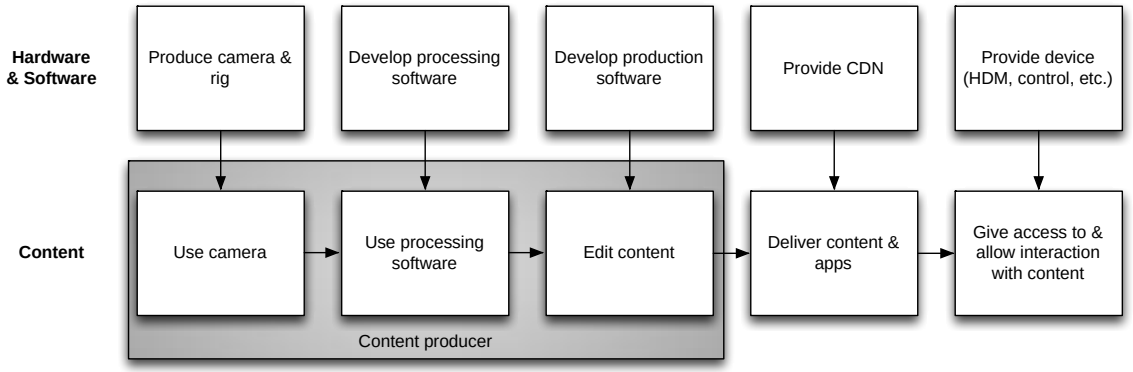


Figure 6: Content producer – Value Network

Companies active in immersive technologies are looking to provide immersive content as they know digital entertainment will certainly drive the market further. This content may span traditional film, music applications, or live sporting events.[24] **One core objective of ImmersiaTV is to demonstrate a novel kind of audiovisual content format**, compatible with immersive displays, coherent across devices, and ready for broadcast distribution. **Immersive content producers are therefore on the one hand competitors** (since they provide content that can directly compete with content produced by ImmersiaTV consortium partners) **and on the other hand supporting ImmersiaTV's objectives in contributing to the overall development of the market for immersive experiences**. This also seems to be the type of industry stakeholders with most players active (similar to other media markets). All the more so that traditional media players (notably film studios) have started developing immersive AV content.

There are different types of content.[25] Some may be more interesting for ImmersiaTV to know about. Hence the description is more detailed for, on the one hand, VR Film Studios and, on the other hand, documentaries and informative immersive content, since they are closer to the type

[23] ImmersiaTV. Immersive Experiences around TV, an integrated toolset for the production and distribution of immersive and interactive content across devices. Part B, technical annex. Project proposal.

[24] Pitchbook, "Virtual Reality. 2015 Analyst Report."

[25] We roughly follow the VR Industry 2016's typology, see https://trello.com/b/srhdQF14/virtual-reality-industry-2016

of content ImmersiaTV aims at developing (by directly producing content and by providing tools thereto). Animation and audio creatives are also overviewed (see list in 6.3). The focus here is on on-demand content. Live events, which suppose integration of all activities from capture to production or even distribution, are analysed in the section on end-to-end platforms (see 3.3.6).

All following statements concern VR films, documentaries and immersive informative content:

- **Most content producers are based in the USA,** or have an office there. We have however identified a number of European content producers (see also 3.4).
- **All content producers rely on Business-to-Business activity.** This means they do not have revenues directly from consumers but get their works commissioned, e.g. by brands (notably for communication agencies), or media (notably for producers of immersive informative content). This is likely to change when a sufficient amount of consumers get access to HMD (see also 3.4).[26]
- Immersive content producers are usually linked to bigger entities, e.g. Oculus Story Studio to Facebook or Google Spotlight Stories to Google. In particular producers of documentaries and informative immersive content are related to traditional or online media.

3.3.4. Distribution

Distributors are providers of solutions allowing to deliver and receive immersive audiovisual content. Although stakeholders can provide both services, this section focuses on their ability to deliver content to end-users.[27] More precisely it focuses on providers of platforms giving access to immersive content for Internet users.

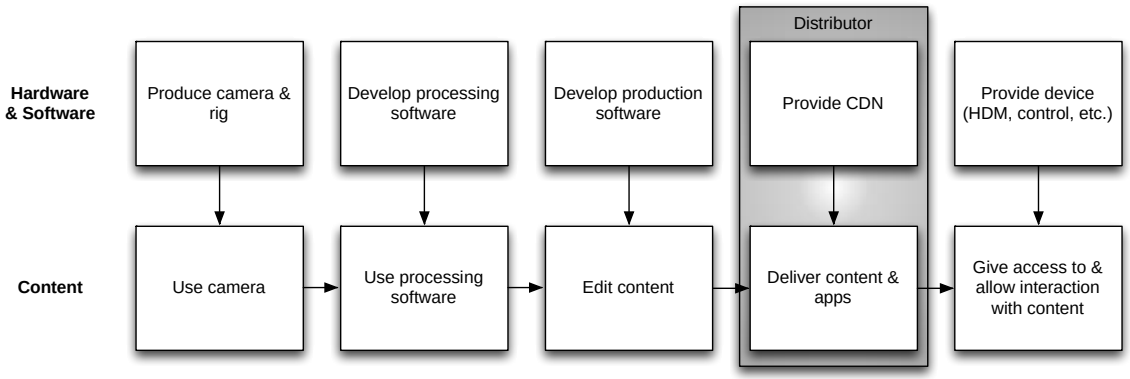


Figure 7: Distributor – Value Network

Some platforms are app stores, others give access to video (see full list in 6.4). As noted by Nelson, virtual reality is going to be the first consumer medium whose **distribution platform is**

[26] Business will continue to drive VR content creation for foreseable future as Consumer adoption dependent on wide spread availability and quality of content created in 360. In early 20th century for example the audio was integrated into silent movies, the demand for better audio from consumers then drove technology companies, movie producers and theatre owners to deliver more movies with better audio.

[27] Hence this section does not describe Content Delivery Network (CDN) providers (e.g. Microsoft Azure CDN, Amazon CloudFront, Google Cloud CDN) Although CDNs are crucial to ensure the delivery of very large files, like VR files CDN providers are not specialised in VR or interactive video. Furthermore, business models are quite different, with CDN providers relying on B2B activities while platforms address end-users.

native to the internet.[28] He believes the long term smart money is on whoever can establish strong content distribution platforms for VR. [29]

Regarding the success of more generalist platforms (e.g. YouTube), it is not expected to have a direct impact on companies relying on business-to-business activity. Actually the latter will prefer to control access through a player embedded on their portal through their own private CDN network.

It is only now that the confluence of affordable hardware for immersive display, improvements in IP-based video distribution and in omnidirectional video capture enable the live delivery of video-based omnidirectional content. **ImmersiaTV benefits from the latest developments in the field of distribution.**

A question relates to how ImmersiaTV should approach both types of platforms**. Their evolutions should be scrutinized to check whether tools and content developed within the project could be made available, and how.** In the longer term, an issue is how to use these platforms to generate revenues from ImmersiaTV's contents and products.

3.3.5. Display

Display devices providers are providers of hardware (and related software) allowing to experience (watch, interact, etc.) immersive audiovisual content. They can be integrated, or working with other devices.

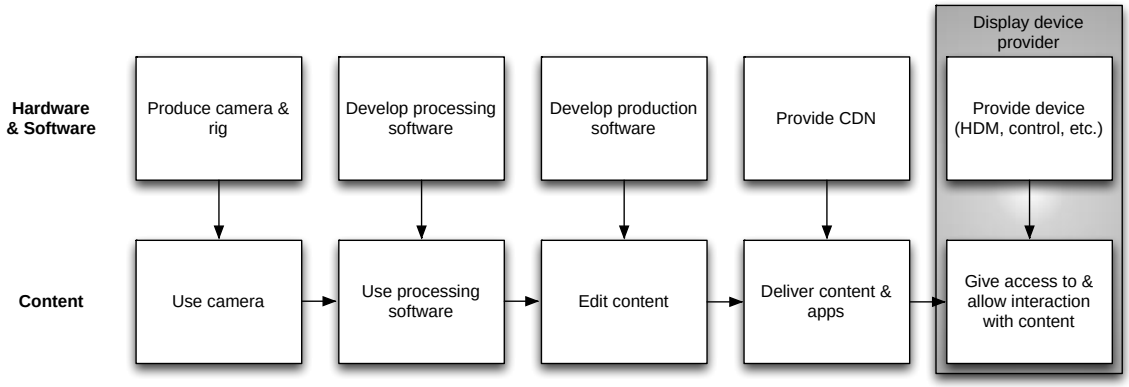


Figure 8: Display device provider – Value Network

Devices allowing to display immersive content constitute the part of the industry most well-known from consumers. They include the most important and **most powerful** companies in this whole industry (Microsoft, Google, Facebook, etc.), which have invested heavily in these technologies. As main points of entry to consumers, they are also expected to pull the whole market for immersive experiences. In other words, **their success is key to have the whole market for immersive experiences succeed.** A key question is therefore: **what is the impact of not having them in the consortium?**

[28] Noah J. Nelson, "Virtual Reality's Distribution Frontier Is Heating Up," *Huffington Post*, February 9, 2016, http://www.huffingtonpost.com/turnstyle/virtual-realitys-distribu_b_11837214.html.
[29] Ibid.

The VR Hardware Radar plots companies developing a range of different hardware peripherals and equipment into one of the following categories:[30] HMD – Integrated, HMD – With Mobile Device, Controller – Hand Device / Glove / Body Unit, Controller – Treadmill / Foot Control, Controller – Haptics, 3D Camera, End-to-End Platform. For the purpose of this deliverable, the Controllers categories were grouped; 3D Cameras were analysed in a previous subsection, while end-to-end platforms are analysed in the next subsection.

- **HMD – Integrated** are displays with the screen integrated into the unit.[31] Therefore they do not require the connection of a mobile device as the screen. However, they may require the connection to hardware, e.g. Sony PSVR requires connection to a PlayStation 4.
- **HMD – with mobile device** are displays that use a third-party mobile device as the screen[32] (e.g. a mobile phone placed inserted in the HMD, thus in front of the eyes of the user).
- **Controllers** are input devices using hands and/or leg and/or foot and/or body movements. Tracking is done using sensors. They can also provide tactile feedback by force or vibration.[33] They enable users to input control, in order to navigate within the immersive experience – although it can partly be done by moving the head in the case of HMD. They are complementary to HMD. Such devices include hand devices, gloves, body units, treadmills, foot control, haptics, etc.
- Second screen software solutions

For the full list of market players, see 6.5.

There are no display device providers within ImmersiaTV. This is not an issue since the innovations (products and content) developed within ImmersiaTV should be **watchable on any device**. The objective is **to avoid lock-in**. There may be **potential additional costs** related to **compatibility**, which will be discussed in the next iteration of D5.2.

3.3.6. End-to-end platforms

End-to-end platforms are providers of immersive experiences and/or of solutions allowing to produce, distribute and sometimes display immersive audiovisual content.[34] This includes platforms giving access to **live events** since this implies an integration of activities from capture to production or distribution. For the full list, see 6.6.

[30] http://www.kzero.co.uk/blog/q2-2015-update-of-the-vr-hardware-radar/
[31] http://www.kzero.co.uk/blog/q2-2015-update-of-the-vr-hardware-radar/
[32] http://www.kzero.co.uk/blog/q2-2015-update-of-the-vr-hardware-radar/
[33] http://www.kzero.co.uk/blog/q2-2015-update-of-the-vr-hardware-radar/
[34] This definition is slightly more restrictive than the VR hardware radar's, i.e. a company that provides HMD systems coupled with input devices and motion capture. This category brings together companies that are creating VR experiences encompassing HMDs, input devices, games and other elements. Survios and VRCade are two examples. (http://www.kzero.co.uk/blog/q2-2015-update-of-the-vr-hardware-radar/).

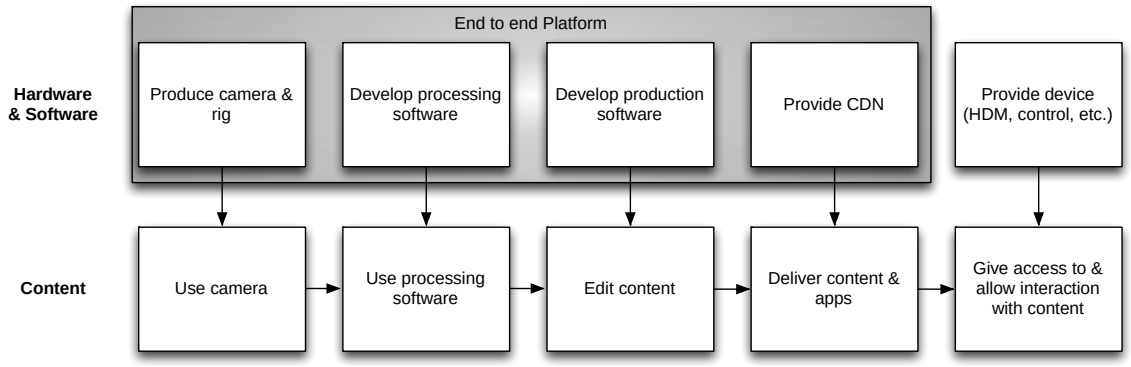


Figure 9: End-to-end platform – Value Network

The end-to-end platforms that are active in the live production and distribution of live events appear as **ImmersiaTV's most direct competitors**, especially if one considers that the most important innovation for the project derives from the integration of its various components. The first iteration of this report identified a need to **follow up how the identified platforms evolve** (activities, market presence, targets, etc.) and **map other similar market players**. This is done in the next section with the in-depth analysis of three companies: Jaunt, NextVR and Immersive Media.

3.4. ImmersiaTV's competitors: a closer look

3.4.1. Jaunt

3.4.1.1. General description

Founded in 2013 and based in Palo Alto (US), Jaunt is a VR company focused on **cinematic virtual reality**. It is one of the most prolific of 360 degree, cinematic VR content providers over the last couple of years, with a dozen or so experiences[35] (in June 2015). In February 2016: Jaunt was included on American business magazine *Fast Company's* list of *The World's 50 Most Innovative Companies 2016*. Jaunt was recognized "for becoming the first VR media company".

Its investors include British Sky Broadcasting Group (one of Jaunt's initial investors in December 2013), Disney, ProSiebenSat.1 and Participant Media.[36] Google have been a support of Jaunt's for some time, with it's 'Ventures' arm having led a funding round in 2014 to the tune of $27.8M.[37] This brings Jaunt's total funding to over $100 million (in Sept 2015).[38]

3.4.1.2. Value Network

Jaunt has created **an end-to-end solution**[39] to record, edit, produce, and deliver stereoscopic virtual reality experiences for various content – including narrative storytelling, music,

[35] http://www.roadtovr.com/jaunt-and-google-announce-high-end-cinematic-content-collaboration/
[36] Stewart Clarke, "Will VR Rock in 2016 - TBI Vision TBI Vision.pdf," *TBI Vision*, March 1, 2016, http://www.tbivision.com/highlight/2016/03/will-vr-rock-2016/555472/..
[37] http://www.roadtovr.com/jaunt-and-google-announce-high-end-cinematic-content-collaboration/
[38] http://venturebeat.com/2015/09/28/jaunts-ceo-on-its-65m-funding-and-the-humanity-advancing-mainstream-future-of-virtual-reality/
[39] Pitchbook, "Virtual Reality. 2015 Analyst Report."

travel/adventure, or sports. [40] They have developed an integrated pipeline of hardware and software tools.[41] Its suite of products includes the one-of-a-kind 360-degree Jaunt ONE camera, processing and production software, and a distribution system. But Jaunt is also in the business of VR content.[42]

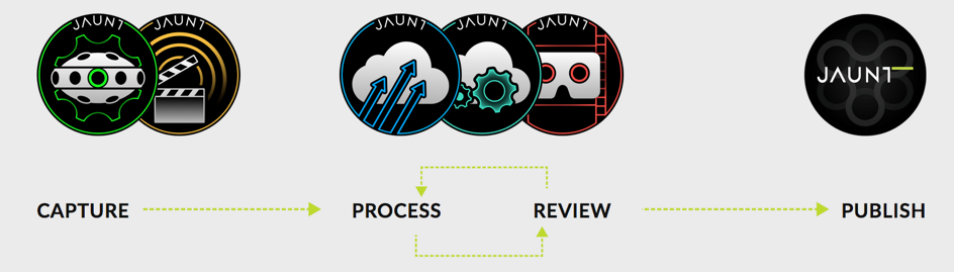


Figure 10: Jaunt's end-to-end solution (source: [43])

Jaunt has its own 360-degree cameras.[44] In 2015, Jaunt released Jaunt ONE (J1-24G), the first professional-grade camera system specifically designed for capturing high-quality 360º, stereoscopic, cinematic VR experiences, which features 24 camera modules.[45]

Jaunt also has its proprietary computational photography algorithms to transform the recorded video data.[46] Files from the ONE are downloaded and organized on a laptop and then uploaded to Jaunt's cloud server for processing and stitching.[47]

Jaunt offers a full suite of post-production tools including editing, colour correction and compositing. Their video format is compatible with industry-standard software.[48]

Jaunt also serves as a one-stop shop that can handle the distribution side, putting out its projects through Oculus, iOS, and Android apps.[49] Jaunt Media Manager deals with data wrangling. It allows to Import video and audio, see slate info, organize into recordings, generate previews, and upload recordings to Jaunt Cloud,[50] its secure cloud-based rendering and asset management.[51] Jaunt already sees half of its traffic coming from outside the United States.[52]

[40] http://venturebeat.com/2015/09/28/jaunts-ceo-on-its-65m-funding-and-the-humanity-advancing-mainstream-future-of-virtual-reality/
[41] https://www.jauntvr.com/jaunt-one/
[42] https://www.fastcompany.com/company/jaunt
[43] https://www.jauntvr.com/jaunt-one/
[44] HOW WILL ZUCKERBERG RULE THE WORLD? BY GIVING FACEBOOK'S TECH AWAY Bryan Bishop, "VR Company Jaunt Is Starting a Virtual Reality Movie Studio - The Verge.pdf," *The Verge*, April 28, 2015, http://www.theverge.com/2015/4/28/8507091/jaunt-studios-interview-virtual-reality-movies-360-degree-camera.
[45] https://www.jauntvr.com/jaunt-one/
[46] https://www.jauntvr.com/technology/
[47] http://www.pdnonline.com/gear/cameras/video/inside-the-jaunt-one-why-a-vr-content-company-had-to-build-the-worlds-best-vr-camera/
[48] https://www.jauntvr.com/technology/
[49] Bishop, "VR Company Jaunt Is Starting a Virtual Reality Movie Studio - The Verge.pdf."
[50] https://www.jauntvr.com/jaunt-one/
[51] https://www.jauntvr.com/jaunt-one/
[52] Nelson, "Virtual Reality's Distribution Frontier Is Heating Up."

Videos can be accessed via Jaunt Player, Jaunt's VR video player.[53] Finally, the Jaunt app allows worldwide distribution for Cinematic VR experiences across all platforms and headsets.[54] Jaunt and within both have the two most reliable and easy to navigate VR video apps currently available for the iPhone, according to Nelson.[55] For example, CBS' behind-the-scenes report about an unmanned mission to Mars, has been added to the Jaunt app.[56]

Since August 2016, Jaunt gives access to 300 videos created by third parties through Jaunt Publishing, a program that allows the growing community of professional VR creators to publish their high quality VR content directly to the Jaunt VR app.[57] Through an online portal on the company's website, Jaunt Publishing enables creators to submit their work for consideration and publishing across the Jaunt platform. Once content is approved by an internal review board, creators will have access to Jaunt Cloud, and the publishing tools within including transcoding, "deep-links," support for premium spatial audio formats like Dolby Atmos, and processing and preparation for distribution on all VR platforms. [58]

In 2015, Jaunt launched Jaunt Studios, a division **to create original VR content**.[59] As Jaunt CEO stated in an interview: "We spent the past two years focusing entirely on building out the technology necessary to do content creation in VR (…) and the final missing piece of the puzzle is the content piece."[60] Jaunt aimed to create as many as 1,000 pieces of content in the next 18 months, including scripted entertainment as well as sports, concerts and other live-event programming.[61]

Significant collaborations to produce content include:

- ABC News and Jaunt released 6 short videos in 2015, which are **accessible for free**. The first one, an immersive experience in Damascus, Syria, was launched in conjunction of the release of ABC News VR in September 2015. President of ABC News, James Goldston, wrote, "The collaboration (…) takes our storytelling to a new frontier. And I can't wait to see how you use this new technology to engage our audience in thrilling new ways." As a reminder, ABC News belongs to Disney, one of Jaunt's investors. More partnerships between Jaunt and Disney are in the works.[62]
- Paul McCartney, first with the recording of his live performance of *Live and Let Die* at a concert in August 2014 at Candlestick Park in San Francisco. Jaunt released the recording

[53] https://www.jauntvr.com/jaunt-one/
[54] https://www.jauntvr.com/jaunt-one/
[55] Nelson, "Virtual Reality's Distribution Frontier Is Heating Up."
[56] Clarke, "Will VR Rock in 2016 - TBI Vision TBI Vision.pdf."
[57] https://www.jauntvr.com/press-releases/jaunt-publishing/
[58] https://www.jauntvr.com/press-releases/jaunt-publishing/
[59] Steven Zeitchik, "VR Watch: Jaunt Forms Studio, Hiring Lucasfilm Veterans to Run It," *LA Times*, April 28, 2015, http://venturebeat.com/2015/09/28/jaunts-ceo-on-its-65m-funding-and-the-humanity-advancing-mainstream-future-of-virtual-reality/. Clarke, "Will VR Rock in 2016 - TBI Vision TBI Vision.pdf."
[60] Bishop, "VR Company Jaunt Is Starting a Virtual Reality Movie Studio - The Verge.pdf."
[61] Zeitchik, "VR Watch: Jaunt Forms Studio, Hiring Lucasfilm Veterans to Run It."
[62] https://www.bloomberg.com/news/articles/2016-10-13/for-a-clue-to-disney-s-view-of-future-look-at-startups-it-aids

as an app on Google Playin. In 2016, McCartney let Jaunt VR's cameras into his British home-studio for a mini-documentary about his latest album.[63]

- The North Face with treks by two athletes/employees through Yosemite National Park and in Moab, UT that were recorded with VR technology and produced into VR content (titled *The North Face: Climb*) that was made available in select North Face stores in Chicago in March 2015 and later in other stores. This was followed by *The North Face: Nepal*. *Outside* magazine also partnered in the campaign.
- Jaunt has forged a partnership with Condé Nast Entertainment (CNE) to create several VR series that "explore Condé Nast's strong portfolio of travel, lifestyle, fashion, sports, and technology content." [64]
- In November 2015, Jaunt Studios and Sundance announced that they were launching a six-month residency program which would be part of the existing New Frontier program associated with the Sundance Film Festival.

In sum, Jaunt is **strongly vertically integrated**, as it provides an end-to-end solution to produce and distribute 360 video content (except for devices allowing to access and watch content). Furthermore, it is getting **more and more integrated** since it now produces content itself. In parallel, Jaunt has opened its distribution platform to third parties creators. In addition, it has a **direct customer ownership**, with customers being the professional customers, for whom Jaunt produces content (e.g. media, brands, etc.). Ownership is indirect in the cases when Jaunt is renting its cameras (see after).

3.4.1.3. Functional Architecture

As the company claims and several sources confirm, **interoperability is a key objective** for Jaunt. They aim at delivering content to the wide array of mobile devices and VR hardware in the industry.[65] Also Jaunt Cloud works not only with their own cameras but with the Nokia Ozo too.[66]

The main reason, Jaunt claims (notably when promoting Jaunt Publishing), is that multichannel distribution can be seen as a sometimes paralyzing challenge for creators in the nascent VR industry.[67] Creations need to be available as broadly as possible.

3.4.1.4. Financial Model

Jaunt's **revenue model is mainly indirect**. Therefore, partnerships are crucial – as exemplified previously. They are also the early sources of funding for content.[68] End-users are important because they are targets for the entity commissioning (for example for advertising), but they never provide direct revenue.

[63] http://www.usatoday.com/story/tech/news/2016/09/28/live-nation-wants-you-hit-next-big-concert-vr/91225372/
[64] Zeitchik, "VR Watch: Jaunt Forms Studio, Hiring Lucasfilm Veterans to Run It."
[65] Pitchbook, "Virtual Reality. 2015 Analyst Report." http://www.roadtovr.com/jaunt-and-google-announce-high-end-cinematic-content-collaboration/ Zeitchik, "VR Watch: Jaunt Forms Studio, Hiring Lucasfilm Veterans to Run It."
[66] Nelson, "Virtual Reality's Distribution Frontier Is Heating Up."
[67] https://www.jauntvr.com/press-releases/jaunt-publishing/
[68] Clarke, "Will VR Rock in 2016 - TBI Vision TBI Vision.pdf."

It is worth noting though that Jaunt is still testing with ways to earn money – and it is no secret. Thus, initially Jaunt was not targeting to generate sales through device sales or rentals.[69] However the Jaunt ONE camera is currently available for rent via Radiant Images in Los Angeles, CA or AbelCine in New York City, NY.[70] Still, Jaunt does not see itself as a camera company at all but a content company. [71]

Furthermore, Jaunt plans to test whether people will pay US$3 to US$9 to download an episode or series." [72]

3.4.1.5. Value Proposition

Jaunt is distinctively emerging into the cinematic industry,[73] with its unique offer. It could however be that it will replace existing, traditional experience. Its positioning is therefore as a **substitute**.

Jaunt proposes a **high involvement of professional users**. It is the cases for partners, e.g. that finance the content produced by Jaunt. This is also the case towards creators, in particular Jaunt Publishing is a form of user-generated content platform aimed at professional creators of 360 video content. Involvement of end-users is in contrast quite low.

3.4.2. NextVR

3.4.2.1. General description

Founded in 2009 and based in Laguna Beach, CA,[74] NextVR aims to enable the transmission of live, long-form virtual reality content in broadcast quality, for sporting events, concerts, cinematic productions, etc. Its focus is on **live streaming of VR videos of live events**.

Its investors include Time Warner, Comcast[75] and the Chinese investment group CITIC Guoan.[76] It is currently valued at $800 million.[77]

3.4.2.2. Value Network

NextVR has an **end-to-end solution**, including cameras and encoders, platforms for distribution, as well as playbacks.[78]

[69] Sjöblom, "Competitive Intelligence–Conducting an Analysis of a Business Environment." http://www.pdnonline.com/gear/cameras/video/inside-the-jaunt-one-why-a-vr-content-company-had-to-build-the-worlds-best-vr-camera/
[70] https://www.jauntvr.com/jaunt-one/
[71] http://www.pdnonline.com/gear/cameras/video/inside-the-jaunt-one-why-a-vr-content-company-had-to-build-the-worlds-best-vr-camera/
[72] Clarke, "Will VR Rock in 2016 - TBI Vision TBI Vision.pdf."
[73] Sjöblom, "Competitive Intelligence–Conducting an Analysis of a Business Environment."
[74] http://mashable.com/2016/04/20/virtual-reality-production-truck-nab-show/#H4eggTA8RGqT
[75] Clarke, "Will VR Rock in 2016 - TBI Vision TBI Vision.pdf."
[76] http://variety.com/2016/biz/asia/citic-guoan-invests-in-nextvr-1201808459/
[77] http://uploadvr.com/fox-sports-new-vr-app-offers-live-sports-broadcasting-livelikes-help/
[78] Sjöblom, "Competitive Intelligence–Conducting an Analysis of a Business Environment."

NextVR has its own stereoscopic 360-degree VR Cam. It is assessed as expensive with $180,000 Worth of RED 6K Cameras. Combined with lenses, the system would well exceed $200,000.[79]

In terms of production, besides its softwares, it is worth mentioning that NextVR owns a virtual reality production truck, to "allow for rapid deployment at an arena or stadium for the increasing demand for live virtual reality content." [80] It is designed to "plug and play," meaning it can pull up to any given venue and deliver a multi-camera, live stereoscopic VR experience complete with fully mixed 3D VR audio.[81]

Regarding distribution NextVR says they can stream the content over an average home internet connection using their proprietary streaming solution.[82] It also proposes the NextVR app, inside which there is a range of regularly scheduled content, including dedicated partners like FOX Sports and Live Nation.[83]

Finally, NextVR is producing content, in particular live content (sport, concerts). Examples are given in the section on the Financial Model. In May 2016, NextVR was live-streaming about one sporting event a week. What they want to do next is to “build a gravitational pull” of content that people return to time and time again to see what’s happening next — like they would with any other channel.[84]

In sum, NextVR’s Value Network is **vertically integrated, with the exception of display**. There is no indication however towards further vertical integration.
Customer ownership is direct with customers being professional customers, and including broadcasters, event organizers or advertisers (see after).

3.4.2.3. Functional Architecture

NextVR’s service does **not** show **much interoperability**. The NextVR App can be downloaded on the Oculus Store.[85] It requires a Samsung Gear VR headset, which is powered by Oculus, and a Samsung mobile phone.[86] However NextVR mentions interoperability as an aim to expand their offerings to other hardwares.[87]

3.4.2.4. Financial Model

NextVR’s revenue model is fully indirect. NextVR only uses its technology to profit by live streaming live events. Thus, the company is not selling the camera system, - they are rather

[79] http://www.roadtovr.com/nextvr-stereoscopic-360-degree-vr-cam-uses-180000-worth-of-red-6k-cameras/
[80] http://mashable.com/2016/04/20/virtual-reality-production-truck-nab-show/#H4eggTA8RGqT
[81] http://mashable.com/2016/04/20/virtual-reality-production-truck-nab-show/#H4eggTA8RGqT
[82] http://www.roadtovr.com/nextvr-stereoscopic-360-degree-vr-cam-uses-180000-worth-of-red-6k-cameras/
[83] http://www.nextvr.com/getvr
[84] https://www.inverse.com/article/15410-nextvr-founder-the-hardware-is-here-we-re-working-to-bring-the-flood-of-content
[85] https://www.oculus.com/experiences/gear-vr/
[86] http://www.nextvr.com/getvr
[87] http://www.nextvr.com/getvr, Pitchbook, “Virtual Reality. 2015 Analyst Report.”

using it to produce content.[88] The broadcasting of 360 videos of live events is sold as a service, but not to the audience. Until now, NextVR has not charged for their app, experiences, and live streams.[89]

For these reasons, **partnerships are crucial.** NextVR's current and former partners include FOX Sports, Live Nation, NBC Sports, HBO/Golden Boy, Turner Sports, and CNN:[90]

- In September 2016, NextVR together with concert promotors Live Nation and banking giant Citi the trio announced a plan to live stream **10 as-yet-unnamed concerts**, an outgrowth of a five-year VR partnership forged previous spring.[91] The concert will be accessible **via the Live Nation Channel on the NextVR app**, which is compatible with Samsung GearVR and Oculus Rift headsets.[92] The concert series is **part of the "Backstage with Citi" program**, which grants credit card members behind the scenes access with their special tickets. [93]

- NextVR has started **a five-year partnership with Fox Sports** in the first quarter of 2015. The companies had already paired on VR at last year's U.S. Open from Chambers Bay Golf Course in Washington and last month's Daytona 500.[94] This includes events such as:
  - Big East Men's Basketball Tournament. The event featured the largest deployment of cameras (five) at a VR event and improved on a truly immersive experience that included Full HD and advanced audio enhancements.[95]
  - The German Bundesliga. The opening match of the 2016/2017 Bundesliga season in live virtual reality was the first time the Bundesliga broadcasted live to a worldwide audience in virtual reality.[96]

  On Fox's side, this partnership allows them to test live VR programming across several sports, to see if the technology does catch on and thus to start to figure out how VR might work best.[97] Fox Sports has a **Fox Sports VR** app, with a subscription, to which users need to log in with their cable account information in order to access any of Fox Sports VR content.[98] Furthermore, Fox Sports also sometimes itself earns money through sponsoring. Thus, Lexus is sponsoring Fox's U.S. Open offerings[99].

[88] http://www.roadtovr.com/nextvr-stereoscopic-360-degree-vr-cam-uses-180000-worth-of-red-6k-cameras/
[89] http://www.nextvr.com/support/how-much-does-nextvr-cost
[90] http://www.nextvr.com/about
[91] http://www.usatoday.com/story/tech/news/2016/09/28/live-nation-wants-you-hit-next-big-concert-vr/91225372/
[92] http://www.usatoday.com/story/tech/news/2016/09/28/live-nation-wants-you-hit-next-big-concert-vr/91225372/
[93] http://www.usatoday.com/story/tech/news/2016/09/28/live-nation-wants-you-hit-next-big-concert-vr/91225372/
[94] http://www.sportsvideo.org/2016/03/15/nextvr-fox-sports-bring-vr-to-big-east-mens-basketball-tournament/
[95] http://www.sportsvideo.org/2016/03/15/nextvr-fox-sports-bring-vr-to-big-east-mens-basketball-tournament/
[96] http://www.nextvr.com/bundesliga
[97] Ibid.
[98] http://uploadvr.com/fox-sports-new-vr-app-offers-live-sports-broadcasting-livelikes-help/
[99] Ibid.

There is **no exclusivity in this partnership**. LiveLike VR can be mentioned as another company that has partnerships with Fox to provide VR sport.[100] The difference lies, according to a representative of LiveLike VR, in the fact that "broadcasters find value in being able to share content under their own umbrella. NextVR only publishes content in their own app. This is why we created Fox Sports VR, and not LiveLike VR."[101]

- **NBA** Champion Golden State Warriors's world championship ring pre-game ceremony and home opener against the New Orleans Pelicans became the first public 360-degree livestreamed sports event on Oct. 27 2015.[102] There is now **one game every week** available in virtual reality **to NBA LEAGUE PASS subscribers**. Thus, on one hand, this service increases the value of this pass. On the other hand, this allows the NBE to reach their global audience. There are viewers from over 215 countries around the world. Everyone wants to go to a game, but for logistical reasons most viewers cannot attend a game inside an arena.[103]
- University of Notre Dame **football** on NBC.[104] NextVR will release several highlight packages throughout the game in virtual reality.[105] In addition, NextVR will offer **exclusive content** with behind-the-scenes virtual reality game day experiences. [106]

3.4.2.5. Value Proposition

NextVR positions itself as the leader in broadcasting live events in virtual reality.[107] This makes the company **complementary to the event and to the traditional broadcasting of the event**. This also explains why it is always closely working with event organisers and broadcasters.

This close cooperation corresponds to a **high user involvement** to ensure the correct functioning of the live streaming of the event. On the other hand, consumers are not much involved.

3.4.3. Immersive Media

3.4.3.1. General description

Based in Kelowna (Canada) and founded in 1994, Immersive Media is **a historical player in the Virtual Reality sector** with the production in 1995 of the world's first full motion, fully immersive video movie.[108] Roughly a decade later, the organization launched its first 360° camera, the Dodeca. The first big undertaking to put it to use was the Geoimmersive City Collection project.[109]

Following this, they claim to be at the origin of the first iteration of Google Streetview, touting 35 cities and amassing 75 million views in less than a week.[110] Google subsequently cancelled its agreement with IMC and chose to build its own cameras for its on-going investment in

[100] http://uploadvr.com/fox-sports-new-vr-app-offers-live-sports-broadcasting-livelikes-help/
[101] http://uploadvr.com/fox-sports-new-vr-app-offers-live-sports-broadcasting-livelikes-help/
[102] http://fortune.com/2015/10/27/turner-nba-nextvr/
[103] http://fortune.com/2015/10/27/turner-nba-nextvr/
[104] http://www.nextvr.com/notre-dame-football
[105] http://www.nextvr.com/notre-dame-football
[106] http://www.nextvr.com/notre-dame-football
[107] https://www.oculus.com/experiences/gear-vr/858258597574484/
[108] (McGovern & Poss, 2016)
[109] (McGovern & Poss, 2016)
[110] (McGovern & Poss, 2016)

immersive geo-media. Afterwards, Immersive Media supported the US Army by collecting element of over 15,000 miles in Iraq and 5,000 miles of roadways in Afghanistan for real-time missions and post-operation analyses.[111]

Since 2010, Immersive Media's focus has shifted to media and entertainment providing radical technological approaches to traditional mediums. This includes live events broadcast, real time, in 360° to computers and mobile devices.[112]

In 2014 Immersive entered into a joint venture with Digital Domain, one of the main visual effects studios in the world. This led to the creation of IM360, a provider of VR content solutions.[113] The aim was to leverage the firms' complementary technology portfolios for the fast-rising virtual reality (VR) market.[114] In 2015, Digital Domain Holdings Ltd purchased Immersive Media.[115]

3.4.3.2. Value Network

Immersive Media provides an end-to-end solution, including cameras and encoders, platforms for distribution, as well as playbacks,[116] with their own software to process, store and deliver the content.[117] This notably applies to experiences live, in real-time – from and to, anywhere in the world,[118] relying on Immersive Media's imLive System to simultaneously stitch, encode and stream live 360 video capture, while also recording direct to disk.[119]

Immersive Media has proprietary HD 360 cameras and capturing systems.[120] For production, the IM360 VR Toolkit (VRT) **provides directors** the capabilities for shooting, capturing and directing virtual reality content. The VRT uses Immersive Media's imLive System to integrate the Director into a virtual video village for real-time monitoring/directing of VR shoots.[121]

IM360's proprietary server platform encompasses a network of web services and client applications providing interactive media management solutions for immersive content.[122]

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[111] (McGovern & Poss, 2016). Immersive Media technologies also aided Somerset County Police Office on a number of fronts. 360° interactive videos of county facilities and infrastructure improved preventative security, emergency preparedness and tactical planning. (McGovern & Poss, 2016)
[112] (McGovern & Poss, 2016). Immersive Media technologies also aided Somerset County Police Office on a number of fronts. 360° interactive videos of county facilities and infrastructure improved preventative security, emergency preparedness and tactical planning. (McGovern & Poss, 2016)
[113] http://www.im360.info/
[114] (McGovern & Poss, 2016). Immersive Media technologies also aided Somerset County Police Office on a number of fronts. 360° interactive videos of county facilities and infrastructure improved preventative security, emergency preparedness and tactical planning. (McGovern & Poss, 2016)
[115] http://www.im360.info/
[116] (Sjöblom, 2015), http://immersivemedia.com/technology/
[117] (Sjöblom, 2015), http://immersivemedia.com/software/
[118] http://www.im360.info/services.html
[119] http://www.im360.info/technology.html
[120] http://www.im360.info/services.html
[121] http://www.im360.info/technology.html
[122] http://www.im360.info/services.html

Through their branch IM360, Immersive Media has an app development division solely dedicated to the creation, design, development and integration of VR-based apps for all popular devices & OS.[123]

Around 2014, Immersive Media **increased the focus on content production by creating IM360** in a joint-venture with Digital Domains. Already since 2004, more than 500 immersive experiences had been conceived, designed, produced and distributed by Immersive Media.[124] Thus, IM360 claims to have produced the first-ever live boxing match in January 2016 that featured David Haye's thrilling comeback victory after a three-year hiatus from the sport. They have also partnered with the PGA Tour to create a series of VR experiences for Samsung Gear VR and the Oculus Store.[125]

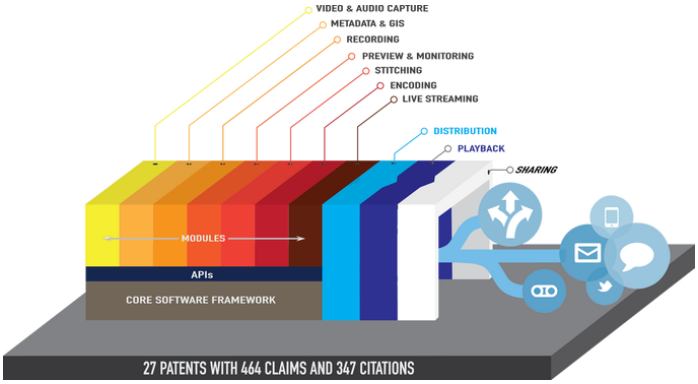

Figure 11: Immersive Media's technology portfolio [126]

In sum, Immersive Media is **vertically integrated** (excluding display). It is getting **more and more integrated** since it is getting more involved in VR content production.

For customer ownership, this is less clear. It is **direct when VR experiences are commissioned**. However Immersive Media allows more for their tools to be used by third parties (e.g. directors) with whom there are less direct contacts.

3.4.3.3. Functional Architecture

Immersive Media aims at **interoperability**. Their objective is universal playback:[127] being able to seamlessly playback 360 video experiences across all major platforms such as desktop, mobile and VR devices. The platform also makes it easy for viewers to share their favourite immersive experiences directly on to Facebook, Twitter, Pinterest, Google+ or other social networks.[128]

3.4.3.4. Financial Model

Immersive Media **combines direct and indirect revenue models**. The indirect revenue model relies on the **partnerships** the company has developed over the years.

[123] http://www.im360.info/services.html
[124] http://www.im360.info/experiences.html
[125] http://www.slashgear.com/pga-tour-golf-vr-made-real-with-im360-11426550/
[126] http://immersivemedia.com/technology/
[127] http://www.im360.info/services.html
[128] http://immersivemedia.com/software/

An interesting example is the development of a 360 Video App for Taylor Swift's *Blank Space* in 2014. The app allows to watch, and interact with, the video. In terms of interaction for example the user can wander in different rooms rather than follow the singer, they can also find collectibles in the various rooms. The app relies on a partnership between Immersive Media, Taylor Swift's label and the bank American Express. Actually, the app is entitled *American Express Unstaged: Taylor Swift Experience*. While one does not need to have an American Express account to experience the interactive music video, it was however required for access to exclusive ticket and event offers.[129] From a creative point of view, Immersive Media worked with Radical Media and Grammy Award winner film & music video director Joseph Kahn.[130] Immersive Media captured its first Emmy win for the production of Taylor Swift's "Blank Space" app and music video.[131]

In addition, though, Immersive Media has direct revenues through the offering of its products.[132] In particular it sells its cameras, the targets being professional users.[133] It is also possible to purchase the im360 (iOS) SDK to create fully customizable 360° experience. ***134***

3.4.3.5. Value Proposition

Immersive Media insists on their technological uniqueness, e.g. "For more than *twenty years*, we've been the *experts* at designing & building *360°* technology and experiences."[135] They claim to own the most patents and intellectual properties in the industry covering 360 video and virtual reality.[136]

It can be considered mainly as **complementary** as it is working in partnerships with other stakeholders, such as brands or event organizers. It creates interactive experiences for them. It's already got to work powering the NYT VR platform. It also put SyFy's Expanse app on Android and iOS. Immersive Media includes the ability to render videos, but also apps and content management.[137]

User involvement is high as far as it concerns partnerships with professional users, e.g. sports event organisers or in the case of the American Express unstaged: the Taylor Swift Experience case. However, and in contrast to the two other cases, it is lower for activities where Immersive Media is selling pieces of software or hardware.

3.4.4. Comparison & Findings

The following table summarises the main business model features of our three cases. The three companies are to a large extent comparable – and this also presided over their choice as point of comparison for ImmersiaTV. First, **they are all vertically integrated**, from capture to the

[129] https://www.americanexpress.com/us/content/unstaged-app/faqs.html
[130] https://virtualrealityreporter.com/360-degree-music-video-taylor-swift-blank-space/
[131] (McGovern & Poss, 2016)
[132] (Sjöblom, 2015)
[133] (Sjöblom, 2015)
[134] http://immersivemedia.com/software/
[135] http://immersivemedia.com/hardware/
[136] http://immersivemedia.com/technology/
[137] http://www.androidheadlines.com/2015/11/im360-vr-to-enable-virtual-reality-content-creation.html

provision of an app, including content production. Regarding the latter, this is a recent evolution for Jaunt and Immersive Media. This is comparable to the fact that Oculus, known for manufacturing headsets, launched a content division early 2015 and hired a number of former Pixar veterans to create animated shorts.[138] However none of them provides displays to watch 360 video and VR content more generally.

All three cases have a **direct customer ownership**, this is to be related to the fact that their **revenue model** is, at least mainly, **indirect** and that they have a **high user involvement**. Actually, all three features point to the importance of **partnerships** for the three companies. Partnerships are more than a mere commissioning of content. They take place **with different types of stakeholders**, from broadcasters to organisers of live events to brands, etc. They rely on **various configurations**: with one or several partners, for content that is available for free or only for subscribers. Reasons for such partnerships from these companies' point of view include that they are a source of income, but also that they reinforce these companies' reputation.

The cases differ as far as interoperability and positioning are concerned. **Interoperability** seems less of a must for NextVR, maybe because it represents an additional cost. **Jaunt**'s positioning is rather **substitute** because the experience they offer could replace what tradition media is offering. On the other side, **NextVR and Immersive Media** propose services or products **complementary** to the way media (and events) are currently functioning. This is consistent with the analysis currently made that VR will impose thanks to its complementarity, with fans still mainly watching the event on their television sets, but using VR for enhancements: game recaps, highlights of a particular play, features, brief forays into watching a certain portion of the action live.[139]

	Jaunt	NextVR	Immersive Media
Vertical integration	Yes & move towards content production	Yes	Yes & move towards content production
Customer ownership	Direct, with exceptions	Direct	Direct, with exceptions
Interoperability as an objective	Yes	No(t yet)	Yes
Revenue model	Mainly indirect	Indirect	Mainly indirect
Positioning	Substitute	Complement	Complement
User involvement	High	High	High, with exceptions

Table 2: Comparison of Jaunt, NextVR and Immersive Media's business models

[138] Steven Zeitchik, "VR Watch: Jaunt Forms Studio, Hiring Lucasfilm Veterans to Run It," *LA Times*, April 28, 2015, http://venturebeat.com/2015/09/28/jaunts-ceo-on-its-65m-funding-and-the-humanity-advancing-mainstream-future-of-virtual-reality/. Bryan Bishop, "VR Company Jaunt Is Starting a Virtual Reality Movie Studio - The Verge.pdf," *The Verge*, April 28, 2015, http://www.theverge.com/2015/4/28/8507091/jaunt-studios-interview-virtual-reality-movies-360-degree-camera.

[139] Ibid.

3.5. Immersive AV: state of the market

3.5.1. VR: a fast-growing market

VR and AR have the potential to become **the next big computing platform**, as we saw with the PC and smartphone.[140]

This is visible in **investments made**. $3.5bn is the value of the 225 VR/AR VC investments made in 2014-2015 – although this includes Facebook paying $2bn to acquire Oculus in May 2014 [141]. Several technology giants are making huge investments.[142] Other firms pursuing projects in the area include Google, Sony, HTC, Samsung.

In such an emerging market, very different figures circulate. The main common point among estimations is the idea that the market will grow rapidly in the coming years. Goldman Sachs estimates a market in 2025 of $35bn for software and $45bn for hardware, including:

- $11.6bn for video games, 216mn users
- $4.1bn for live events, with 95mn users.
- $3.2bn for video entertainment, 79mn users.

Digi-Capital predicts AR/VR revenues to reach $120bn by 2020, respectively 90 for AR and 30 for VR.[143] Finally Futuresource forecasts that the global spend on virtual reality video and games content will be just US$79 million this year (in 2016). As the array of content to buy grows it projects that will rocket to US$8.3 billion by 2020. [144]

In Units, CCS Insight expects 24 million VR and AR devices to be sold in 2018 (vs. 2.5 mln in 2015).[145] The analysts estimate that more than 12 million virtual reality headsets will be sold in 2017, with sales of augmented reality smart glasses expected to be worth $1.2 billion in the same year. CCS Insight forecasts shipments of AR and VR headsets forecast to grow to 96 million units by 2020, at a value of $14.5 billion. [146]

Virtual reality has the most potential with consumers in the near term.[147] Beyond sales of HMD (see section 3.5.3), many significant VR-focused companies are widely known.[148] However it is expected that the ultimate market potential for AR will dwarf the VR market, because AR's semi-immersive (rather than fully-immersive) nature means that AR applications are much broader in

[140] Goldman Sachs, "Virtual & Augmented Reality. Understanding the Race for the next Computing Platform," Equity Research, January 13, 2016.
[141] Ibid.
[142] http://www.ccsinsight.com/press/company-news/2251-augmented-and-virtual-reality-devices-to-become-a-4-billion-plus-business-in-three-years
[143] http://www.digi-capital.com/news/2016/01/augmentedvirtual-reality-revenue-forecast-revised-to-hit-120-billion-by-2020/. They had initially forecast it would reach $150bn
[144] Clarke, "Will VR Rock in 2016 - TBI Vision TBI Vision.pdf."
[145] http://www.ccsinsight.com/press/company-news/2251-augmented-and-virtual-reality-devices-to-become-a-4-billion-plus-business-in-three-years
[146] http://www.ccsinsight.com/press/company-news/2516-wearables-momentum-continues
[147] http://www.ccsinsight.com/press/company-news/2251-augmented-and-virtual-reality-devices-to-become-a-4-billion-plus-business-in-three-years
[148] http://digitalmediaupdate.blogspot.be/2015/10/vr-in-2016-several-million-headsets.html

scope.[149] **Several advances in technology over the past five years** have made the prospect of widespread adoption of virtual reality seem more possible, if not inevitable, than ever before:[150]

- The development of low-cost high-quality mobile components, thanks to the pervasive adoption of smartphones
- An extremely low-latency technology in order to create an experience free of motion sickness

It is possible to conclude that VR is no longer in start-up world, notably thanks to the arrival in 2016 of the high-end headsets[151] and their diffusion among consumers. Thus, according to Oculus, about 1 million people used the Gear VR in April 2016 for an average of 25 minutes per day.[152]

3.5.2. The place for AV content in VR experience

Video entertainment is far from being the only field in which VR (and AR) technologies will be applied. For Goldman and Sachs [153], live events and video entertainment are only 2 of the 9 use cases envisioned.

Currently **gaming is considered the leading application of VR**[154] and the early driver of uptake of high-end VR headsets.[155] At the center stage[156], it is the low-hanging fruit for virtual reality devices.[157] A Trojan horse effect, of getting headsets into homes that can then be used for different applications beyond gaming, is thought likely.[158]

However, **video will also drive adoption of this technology**.[159] Research by Futuresource Consulting in the US even suggests the content that people want movies even more than games in VR (with 39% of consumers sampled interested in experiencing movies, 38% in gaming, and 26% in experiencing VR sports).[160] Immersive AV notably has potentially positive impact on viewers engagement, e.g. towards advertising. Viewers watch immersive 360˚ video longer than other online or mobile videos.[161] Due to the interactive nature of 360˚ video, viewers tend to re-

[149] http://digitalmediaupdate.blogspot.be/2015/10/vr-in-2016-several-million-headsets.html
[150] Alex Russell, "The Enterprise Applications of Virtual Reality Emerging Technologies and Applications of Virtual Reality for Business" (Center for Digital Strategies Fellow, 2015).
[151] Clarke, "Will VR Rock in 2016 - TBI Vision TBI Vision.pdf."
[152] Ibid.
[153] Goldman Sachs, "Virtual & Augmented Reality. Understanding the Race for the next Computing Platform."
[154] http://www.ccsinsight.com/blog/vr-movie-revolution-goes-dutch
[155] Clarke, "Will VR Rock in 2016 - TBI Vision TBI Vision.pdf."
[156] Goldman Sachs, "Virtual & Augmented Reality. Understanding the Race for the next Computing Platform."
[157] http://www.ccsinsight.com/press/company-news/2251-augmented-and-virtual-reality-devices-to-become-a-4-billion-plus-business-in-three-years
[158] Clarke, "Will VR Rock in 2016 - TBI Vision TBI Vision.pdf."
[159] http://www.ccsinsight.com/press/company-news/2251-augmented-and-virtual-reality-devices-to-become-a-4-billion-plus-business-in-three-years. Amateur users are currently outside of the scope of ImmersiaTV but it could be that tools developed within the project are of interest also for end-users, thus opening a new market niche, especially if the project succeeds in making the edition of synchronized content user-friendly enough.
[160] Clarke, "Will VR Rock in 2016 - TBI Vision TBI Vision.pdf."
[161] http://immersivemedia.com/?page_id=60

watch the content much more frequently than they would do with a normal video. This can be combined with the possibility of game-like elements such as hot-spots and personalization.[162] Such impact may also be due to the character of novelty, and therefore may not last when VR has become mainstream.

Besides, the technology is evolving into a medium to deliver social experiences. For example, Samsung is teaming up with one of the world's largest amusement park operators, Six Flags, to launch a series of VR roller coasters equipped with Samsung's Oculus-powered Gear VR headset.[163]

3.5.3. Display and content are crucial for growth

The crucial challenge for immersive experience technologies is to ensure their adoption. Of all the steps of the VC for immersive experiences, display and content appear as crucial for the success of this industry. They are B2C activities while other steps are for the moment mainly B2B activities (e.g. CDN providers, softwares allowing to edit immersive AV content, and even omnidirectional cameras).

Currently **display providers act as platforms mediating between two types of users: consumers and content makers.** In a typical setting of two-sided markets, for their platform (their display and the related ecosystem: their app store, related hardware e.g. PlayStation or Samsung smart phones) to succeed they need as many consumers and content makers as possible adopting them. Content makers are hesitant to develop immersive content without an installed base while consumers are reluctant to buy devices without content to experience[164].

Displays sales and shipment are the most impressive feature in this market. For example, a great amount of Google cardboards have been distributed although figures vary between 2mn distributed since its launch in June 2014 [165] and sales of almost 5 mln low-cost designs based on Google Cardboard in 2015.[166] VR devices sales are expected to increase from 2.2mln (2015) to 20lmn (2020).[167] In 2016, 12.8 mln unit VR headset are expected to be sold for revenues of $895 mln, according to Strategy Analytics.[168] **77% of that value** is accounted for **by** newly launched premium devices from **Facebook's Oculus Rift, HTC-Valve's Vive and Sony PlayStation VR**, which however will only account for 13% of volumes in 2016. Actually, **HMD – with mobile**

[162] http://immersivemedia.com/?page_id=60
[163] http://www.ccsinsight.com/blog/vr-movie-revolution-goes-dutch
[164] Goldman Sachs, "Virtual & Augmented Reality. Understanding the Race for the next Computing Platform."
[165] Ibid.
[166] http://www.ccsinsight.com/press/company-news/2516-wearables-momentum-continues
[167] http://www.ccsinsight.com/press/company-news/2251-augmented-and-virtual-reality-devices-to-become-a-4-billion-plus-business-in-three-years
[168] https://www.strategyanalytics.com/strategy-analytics/news/strategy-analytics-press-releases/strategy-analytics-press-release/2016/04/13/strategy-analytics-oculus-rift-htc-vive-sony-playstation-vr-will-dominate-$895-million-virtual-reality-headset-market-in-2016-on-just-13-of-unit-shipments

should represent 87% of units shipped in 2016.[169] Related are control input, which will be vital in the growth of the VR ecosystem.[170]

The Virtual Report provides slightly different estimates, because it is more recent and relies on a different methodology. In units, HMD – with mobile is indeed leading, with 5 mln units for Google Cardboard, followed by Baofeng (1.5 mln), and Samsung (1 mln).[171] However in value, Playstation VR and Vive represent the best sales.[172]

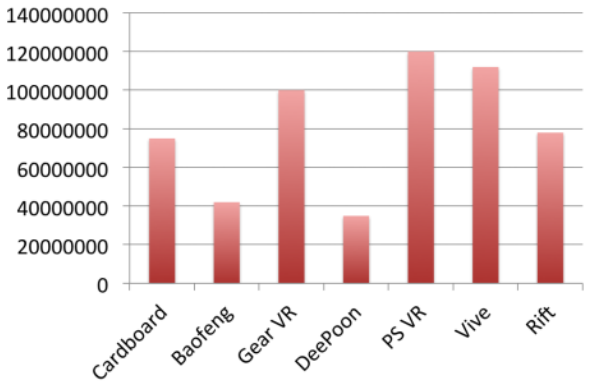

Figure 12: Value of hardware sales (leading platforms) in $[173]

[169] https://www.strategyanalytics.com/strategy-analytics/news/strategy-analytics-press-releases/strategy-analytics-press-release/2016/04/13/strategy-analytics-oculus-rift-htc-vive-sony-playstation-vr-will-dominate-$895-million-virtual-reality-headset-market-in-2016-on-just-13-of-unit-shipments

[170] Pitchbook, "Virtual Reality. 2015 Analyst Report."

[171] http://www.thevirtualreport.biz/asia/feature/63914/the-size-of-the-vr-consumer-market-today/

[172] http://www.thevirtualreport.biz/asia/feature/63914/the-size-of-the-vr-consumer-market-today/

[173] http://www.thevirtualreport.biz/asia/feature/63914/the-size-of-the-vr-consumer-market-today/

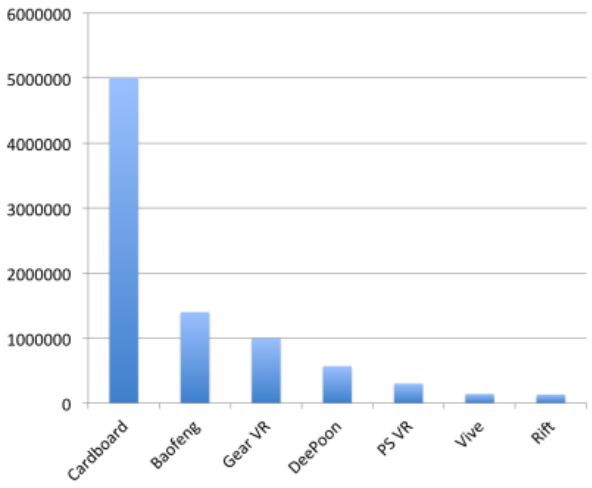

Figure 13: Volume of hardware sales (leading platforms) in units[174]

Displays vary greatly in terms of price and quality, the underlying trade-off is the one between quality and accessibility. This trade-off is exemplified by Facebook and Google's opposite strategies[175]. **Facebook, owner of Oculus, represents quality**. Proponents of this approach argue that the most important factor in popularizing VR is to provide the highest quality experience possible (low latency, high resolution, etc.). Quality, the argument goes, is paramount because at this early stage of the game, one or two low-quality apps might convince people that today's VR is no different from the disappointing efforts of the 1990s [176]. **Quality however has a price.** Oculus was launched at a price of $599 (including two videogames and an xbox controller), and it was estimated that a PC meeting Oculus' requirements would cost $1,000 [177]. There is notably a competition between Facebook's Oculus and HTC-Valve. The latter can count on Steam, the leading personal computer video game marketplace while Oculus is backed by Facebook, in particular its reach into a billion-plus internet users.[178]

Proponents of the **accessibility** approach argue that the key factor in creating demand is to make VR devices as cheap and easy-to-get as possible[179]. **Google represents accessibility**. Cardboard's (a fold-up headset into which users slip their smart phones) first iteration can be bought for less than $5 online. Google says that a least a million units have sold. Another 1 mln were distributed for free via *The New York Times*[180]. Another example is the Samsung Gear VR that was launched at $99 and which has seen strong shipments in 2015.[181] In April 2016, more than 1 million people used the Samsung Gear VR.[182]

[174] http://www.thevirtualreport.biz/asia/feature/63914/the-size-of-the-vr-consumer-market-today/
[175] Wright, "A Brief History of VR."
[176] Ibid.
[177] Goldman Sachs, "Virtual & Augmented Reality. Understanding the Race for the next Computing Platform."
[178] Ibid.
[179] Wright, "A Brief History of VR."
[180] Goldman Sachs, "Virtual & Augmented Reality. Understanding the Race for the next Computing Platform."
[181] http://www.ccsinsight.com/press/company-news/2516-wearables-momentum-continues
[182] https://www.oculus.com/en-us/blog/gear-vr-ecosystem-expands-to-include-facebook-360-photos-over-250-apps-and-new-video-content/. Samsung Gear VR is powered by Oculus.

Importantly neither approach precludes the other; both may actually represent a market segment.[183]Possibly, Sony's PlayStation VR is a compromise between both approaches. So far, however, mass-market VR is mostly a low-end experience via Google's Cardboard viewer.[184]

Consumers will however adopt VR only if relevant, innovative content is developed. It is fruitful here to **draw a comparison with 3D technology.** Even more than in the case of 3D, it is not possible to simple port a film over. Content is perceived as driver, with one expert mentioning the need "to do for VR what *Snow White* did for animated film, or *Avatar* did for 3D."[185] Actually, more than a conceptual comparison, some of the technology in VR — and some of the people working behind the scenes — come from those short-lived 3-D productions, which never caught on widely among television viewers at home.[186] VR also faces some of the same challenges that hindered 3-D, namely viewers need to buy special equipment to view the broadcast (hence the importance of the price), and even once they do, they might decide they find the devices too inconvenient and cumbersome to wear regularly.[187] Another necessary technological advance is the quality of the picture.[188]

The challenge (for video entertainment and video games) is to create new forms of content.[189] People want proper stories.[190] Immersive AV content requires new storytelling with different writing and producing techniques,[191] e.g. with more long takes, since cutting may make give nausea to users.

For live events, Goldman Sachs argues that the challenges are a bit different. VR comes, after radio and TV, as a convenient solution to remedy the by nature limited number of seats available for each event.[192] And, notably for sport, VR technology can put viewers in the center of the action.[193] There are however **challenges in acquiring rights and on the user adoption side** since the experience with a HMD is more individual and less social.[194]

Another challenge, of economic nature, relates to **the lack of a sustainable model for the creation of content and a clear pathway to monetization**.[195] On the other hand, possibly cost for content production may become lower since 360 degree camera reduces the need for multiple cameras and editing work typical to 2D video[196].

[183] Wright, "A Brief History of VR."
[184] Clarke, "Will VR Rock in 2016 - TBI Vision TBI Vision.pdf."
[185] Ibid.
[186] Ibid.
[187] Ibid.
[188] Ibid.
[189] Goldman Sachs, "Virtual & Augmented Reality. Understanding the Race for the next Computing Platform."
[190] Clarke, "Will VR Rock in 2016 - TBI Vision TBI Vision.pdf."
[191] Ibid.
[192] Ibid.
[193] Todd Longwell, "Virtual Reality in Sports Poses Unique Challenges for Producers," *Variety*, July 12, 2016, http://variety.com/2016/digital/news/virtual-reality-sports-cameras-1201811516/.
[194] Ibid.
[195] Clarke, "Will VR Rock in 2016 - TBI Vision TBI Vision.pdf."
[196] Goldman Sachs, "Virtual & Augmented Reality. Understanding the Race for the next Computing Platform."

Stakeholders in these markets are aware of such challenge, and **try to produce content and attract content producers.** For example, 200k developers have registered to create games on Oculus' VR platform (as of Sept 2015). Oculus says 100 games will be available in 2016 (including 20 developed internally) [197]. CCS Insight believes that although augmented reality and virtual reality are two very different technologies, they each have the potential to deliver transformative experiences. [198]

CCS Insight expects **user-generated** 360-degree pictures and films will be an important source of viewing material for VR headsets. [199] This will trigger greater interest in 360-degree wearable cameras, with sales of 250,000 units expected in 2016. Sales will rise to 3.3 million in 2020, accounting for 13 percent of the entire wearable camera market of 25 million units.

[197] Ibid.

[198] http://www.ccsinsight.com/press/company-news/2251-augmented-and-virtual-reality-devices-to-become-a-4-billion-plus-business-in-three-years

[199] http://www.ccsinsight.com/press/company-news/2516-wearables-momentum-continues

4. CONCLUSION AND RECOMMENDATIONS

Following the methodology of Market Opportunity Analysis, this report has provided a simple description of ImmersiaTV's Value Network, used mainly to identify potential competitors, and position ImmersiaTV in comparison to them. The report has then identified the main types of actors being active in the VR industry, providing an in-depth business model analysis of three cases (Jaunt, NextVR and Immersive Media). Finally, it has provided a general overview of market trends for Virtual Reality and raised important questions concerning how the sector could evolve in the coming years.

4.1. Market trends

ImmersiaTV touches upon three related fields: Virtual Reality (VR), interactive video and orchestration apps offering content for second screens. The analysis of market trends has focused on VR. Main trends are:

- VR is a fast growing market. Following the PC and smartphone VR (together with AR) has the potential to become the next big computing platform. This is particularly visible in the amounts invested in VR (and AR).
- Next to games, video and user-generated content will drive the adoption of VR technology
- Shipments and sales of display devices are the most visible feature of the market, notably for consumers. HMD – with mobile represent most of the market in volume.
- Displays vary greatly in terms of price and quality, the underlying trade-off is the one between quality and accessibility. Proponents of the quality approach argue that the most important factor in popularizing VR is to provide the highest quality experience possible. Proponents of the accessibility approach argue that the key factor in creating demand is to make VR devices as cheap and easy-to-get as possible
- Consumers will adopt VR only if relevant, innovative content is developed as the previous example of the failure of 3D somehow exemplifies. Stakeholders in these markets are aware of such challenge, and try to produce content and attract content producers.

4.2. ImmersiaTV's positioning - recommendations

The following figure represents ImmersiaTV's positioning in the Value Network. **ImmersiaTV's first specificity** is to cover the whole value chain from capture to production, i.e. to provide **an end-to-end tool**. The project itself and/or its consortium partners will provide solutions in terms of capture, stitching, editing, and distributing immersive AV content. Other stakeholders are providing end-to-end tools, though (see 3.3.6 and 3.4). However, **ImmersiaTV's second specificity** is the focus on the **synchronisation**. Developed tools will allow to have different experiences for the same content on a TV set, a HMD and a mobile device (e.g. smartphone or tablet). This in particular will be applied to **live streaming of content** (e.g. sport events). Finally, **ImmersiaTV** will develop **innovative immersive content** notably aimed at demonstrating the project's Value Proposition.

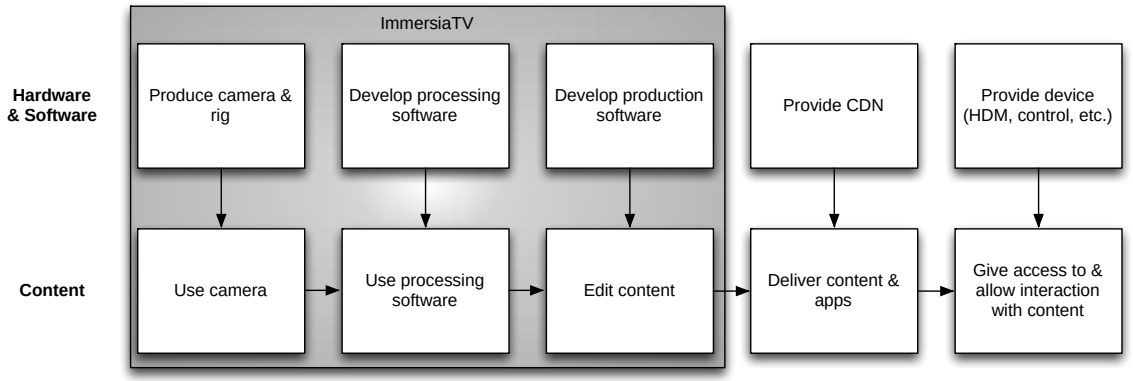

Figure 14: ImmersiaTV's positioning

The previous iteration of the report aimed at positioning ImmersiaTV towards the six types of stakeholders that have been identified:

- **Capture** and **pre-production** stages have been presented together because of the strong trend towards the integration of both activities (including also the role of displaying). the players active in providing hardware and software for capture and/or processing should not be considered as competitors. Their products are complementary to what ImmersiaTV is developing. However, several companies listed here are also developing hardware of software in other steps of the Value Network, which makes them more likely competitors for ImmersiaTV. Finally, the mapping shows that several important players are present in this stage including players that are strong in other stages.
- In the **production** stage it is crucial for ImmersiaTV to propose something different from what competitors are currently developing. **A first differentiator** in this respect is that tools developed within ImmersiaTV will make it **easier to produce** immersive content that can be experienced **on different devices** (i.e. one edits once for various platforms). **A second differentiator** concerns the importance of **live** (vs. offline) **production**, as developed in Pilot 2. This report therefore **recommends** in a next iteration **to further question the relevance in the value proposition of both differentiators**.
- **Immersive content producers** can be competitors. However, they also support ImmersiaTV's objectives in contributing to the overall development of the market for immersive experiences. The mapping on films and documentaries shows that most of them are based in the USA; they rely on business-to-business activity, and a significant proportion of them are related to traditional or online media. While being in the USA is not a must, from this comparison, this report **recommends** (i) **to explore business-to-business business models** rather than business-to-consumers; (ii) **to sustain and develop links with traditional and online media**.
- Regarding **distribution**, online platform's evolution should be scrutinized to check whether tools and content developed within ImmersiaTV could be made available, and how. In the longer term, an issue is how to use these platforms to generate revenues from ImmersiaTV's contents and products. For example, 360 AV content that will be developed could be made available through platforms such a YouTube or Bitmovin. However, synchronicity between devices is currently not ensured by those platforms, which would limit the experience for viewers.
- Devices allowing to **display** immersive content constitute the part of the industry most well-known from consumers. They include the most important and most powerful companies in this whole industry. Facebook's Oculus Rift, HTC-Valve's Vive and Sony PlayStation VR are currently the most important integrated HMD in the global market, while Samsung Gear VR seems to be the most important market player in the "HMD – with mobile device" segment. These devices' success is key to have the whole market for immersive experiences succeed. **There are no display device providers within**

ImmersiaTV. This should **not** be **an issue** since the innovations (products and content) developed within ImmersiaTV should be watchable on any device. The objective is to avoid lock-in. However next iterations should consider the potential additional costs related to compatibility.

- Finally, **end-to-end platforms** appear as **ImmersiaTV's most direct competitors, especially those that are active in the live production and distribution of live events**, especially if one considers that the most important innovation for the project derives from the integration of its various components. The report **recommends to follow up how the identified platforms evolve** (activities, market presence, targets, etc.) **and to map other similar market players**.

The detailed case studies led to comparison along the following business model features: vertical integration, customer ownership, interoperability, revenue model, positioning and user involvement. These cases have **in common the vertical integration, the direct customer ownership, the (mainly) indirect revenue model and the high involvement of professional users**. It remains to be checked **whether ImmersiaTV should follow these strategic business choices**.

They however differ regarding interoperability and their positioning towards other market stakeholders.

Four core questions can be derived from theses generic business model parameters:

- **Should ImmersiaTV provide separated components or an integrated suite of tools?**
- **Is it important for ImmersiaTV to innovate in terms of format/content?**
- **Is it important for ImmersiaTV to be available on several platforms?**
- **Is enabling live streaming crucial?**

These questions were first discussed in the Business Model Workshop in Porto on November, 24, 2016. Beyond a mere yes/no answer, the idea was to **develop the consequences of each choice**. For example, if enabling live streaming is crucial, hence there is a need to develop partnerships with broadcasters, brands, etc. The results of the discussion will be discussed in more details in the next iteration of D5.2.

4.3. Next steps

This report is intended to be a living document, to be updated in a last twice (September 2017). The next iteration will aim at gathering more statistics.

It will further address questions and findings in this document, also based on the project consortium's needs and identified gaps in the analysis.

Finally, it will provide further analysis of *strategies for successful exploitation*, i.e. the conditions for successful exploitation of the proposed immersive audiovisual solutions, and the best strategies to address these.

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6. ANNEXES: LIST OF STAKEHOLDERS

6.1. Capture & Processing

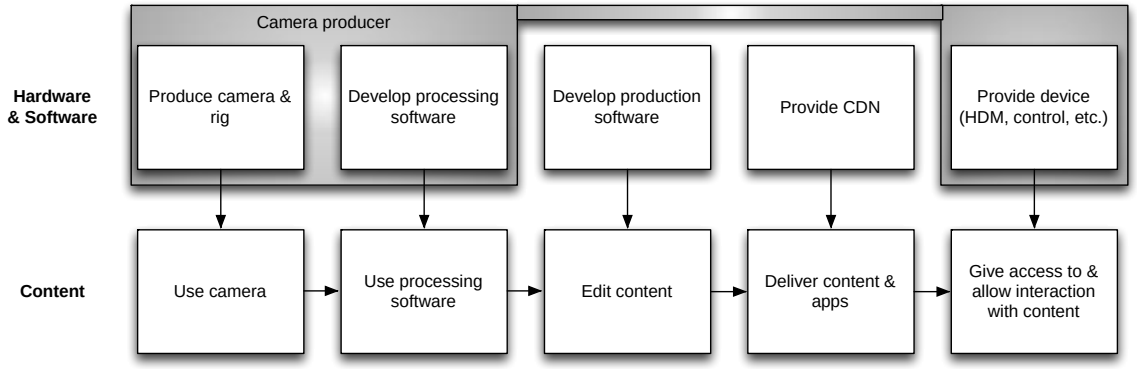

Figure 15: Camera producer – Value Network

Important players in this sector include:

- **Facebook**'s Surround 360 includes a design for camera hardware and the accompanying stitching code.[200]
- The **Google** Jump Assembler is an open-source VR platform consisting of three main components: the 16-camera rig, an assembler that takes raw footage and compiles it into stereoscopic VR video, and a player, which will live inside Google-owned YouTube.[201] The Open Source release aims at encouraging third-parties to create 'Jump' cameras which will capture 3D 360 degree footage for virtual reality playback. This approach is similar to Google's Cardboard VR viewer that the company opted not to sell, but rather chose to release the plans, allowing third parties to manufacture and sell the device
    - **IMAX** VR camera, "a cinema-grade virtual reality (VR) camera" that will enable producers to shoot 360 degree, 3D content. IMAX is working with Google on the project, which will use its Jump platform and is expected to take 18 months to be developed.[202]
- **Kodak** notably provides the Kodak SP360 camera[203]. Furthermore, Kodak proposes all kinds of software downloads for free (e.g. PIXPRO 360 Stitch)[204]
- **Lenovo** is developing a 360-degree live streaming camera targeted at the consumer market[205]
- **LG** 360 Cam

[200] https://code.facebook.com/posts/1755691291326688/introducing-facebook-surround-360-an-open-high-quality-3d-360-video-capture-system
[201] https://www.google.com/get/cardboard/jump/
[202] https://techcrunch.com/2016/05/20/imax-to-open-vr-experience-centers-worldwide-and-develop-its-own-vr-camera/
[203] http://kodakpixpro.com/Americas/cameras/activeCam/sp360.php
[204] http://kodakpixpro.com/Europe/fr/support/downloads.php
[205] http://uploadvr.com/lenovo-live-stream-360-vr-camera-exclusive/

- **Nikon** with the Nikon KeyMission 360[206]
- **Nokia** with e.g. Nokia OZO[207]
- **Ricoh** notably provides the Ricoh Theta[208]. Its software also allows to edit immersive content
- Project Beyond is a 360 stereoscopic camera with live streaming from **Samsung**. The camera was unveiled at the Samsung Developer Conference 2014. The Project Beyond camera is designed specifically for compatibility with the Samsung Gear VR.[209]
- **Video Stitch**, an ImmersiaTV consortium partner (see also Orah,[210] a 360 live camera, launched on April 6, 2016)
- **GoPro** notably provides the GoPro Odyssey. Furthermore, and to illustrate the trend towards integration of capture and processing, in 2015 GoPro acquired **Kolor**, a provider of software products to stitch static pictures and videos.[211] Founded in 2004, Kolor was the first company to perceive the potential of SIFT technology in the identification of interest points in an image, and created Autopano, an image stitching software. Kolor has since provided panoramic imagery solutions, including panorama software, virtual tour software, video-stitching software and a full range of hardware products. Furthermore, a few systems are based on GoPro cameras, e.g. rigs designed to hold and synchronize a few GoPro cameras. This includes
    - Developed by **VFX Studio Hive Division** and **InVRsion**, PanoptikonVR is a 360° stereoscopic camera system designed to shoot immersive, live action video content to be experienced with the new generation of virtual reality devices.[212]
    - The **Freedom360** mount.[213] They also own the Koncept VR virtual reality production agency.
    - **360Heros**[214]

Other players include:

- **360 Designs** Mini Eye[215]
- **360Fly**[216]
- **Argon360** is an IP core for chip or FPGA offering video stitching in real time, enabling live streaming and live preview of 360° panoramic videos.[217]
- **Bublcam**[218]
- **CENTR** Camera[219]

[206] http://www.nikonusa.com/en/about-nikon/press-room/press-release/iihiz21t/Nikon-Charges-Into-the-Action-Camera-Market-with-the-360-Degree-KeyMission-360.html
[207] https://ozo.nokia.com/
[208] https://theta360.com/en/
[209] http://thinktankteam.info/beyond/
[210] http://www.engadget.com/2016/04/06/orah-live-360/
[211] http://www.kolor.com/about-us/
[212] http://www.panoptikonvr.com/en/
[213] http://freedom360.us/
[214] http://www.360heros.com/
[215] https://360designs.io/product/mini-eye/
[216] http://www.360fly.com/
[217] http://www.argondesign.com/products/argon360/
[218] http://www.bublcam.com/
[219] http://www.centrcam.com/

- Based in Lille (France) and San Francisco (USA), **Giroptic**[220] specializes in 360° imaging technology. Powered by the GIROPTIC 360 Virtual Sensor Technology, the Giroptic 360cam is the first and only 360 camera able to record full spherical photos and videos as a .jpg or .mp4 file, without any software or post-processing.[221]
- The Vuze virtual reality camera was created by **HumanEyes Technologies**. It is a Consumer 3D 360 Video camera.[222]
- The new Allie camera from **IC Real Tech** can turn two 360-degree camera feeds into an "all-D" image that lets users look in any direction they want.[223]
- **Insta360 4k**[224]
- **Kogeto** Joey 360, a versatile 4K full motion 360º desktop video camera providing capture, live webcast, and two-way panoramic teleconferencing.[225] They also make the Dot, a $49 iPhone attachment for 360 video.
-
- **LucidCam** is a stereoscopic 3D camera with 180° wide-angle lenses and spacial audio.[226]
- **Matterport** Pro 3D
- **Moovr** produces rigs using Samyang and Canon cameras for professional 360 video shoots.[227]
- **MULTICAM**[228]
- **Narvaro**, A 3D camera on a robotic rig that moves based on input from the HMD[229]
- **Panono** Ball Camera[230]
- **Panocam 3D**[231]
- Camargus by **Qamira**[232]
- **Radiant Images** provides custom professional rigs. Customized 2D and 3D solutions are specific and appropriate to each client and cove the whole workflow from pre- to post-production.[233]
- **Sphericam**
- **Triggar VR**
- **VSN Mobil V.360**[234]

[220] http://www.giroptic.com/
[221] http://eu.360.tv/en/
[222] http://vuze.camera/
[223] http://techcrunch.com/2015/01/04/allie/
[224] http://www.insta360.com/
[225] http://kogeto.com/
[226] http://lucidcam.com/
[227] http://mooovr.com/
[228] http://cinfo.es/our-products/synthetrick/multicam
[229] http://www.narvaro3d.com/
[230] http://jonaspfeil.de/ballcamera
[231] http://www.panocam3d.com/camera.html
[232] http://qamira.com/
[233] http://www.radiantimages.com/
[234] http://www.vsnmobil.com/cameras/v360

6.2. Production

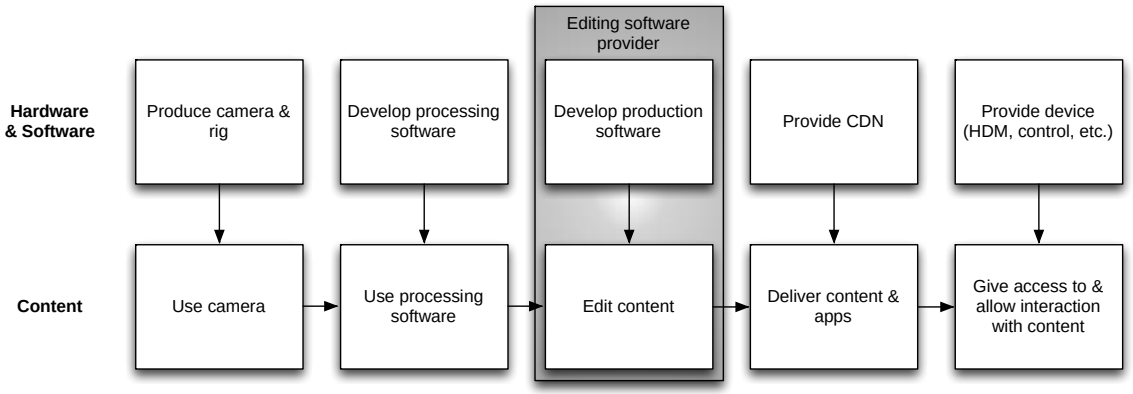

Figure 16: Editing software provider – Value Network

Producers of editing software for omnidirectional video include:

- **Adobe** has announced, during the NAB Show in April 2016, full support for VR video workflows for its two software applications Premiere Pro and After Effects. This would include a new VR Video mode to preview and control pan and tilt in the non-linear editing system, and new metadata flags to ensure support on VR-capable sites like YouTube and Facebook (see 3.3.4)
- **Mettle** SkyBox products for 360/VR are plug-ins for Adobe softwares, which include:[235]
    - SkyBox 360 Post FX for After Effects: described by Mettle as the most complete set of tools available for 360/VR Production in After Effects.[236]
    - Mettle 360/VR Plugin for Premiere Pro: the toolset allows users to add text, logos, and layer 2D footage on 360 footage. Editors can also correct the horizon line, denoise, blur, and sharpen footage.
    - Mettle's Skybox 360/VR Transitions for Adobe Premiere Pro is the latest addition for Premiere Pro provides 360 gradient wipe, 360 random blocks, 360 iris wipe and 360 mobius. Many of the 360 Transitions will have X,Y start points to help storytellers direct the viewer's gaze.
- **Dashwood** provides the 360VR Toolbox (Public Beta), enabling real-time 360 degree VR headset monitoring (support for Oculus DK2, other headsets planned) while editing, and a full-featured plugin suite for Adobe Premiere Pro, After Effects and Final Cut Pro.[237]
- **Foundry NUKE** offers toolkits covering VFX, editorial and finishing.[238]
- **Im360 Entertainment**[239]
- **Improbable** SpatialOS[240]
- **Pixvana**[241]
- **Point Grey Research Inc**[242]

[235] http://www.mettle.com/product/skybox-360vr-tools/
[236] http://www.mettle.com/product/skybox-studio/
[237] Plug-in functionalities: plugins for 360° XYZ-axis re-orientation, projection of 2D logos or video on 360VR, pan and scan output of "flat" video from 360VR sources, output of stereographic "little planet" or cubic "skyboxes" from 360VR sources, and spherical 360 blur, sharpen, glow and noise reduction filters. Source: www.dashwood3D.com
[238] https://www.thefoundry.co.uk/products/nuke/
[239] https://www.im360.com/
[240] https://www.improbable.io/
[241] http://www.pixvana.com/
[242] https://www.ptgrey.com/

- **Video Stitch**, an ImmersiaTV consortium partner
- **Worldviz** provides the Vizard VR Toolkit, a platform designed specifically for authoring VR/AR experiences. It is aimed at professional users.[243]

6.3. Content production

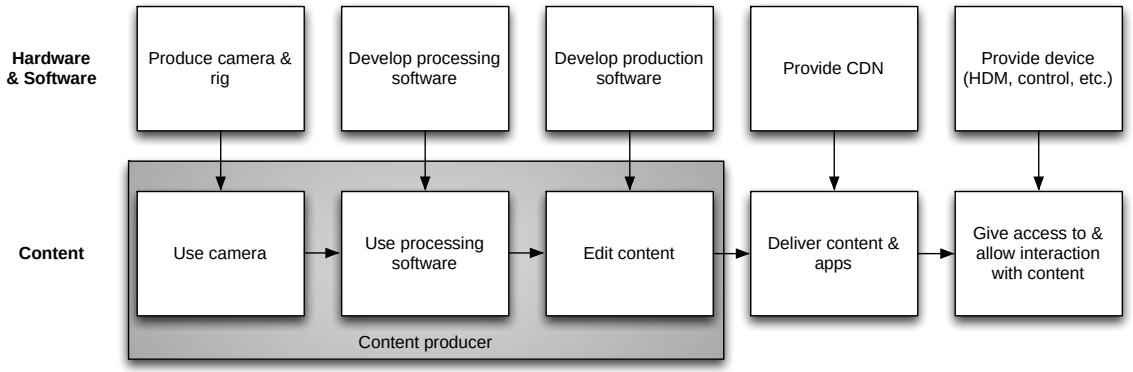

Figure 17: Content producer – Value Network

6.3.1. VR Film Studios (360 video)

Name	Location	Comments
European		
AlchemyVR[244]	UK	Born out of a collaboration between Atlantic Productions and Zoo VFX Has partnerships with museums
Exozet[245]	Germany & Austria	Communication agency
Fisheye[246]	Belgium	
Happy Finish[247]	UK, USA, China & India	Communication agency
Lightbox	Portugal	ImmersiaTV consortium partner
Scopic[248]	Netherlands	
Vehicle VR[249]	USA & UK	**Uprising Creative**'s VR content studio.
Visualise[250]	UK, USA & UAE	Communication agency
WeMakeVR[251]	Netherlands	They are also specialised in journalism
Yondr	Belgium & USA	Media agency

[243] http://www.worldviz.com/products/vizard
[244] http://www.alchemyvr.com
[245] http://global.exozet.com/
[246] http://www.fisheye.eu
[247] http://www.happyfinish.com/en/
[248] http://www.scopic.nl/
[249] http://vehicle-vr.com/
[250] http://visualise.com/
[251] http://wemakevr.com/company/wemakevr/. They have been creating Virtual Reality experiences since 2013. They aim at exploring news ways of storytelling, developing best practices, new technologies and workflows. They produce reasonably big productions, with custom cameras and software.

Zakato[252]	Spain	They also propose immersive advertising
Non-European		
30 Ninjas[253]	USA	Founder is film director Doug Liman
Bipolar Id[254]	USA	
Cryworks[255]	USA	Strong links with the film industry
Dimension Gate[256]	Canada	
Experius[257]	USA	
Felix & Paul[258]	Canada	
Framestore VR Studio[259]		Division of Framestore, a major visual effect studio
Google Spotlight Stories	USA	Linked to Google
GoPro		Linked to GoPro (see section 3.3.1)
Headcase VR[260]	USA	Strong links with the film industry
Honey VR[261]	USA	
Jaunt Studios[262]	USA	Linked to Jaunt (see section 3.3.6)
Matter VR[263]	USA	Media professionals (beyond VR)
Mirada[264]	USA	
New Deal Studios[265]	USA	Visual effects studio
Panogramma[266]	Brazil, USA & Canada	
Secret Location[267]	USA & Canada	They won VR's first Emmy for their work on the Sleepy Hollow VR experience

[252] http://web.zakato.com/?page_id=12. They are specialised in the capture of immersive 360º images (photo and video), and in their interactive visualisation in all kind of devices: desktop, mobile, tablets, HMD, fulldome cinemas. One of their projects is #3in360, an experimental project on immersive journalism in which by means of short and simple 360º video capsules they are trying to develop new concepts to document reality

[253] http://www.30ninjas.com/

[254] http://bipolarid.com/

[255] http://cryworks.com/

[256] http://www.dimensiongate.com/

[257] http://experius.com/?mc_cid=c2a29104d9&mc_eid=6fb3b6b9b6

[258] http://www.felixandpaul.com/, http://www.latimes.com/entertainment/movies/la-et-mn-felix-paul-vr-movies-universal-comcast-20160615-snap-story.html, https://www.whitehouse.gov/blog/2016/08/25/watch-join-president-obama-virtual-reality-tour-yosemite

[259] http://framestorevr.com/about/

[260] http://www.headcasevr.com/

[261] http://www.digitaltrends.com/virtual-reality/honeyvr-virtual-reality-films/ & http://www.honeyvr.com/about/

[262] http://www.jauntvr.com/jaunt-studios/

[263] http://mattervr.com/web/

[264] http://mirada.com

[265] https://newdealstudios.com/

[266] www.panogramma.com

[267] http://thesecretlocation.com

The VR Company[268]	USA	Strong links with the film industry
Unit 9[269]	USA	Media professionals (beyond VR)
Visual[270]		
VR Playhouse[271]	USA	
WITHIN (aka **VRSE**)[272]	USA	They also propose an app to view their content See also 3.3.4

6.3.2. Documentaries and informative immersive content

Name	Location	Comments
European		
Arte[273]	France & Germany	Publicly-funded Arte started on its *Polar Sea 360* project in 2014. Looking at getting 360-degree content direct to smart TVs, Arte has launched in 2016 a full-fledged VR app that has been downloaded 25,000 times in end February 2016. Most of its VR content will relate to an Arte TV show.
Atlantic[274]	UK	Atlantic was one of the first content companies experimenting with VR, and has set up Alchemy VR, which has co-produced with the Natural History Museum in the UK *David Attenborough's Great Barrier Reef Dive* and *David Attenborough's First Life* (11-minute and 20-minute formats, both paid-for experiences priced at £6.50 (US$9.40)).[275]
BBC News[276]	UK	Related to traditional media
Digivision	Spain	They produce documentaries with VR effects. They did the Tarraco series for RTVE.[277]
Immersive Journalism Lab[278]	Spain	
VRT	Belgium	ImmersiaTV consortium partner. Related to traditional media

[268] http://www.thevrcompany.com/, http://variety.com/2016/digital/news/robert-strombergs-virtual-reality-company-raises-23-million-from-chinese-investor-1201792809/
[269] http://www.unit9.com/
[270] http://visualisgood.com/
[271] http://www.vrplayhouse.com/. Examples: http://time.com/4498374/defying-the-nazis-virtual-reality/ http://presskitchen.com/2016/09/01/wired-moon-vr-playhouse-ian-forester/
[272] http://vrse.com/ & http://with.in/ http://variety.com/2016/digital/news/vrse-within-series-a-chris-milk-1201796161/
[273] Stewart Clarke, "Will VR Rock in 2016 - TBI Vision TBI Vision.pdf," *TBI Vision*, March 1, 2016, http://www.tbivision.com/highlight/2016/03/will-vr-rock-2016/555472/.
[274] http://www.alchemyvr.com
[275] Clarke, "Will VR Rock in 2016 - TBI Vision TBI Vision.pdf."
[276] An example is: https://www.youtube.com/watch?v=c3zeH-YEHkE «BBC Click 360: The world's first entirely 360 TV episode ».
[277] http://www.e-digivision.net/
[278] http://www.immersivejournalism.es/

Non-European		
ABC News VR[279]	USA	Related to traditional media
Discovery VR App[280]		Related to traditional media. Discovery-owned Eurosport tests the medium, with the idea of transporting sport fans to iconic locations or circuits. It worked with ski legend Bode Miller (above) on its first VR video, part of the wider Discovery VR app, and posted it just before a World Cup skiing competition taking place on the same course featured. [281]
Emblematic Group	USA	Their activities include journalism pieces (e.g. Project Syria[282])
Gannet	USA	Belongs to USA Today
National Geographic[283]	USA	They announced in May 2016 that they will be launching NG VR Studio , which will offer a mix of original and franchise experiences
The New York Times	USA	They shipped 2M cardboard in 2015[284] and 300,000 more in 2016. The company published its first VR app in November 2015.[285] The New York Times has produced more than 20 different mini-documentaries or art pieces for the New York Times VR app by mid-September 2016.[286]
Ryot[287]	USA	Bought by AoL and now available via the Huffington Post
Syfy[288]		NBCU's Syfy cable net launched immersive and multiplatform unit, Syfy Labs, in January 2016.
Time Inc Life VR		
Verge	USA	Online media
Vice	USA & Canada	Online media

6.3.3. Immersive animation

- **apelab**, from Switzerland
- **Artanim interactive**, from Switzerland

[279] http://abcnews.go.com/Video/fullpage/abc-news-vr-inside-syria-33768357
[280] http://tbivision.com/highlight/2016/03/will-vr-rock-2016/555472/ (Will VR rock in 2016? - TBI Vision TBI Vision)
[281] Ibid.
[282] http://www.emblematicgroup.com/#/project-syria/
[283] http://realscreen.com/2016/05/09/nat-geo-to-launch-virtual-reality-studio/#ixzz48DmiM0Ou
[284] http://www.nytimes.com/newsgraphics/2015/nytvr/
[285] Esa Sirkkunen et al., "Journalism in Virtual Reality: Opportunities and Future Research Challenges" (ACM Press, 2016), 297–303, doi:10.1145/2994310.2994353.
[286] Esa Sirkkunen et al., "Journalism in Virtual Reality: Opportunities and Future Research Challenges" (ACM Press, 2016), 297–303, doi:10.1145/2994310.2994353.
[287] http://www.ryot.org/
[288] http://tbivision.com/highlight/2016/03/will-vr-rock-2016/555472/ (Will VR rock in 2016? - TBI Vision TBI Vision)

- **Baobab Studios**[289]
- **IG Port**
- **Illusion Ray Studio**[290]
- **Innerspace VR**[291]
- **Kite & Lightning**[292]
- **Oculus Story Studio**
- **Penrose**[293]
- **Rascali**[294]
- **Reality One**[295]
- **Reel FX**[296]
- **Skullmapping** is a boutique animation (VR-CGI based content) studio based in Belgium. They create projection mapping projects, VR experiences and holograms.[297] One example is *The Styx*, an immersive multi-sensory virtual reality experience, which can be adapted to any location or venue. It relies on the use of an Oculus Rift, headphones (3D sound), but also other sensoric experiences such as smell and touch.
- **Survios**
- **Weta Workshop**[298]
- **WeVR**[299]
- **Xiola**[300] Producers of animated content with good character animations skills.

6.3.4. Audio creatives

Finally, among immersive content producers are **audio creatives**, i.e. creators focused on 3D audio creation. These include:

- **Abbey Road studios**, who have an interest in R&D, in particular on immersive environments
- **Queen Mary University of Londo**n, in particular its sound department[301]
- **two big ears**. They have developed 3Dception, an in-house spatial audio production software for developing fast, efficient and scalable virtual and augmented reality experiences.[302] They have been acquired in May 2016 by **Facebook**.[303]

[289] http://venturebeat.com/2015/12/03/baobab-studios-aims-to-tell-animated-stories-in-vr-with-6m-in-funding/
[290] http://illusionray.com/
[291] http://innerspacevr.com/
[292] http://kiteandlightning.la/
[293] http://www.penrosestudios.com/
[294] http://www.rascali.xyz/
[295] http://reality.one/
[296] http://www.reelfx.com/
[297] http://www.skullmapping.com/
[298] http://wetaworkshop.com/
[299] http://wevr.com/
[300] http://www.xiola.be
[301] http://c4dm.eecs.qmul.ac.uk/audioengineering.html
[302] https://twobigears.com/
[303] http://techcrunch.com/2016/05/23/facebook-just-bought-vr-audio-company-two-big-ears-and-is-making-their-tech-free-to-developers/

6.4. Distribution

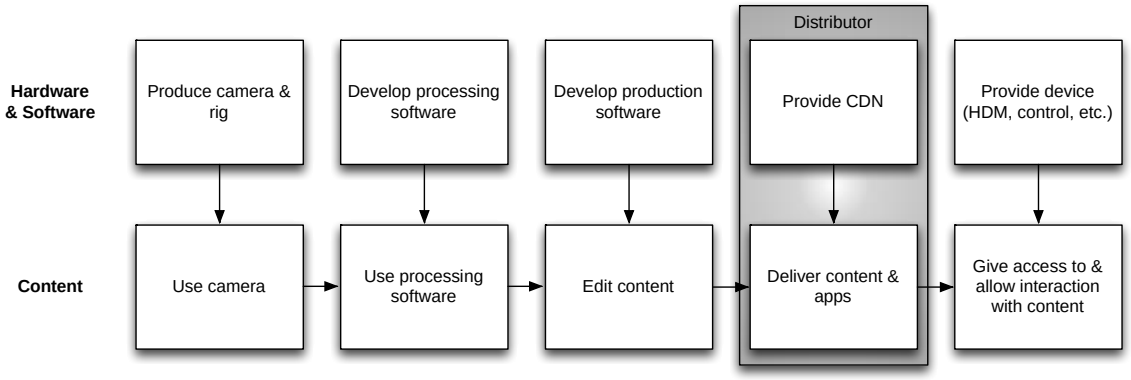

Figure 18: Distributor – Value Network

Some platforms are **app stores**, they include:

- **HTC**'s virtual reality app portal 'Viveport'[304]
- **Next Galaxy Corp** is developing CEEK – a fully immersive social content hub and distribution platform for accessing virtual reality experiences, 3D and 360 videos with the Oculus Rift and other VR Displays. They are also creating headphones and a controller for VR[305]
- **Facebook**'s **Oculus** Home[306]
- **Valve** with SteamVR[307]
- **WEARVR**[308]

Some platforms give access to video, they include:

- **Bitmovin**[309]
- **Deepoon's** dedicated mobile app 3DBoBo
- **EEVO**[310]
- **Facebook** 360 (monoscopic)
- **Google's** YouTube 360 supports uploading and playback of 360 degree spherical videos on desktop Chrome (monoscopic). One can also watch 360 degree videos on YouTube apps for Android and iOS. Google Play aggregates VR content for consumer download.[311]
- **GoPro** VR
- **Hulu**
- **Jaunt VR App**
- **Littlstar**[312]

[304] http://www.roadtovr.com/htc-viveport-vr-app-store-client-available-new-images-suggest-breaking/
[305] http://www.nextgalaxycorp.com/
[306] https://share.oculus.com/
[307] http://store.steampowered.com/universe/vr
[308] https://www.wearvr.com/
[309] https://bitmovin.com/tutorials/vr-360-video-encoding-playout/
[310] https://eevo.com/
[311] Philip Lelyveld, "Virtual Reality Primer. With an Emphasis on Camera-Captured VR" (USC Entertainment Technology Center, July 2015).
[312] http://littlstar.com/

- **Netflix**
- **NextVR**
- **Rhapsody VR** provided by music streaming service Rhapsody. It gives access to videos of live concerts[313]
- **Samsung** Milk VR[314]
- **Sony Pictures Television's** Crackle
- **SpherePlay**[315]
- **Vantage.tv**[316]
- **VRideo**[317] **(now shut down)**
- **VRSE**[318] **(Within) (see also 3.3.3.1)**
- **WEVR** Transport

6.5. Display

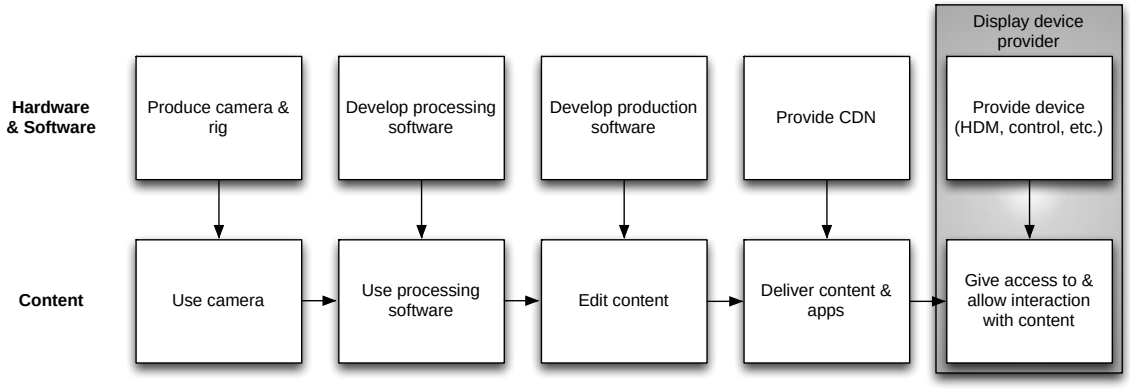

Figure 19: Display device provider – Value Network

6.5.1. Head-Mounted Displays – Integrated

HMD – Integrated are displays with the screen integrated into the unit.[319] Therefore they do not require the connection of a mobile device as the screen. However, they may require the connection to hardware, e.g. Sony PSVR requires connection to a PlayStation 4. They include

- **AntVR**[320]
- **Avegant** Glyph[321]
- **DotLab DoVision**
- **Facebook Oculus** (aka Oculus Rift) (desktop/console). Emerging out of an initial $250,000 Kickstarter campaign in 2012 that ended up raising nearly 10 times that target, Oculus has developed a fully immersive tethered VR HMD that will likely be the most heavily used and most capable headset in the consumer market, the Oculus Rift. The company was acquired by Facebook in a $2 billion deal in 2014. Oculus has also invested

[313] https://www.engadget.com/2016/05/19/rhapsody-vr/. The app is also available via Napster's website: http://us.napster.com/vr
[314] https://milkvr.com/#/
[315] http://www.sphereplay.com/
[316] Philip Lelyveld, "Virtual Reality Primer. With an Emphasis on Camera-Captured VR" (USC Entertainment Technology Center, July 2015).
[317] https://www.vrideo.com/, http://blog.vrideo.com/taking-our-goggles-off/
[318] http://vrse.com
[319] http://www.kzero.co.uk/blog/q2-2015-update-of-the-vr-hardware-radar/
[320] http://www.antvr.com/
[321] https://www.avegant.com/

to build out a complete VR platform spanning control inputs (acquisition in 2014 of the makers of the Xbox controller), content creation (Oculus Story Studio in 2015) and partnerships, along with its own proprietary headset. On the partnerships front, Samsung's Gear VR, a mobile and untethered HMD, is powered by Oculus. Oculus has also maintained a relatively open platform from the beginning and sold over 175,000 software developer kits [322].

- **Fove**[323]
- **HTC-Valve**'s Vive (desktop/console). The Vive is an HMD developed in conjunction with game developer Valve and consumer electronics manufacturer HTC. The device is powered by Valve's SteamVR, a full-featured, 360-degree, room-scale VR experience. The collaboration links the hardware expertise of HTC with the content creation expertise of Valve. The two are also already working with a wide range of partners such as HBO, Lionsgate and Google to develop Vive-specific experiences. With over 125 million active accounts on the company's traditional Steam entertainment and gaming platform, SteamVR will look to leverage a pipeline direct to its customers to allow to enjoy VR applications on the Vive[324]. They have just released one wireless version.
- **Hypereal**[325]
- **Immerex**[326]
- **Immersion** Neo VR[327]
- **Intel** Alloy[328]
- **MindMaze**[329]
- **Razer OSVR**[330] powered by **Sensics**
- **Sony** PlayStation VR[331] (console), aka Project Morpheus. It is expected to be launched in October 2016.[332] The HMD is designed to be fully functional with the PlayStation 4 video game console.
- **Starbreeze** StarVR[333]
- **Survios** (console)[334]
- **Virtual Reality (VR) Technology Limited** has introduced in June 2015 the first mass-produced 2K Virtual Reality headset: 3Glasses D2.[335]
- **VR Union Claire**
- **VRvana Totem**[336]
- **Vuzix** iWear

[322] Pitchbook, "Virtual Reality. 2015 Analyst Report."
[323] http://www.fove-inc.com/
[324] Pitchbook, "Virtual Reality. 2015 Analyst Report."
[325] http://hypereal.com/#/
[326] http://www.theverge.com/2016/6/14/11916918/immerex-virtual-reality-headset-e3-2016
[327] http://www.immersion.fr/en/neopro-vr-headset/
[328] https://newsroom.intel.com/chip-shots/intel-unveils-project-alloy/
[329] http://www.mindmaze.ch/
[330] http://www.razerzone.com/osvr
[331] http://www.wareable.com/project-morpheus/sony-project-morpheus-release-date-price-games
[332] http://fortune.com/2016/04/15/gamestop-playstation-vr-demos-key-to-sony-marketing/
[333] http://www.starvr.com/
[334] http://survios.com/
[335] http://the3glasses.com/
[336] http://www.vrvana.com/

6.5.2. Head-Mounted Displays – with mobile device

HMD – with mobile device are displays that use a third-party mobile device as the screen[337] (e.g. a mobile phone placed inserted in the HMD, thus in front of the eyes of the user). They include:

- **AlterGaze**[338]
- **Archos**[339]
- **Asus**' VR headset, to be used with the company's ZenFone.[340]
- **AuraVisor**[341]
- **Baofeng**
- **Cordon Pinc VR**[342]
- **DëePoon Virglass**[343]
- **DODOcase DIYVR**[344]
- **Durovis** Dive[345]
- **Fibrum**[346]
- **FiresVR JiDome-1**[347]
- **GameFace**[348]
- **Google** Cardboard[349]
- **Homido**[350]
- **Huawei** VR[351]
- **I Am Cardboard** DSCVR VR Headset[352]
- **Immersion VRelia**[353]
- **Ion VR**
- **LeTV LeVR Cool 1**[354]
- **LG** Vortex VRTX One[355] and LG 360 VR[356]
- **Mattel** View-Master (powered by Google)[357]
- **MergeVR**[358]
- **Metatecture AirVR**[359]

[337] http://www.kzero.co.uk/blog/q2-2015-update-of-the-vr-hardware-radar/
[338] http://www.altergaze.com/
[339] http://www.archos.com/us/products/objects/cself/avr/index.html
[340] https://www.engadget.com/2016/05/30/asus-vr/
[341] http://www.auravisor.com/
[342] http://hellopinc.com/
[343] http://www.virglass.com/
[344] http://www.dodocase.com/
[345] http://www.durovis.com/index.html
[346] http://www.fibrum.com/
[347] http://www.firesvr.com/
[348] http://gamefacelabs.com/
[349] https://cardboard.withgoogle.com/
[350] http://homido.com/
[351] https://www.engadget.com/2016/04/15/huawei-vr-headsets/
[352] http://www.imcardboard.com/dscvr.html
[353] http://immersionvrelia.com/
[354] http://technode.com/2015/12/27/letv-edges-into-virtual-reality-with-levr/
[355] http://vrtx.io/
[356] http://gizmodo.com/lg-360-vr-is-one-of-the-shittiest-virtual-reality-heads-1760569996
[357] http://www.view-master.com/en-us
[358] http://www.mergevr.com/
[359] http://getairvr.com/

- **Pico VR**[360]
- **Quantum Bakery Figment VR**[361]
- **Samsung** Gear VR is a HMD based on Samsung's smartphones. It relies on a partnership between Samsung Mobile & Oculus. It has provided the first VR appstore [362]. Samsung 360 Camera.[363]
- **Seebright**[364]
- **Stooksy**[365]
- **Sulon** Cortex[366]
- **Tencent**[367]
- **Visus VR**[368]
- **vrAse**[369]
- **Vrizzmo**
- **Wearality Sky**
- **Yay3D VR Viewer**[370]
- **Zeiss** VR One[371]

6.5.3. Controllers

Controllers are input devices using hands and/or leg and/or foot and/or body movements. Tracking is done using sensors. They can also provide tactile feedback by force or vibration.[372] They enable users to input control, in order to navigate within the immersive experience – although it can partly be done by moving the head in the case of HMD. They are complementary to HMD. Such devices include hand devices, Gloves, body units, treadmills, foot control, haptics, etc. Companies/brands include:

- **Control VR**
- **Cyberith Virtualizer**
- **Enflux**
- **iMotion**
- **InfinAdeck**
- **KOR-FX Gaming Vest**
- **Leap Motion**
- **PrioVR**
- **Reactive Grip**
- **STEM**
- **Stompz**

[360] http://www.picovr.com/
[361] http://figmentvr.com/
[362] Ray Hwang, "Enable Your Virtual Reality & Augmented Reality Technology on ARM" (ARM, 2015).
[363] http://gizmodo.com/samsung-built-its-own-360-degree-camera-for-streaming-v-1657936437
[364] http://seebright.com/
[365] http://www.stooksy.com/VR-Spektiv/
[366] http://sulontechnologies.com/
[367] http://vr.tencent.com/
[368] https://www.visusvr.com/
[369] http://www.vrase.com/
[370] http://yay3d.com/
[371] http://zeissvrone.tumblr.com/
[372] http://www.kzero.co.uk/blog/q2-2015-update-of-the-vr-hardware-radar/

- **Virtuix Omni** provides a VR interface and treadmill (and dedicated shoes) that allows users to move freely and naturally while in a virtual environment. Other products include IMU-based tracking devices named Omni PODs that attach to the Omni Shoes and aim to track the movement of each foot without noticeable latency[373].

6.5.4. Second screen software solutions

ImmersiaTV's solutions will to some extent rely on second screens, with the related challenge of ensuring multi-device synchronisation. Such providers include:

- **Ares Interactive Media**
- **Companion Screens by BBC R&D**[374] This research explored the technologies that could be used to control and synchronise a TV programme across a number of devices, and experimented with the kind of programme formats that might work across more than one screen. They have developed a new protocol, Universal Control, which provides a standard for devices on the home network, such as a mobile phone or tablet, to access and control network-connected set-top boxes.
- **Dish Network's** Dish Anywhere Mobile App
- **Disney** Second Screen
- **Mufin**[375] provides software solutions (audioid) for second screen applications, which enable to connect and synchronize the second screen such as a smartphone, tablet or laptop with the TV, VoD and movie. This notably allows to create new ways of storytelling by considering new formats, multiple screens or interfaces from the beginning and to measure viewers interests and participation
- **SmallTownHeroes**, a spin-off of VRT-medialab

There also several apps that allow social consumption of TV content, such as **GetGlue, SocialGuide, Miso or Tunerfish**.[376]

6.6. End-to-end platforms

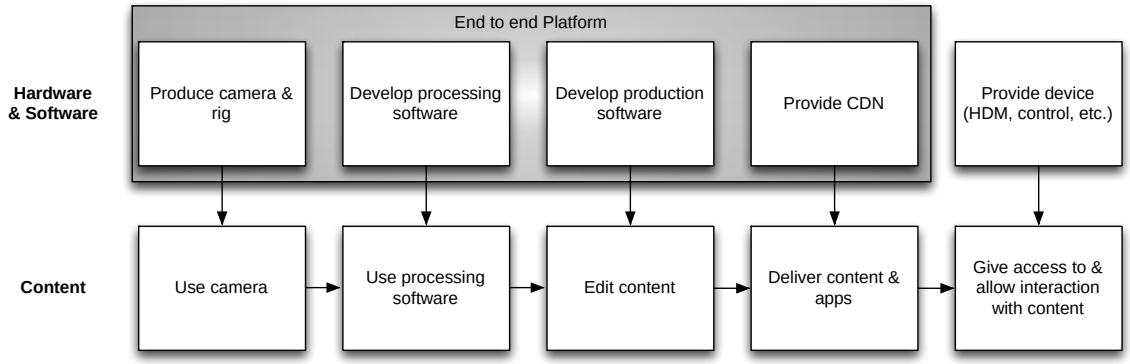

Figure 20: End-to-end platform – Value Network

Platforms proposing live production include:

- **Immersive Media** (see case study)

[373] Pitchbook, "Virtual Reality. 2015 Analyst Report."
[374] http://www.bbc.co.uk/rd/projects/companion-screens
[375] https://www.mufin.com/usecase/second-screen/
[376] https://www.good.is/articles/double-the-glow-will-second-screen-apps-change-the-way-we-watch-tv

- **LiveLike**[377] is a VR platform that enables broadcasters and sports teams to deliver immersive, live sports viewing experiences. This US company with European offices in France insists on (i) being the first to offer an experience with strong connection through social networks; (ii) the easiness for broadcasters to adopt LiveLike's technology.
- **LiveSphere** provides a turnkey solution that allows broadcasters to create and deliver a high-quality live 360° television experience for their viewers. It includes 360° Video Capture (up to 500 Megapixels per second, using multiple cameras with overlapping fields), 360° Video Stitching, Encoding & Streaming, and Decoding & Displaying (real-time decoding and dynamic display - one field of view on the end-user's second screen)[378]
- **NextVR** (see case study)
- **Perfant**, a VR visual technology solution provider who claims to be the only high-tech company in the world that owns the mobile VR live streaming technology[379]
- **Reality Lab**[380]
- **Specular Theory** is a technology company and full service production facility for virtual reality content. They have developed proprietary content creation tools for recording, uploading and sharing live-action VR content.[381]
- **Universal Music Group (UMG)** has partnered in early 2016 with US radio and events giant **iHeartMedia** to create a series of virtual reality (VR) music experiences. They are supposed to 'connect artists, music fans and brands and sponsors'.[382]
- **Teradek**'s Sphere[383]
- **VantageTV**[384]
- Vahana VR1.0 **(VideoStitch's)**[385]
- **Voke VR**[386] Their fields include sport and entertainment (e.g. live concerts).

Other platforms include:

- **Condition One**[387] provides cameras with proprietary stitching software, video player and mobile apps for Samsung Gear VR and Google Cardboard. It also develops content, e.g. in partnership with *The New York Times* or the Utah Office of Tourism.
- **Jaunt** (see case study)
- **Scratch VR** Suite,[388] a commercial software for grading VR content

[377] http://www.livelikevr.com/ https://evs.com/en/news/evs-announces-winners-its-first-ever-c-cast-applied-challenge
[378] http://www.livesphere.com/solution.php
[379] http://www.perfant.com/en/aboutus.html
[380] http://fortune.com/2016/01/11/cnet-founder-launching-virtual-reality-network/?utm_content=bufferfd5f7&utm_medium=social&utm_source=twitter.com&utm_campaign=buffer
[381] http://www.speculartheory.com/
[382] http://www.musicbusinessworldwide.com/universal-music-is-making-virtual-reality-concerts-with-iheartmedia/
[383] http://teradek.com/collections/sphere-family
[384] https://vantage.tv/
[385] http://www.video-stitch.com/vahana-vr-live-360-video-1-0-released/
[386] http://vokevr.com/
[387] http://www.conditionone.com/
[388] http://www.assimilateinc.com/products/scratch-vr/

- **Total Cinema 360**[389] is a full-service production studio and software development company (including content distribution software) specializing in virtual reality and spherical 360 audio-video content.
- **VRCade**[390]
- **Vrtify**[391] defines itself as the first VR music platform.

[389] http://totalcinema360.com/
[390] http://vrcade.com/
[391] http://www.vrtify.com/