



Report on the current
state of the VR market

INTRODUCTION

“One day, we believe this kind of immersive, augmented reality will become a part of daily life for billions of people.”

Mark Zuckerberg

In March 2014, Facebook acquired Oculus VR, a manufacturer of virtual reality goggles, for an equivalent of USD 2 billion (USD 400,000,000 in cash plus 23.1 million Facebook shares). Since that moment, the world has become more virtual than we ever thought it would be. Technological media, whose traditional area of interest was the release of new smartphones, tablets or graphics adapters, now have another intriguing topic to focus on.

ality market is expected to reach USD 150 billion in 2020², and there will be 30,000,000 dedicated devices in the US and EU in 2018. These figures are impressive to everyone.

Today, on this market, Facebook and Oculus are joined, or will be joined within the next few months, by nearly all major hardware vendors (Samsung, HTC, Sony, Microsoft, Google, Epson, LG) and by many aspiring players active in niche segments. The increase of VR devices from 2016 will entail a growing demand for dedicated virtual reality applications because, as participants of the AMD conference have unanimously admitted at the 2015 E3 event: “It’s all about content.”³

The broad representation of the world’s largest corporations among virtual reality goggle manufacturers certainly means one thing: **the virtual reality market is currently unfolding before our very eyes.** However, its successful growth depends on more factors than just large goggle vendors. For the customer, hardware design and capabilities are not the only thing that matters. The key is the VR applications able to fully exploit these capabilities. The aforementioned VR equipment manufacturers are aware that, once their devices are released, the development of a broad portfolio of games and applications will provide the greatest monetizing opportunities in the VR segment. That view on market is confirmed by large corporations looking for acquisition targets among companies who employ teams skilled in VR application development. For instance, Google invested in VR Resolution Games, a startup studio valued at USD 25,000,000.⁴

2 <http://www.digi-capital.com/news/2015/04/augmentedvirtual-reality-to-hit-150-billion-disrupting-mobile-by-2020/#VYx4b-q1iY>

3 <http://www.roadtovr.com/tech-industry-heavyweights-debate-the-future-of-vr-at-amd-vr-advisory-council/>

4 <http://blogs.wsj.com/digits/2015/08/26/google-ventures-funds-swedish-vr-gaming-startup/>



The purpose of this paper is to provide readers with a closer look at the current progress and potential behind the Virtual Reality market. We write here about a potential which comes as a pleasant surprise even to the Reality51 team, the technological department of The Farm51 Group S.A. (a computer games manufacturer listed on Warsaw Stock Exchange). No wonder we react this way: the forecasted CAGR (Compound Annual Growth Rate) within the next 5 years is 100%¹, the value of the Augmented/Virtual Re-

1 <http://www.businessinsider.com/virtual-reality-headset-sales-explode-2015-4>

Such valuations become less surprising given that, according to forecasts by Tractica, an analytical company, the VR applications market is supposed to reach ca. USD 15 billion within 5 years.

VR applications may be used by many industries to satisfy various users' needs. Unknown experience involved in virtual trips from a hotel room (VRoom Service developed by Marriott)⁵, fashion shows and backstage (Dior Eyes)⁶, virtual presence at concerts⁷, or doctor training and virtual surgery⁸ are the areas that might turn out be of key importance, in addition to games. What also needs to be mentioned are the countless applications of augmented reality which, according to available forecasts, may become a market four times larger than virtual reality.

We hope that the virtual reality market will come up to expectations. We also believe that, at

least as regards VR applications, the position of Polish developers on the VR market will be comparable to that they hold on the computer games market. Note that applications which achieve a substantial market success obviously result from an interesting concept of the developer rather than from a huge production budget. And, as a nation, we have always been ingenious, no further evidence is necessary in this respect...

Reality 51 demonstrates skills and experience in that area. We are implementing our first projects for customers from various industries, such as the army (projects for Polska Grupa Zbrojeniowa/**Polish Armaments Group**), computer games (a Get Even version dedicated to VR devices will be developed), automotive sector (virtual configuration wizard for the Arrinera supercar), and proprietary educational and tourist projects (Chernobyl VR Project).



DEFINITIONS

[Virtual reality] is really a new communication platform. You can share unbounded spaces and experiences with the people in your life. Imagine sharing not just moments with your friends online, but entire experiences and adventures."

Mark Zuckerberg

Virtual Reality (VR) means the experience of being totally immersed in a purely virtual world.

When using VR devices, the user wears on his/her head a dedicated headset with built-in display or two oculars, powered by a computer, game console or smartphone. With specialized software and sensors, your virtual experience becomes reality. Usually, virtual content is enhanced with 3D spatial sound.

Augmented Reality (AR), means an experience of actual reality enhanced with virtual images or data which coexist with the real world.

A typical AR experience will probably be much less exciting than meeting a virtual dinosaur or riding a roller coaster. However, according to analysts, the market potential behind AR uses is

actually much higher than that behind the commercial use of VR. For now, reality is augmented by adding digital information, mainly in the form of simple character strings, phone numbers or text notifications. But there are experiments that go much further.

MR, Mixed (or Hybrid) Reality, means a system that combines real and virtual objects with information shown based on Augmented Reality. MR endeavors to combine the best of VR and AR.

Theoretically, Mixed Reality allows the user to see the real world (just as AR) while seeing credible virtual objects (just as in VR). Placing virtual objects in real space allows them to be considered "real," at least from the perspective of the person involved in the MR experience.



CURRENT STATE OF THE VR MARKET

"I believe Virtual reality is another large computer platform. Many people will experience it for first the first time using their phones."

Mark Zuckerberg

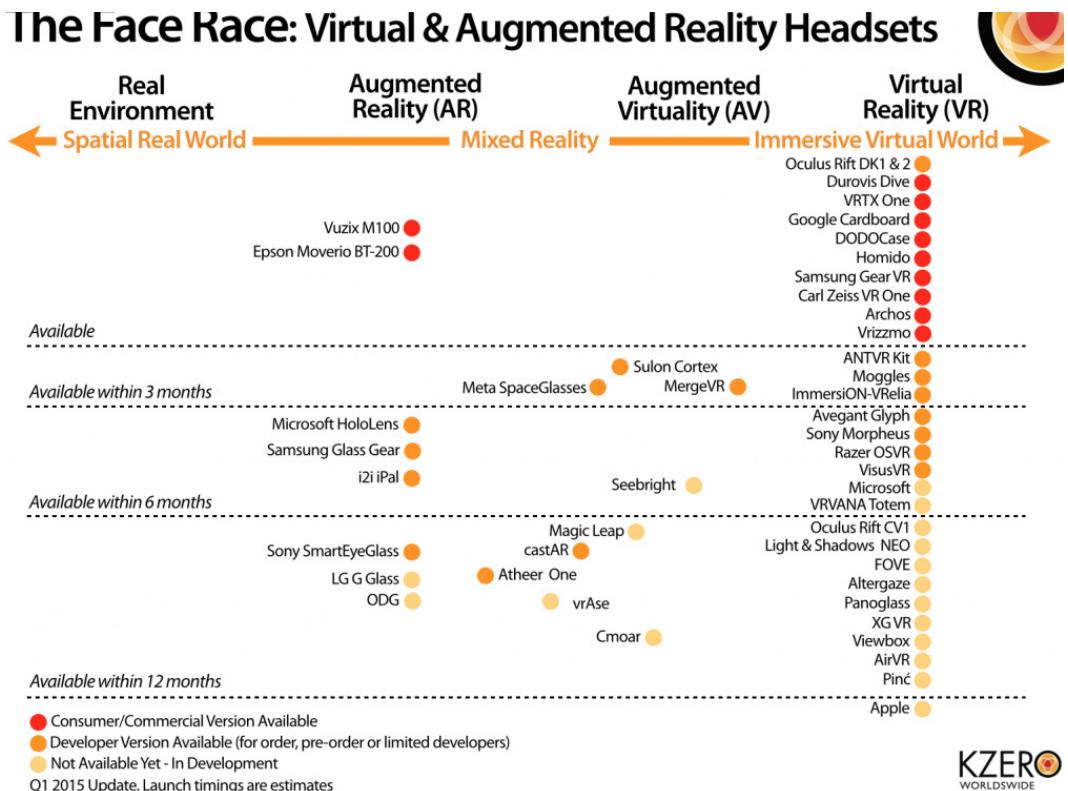
It is very difficult to unambiguously assess the current state of the world's VR and AR market. Most of currently available devices are prototypes or development kits and cannot be considered as a reference to the potential behind commercial products announced to be released in 1Q and 2Q 2016. According to CCS Insight, an analyst company, 2.5 million VR and AR devices will be sold by the end of 2015. However, the Business Insider Intelligence report specifies the current value of the market to be only USD 37 million. This is a definitely smaller amount, bearing in mind that the standard price

of Samsung VR Gear is USD 100-200, and the final prices of Oculus and HTC are estimated to be USD 300 and USD 400-500, respectively.⁹

In turn, according to Tractica, a research company focused on human interaction with technology, the value of the combined market of VR headsets, VR applications and VR accessories was USD 108.8 million in 2014.¹⁰

9 Report by Travis Jakel from Piper Jaffray, <http://fortune.com/2015/05/07/vr-headset-launches/>
10 <https://www.tractica.com/research/virtual-reality-for-consumer-markets/>

Summary of VR and AR devices



The summary above shows the current state of the VR and AR devices market and the planned release dates of devices within the next year. The 11 currently available devices are only a small portion of what is planned to be released within the next 6 months (17 devices) and by the end of 2016 (subsequent 17 devices).

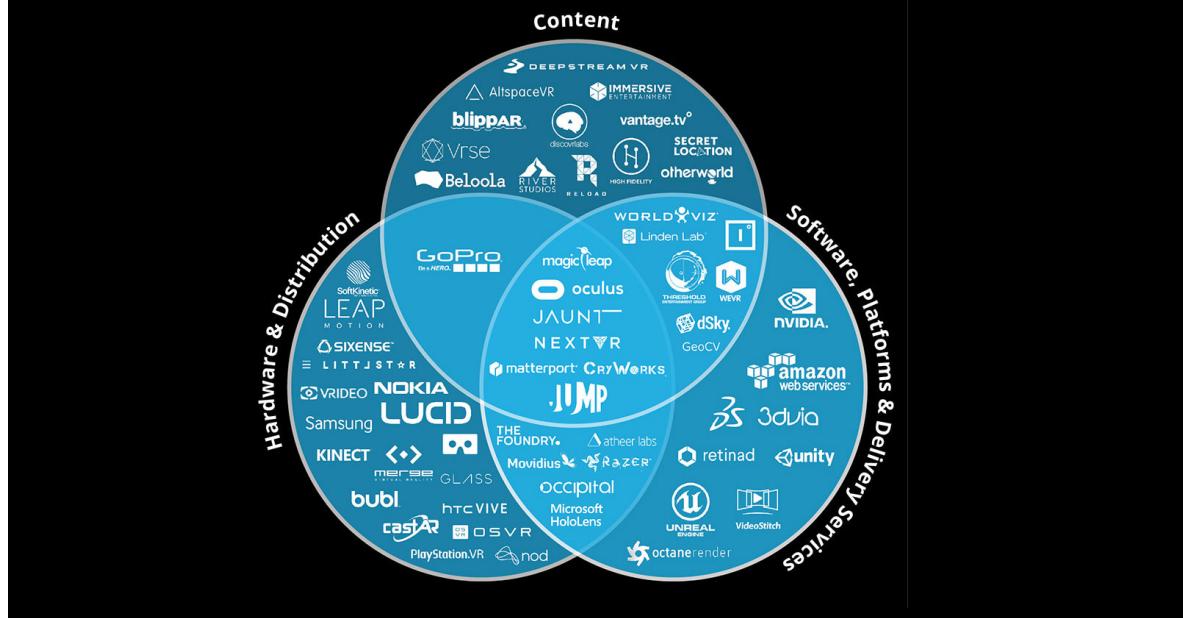
The Side-kick Games study on the consumers' interest in using VR equipment also provides valuable insights. According to the sur-

vey conducted by YouVisit on a group of 1,000 Americans, 11% of respondents (18% in the 18-24 group) already have some experience in using VR equipment, while 30% declare to be interested in testing that technology. And this means 86 million potential end users in the US alone.¹¹

Below, you may see the related infographics showing key VR players and commercial users of VR applications.

11 <http://www.slideshare.net/guybendov/vr-market-for-gi-s-15>

Key players on the VR market



Companies who use VR for commercial purposes



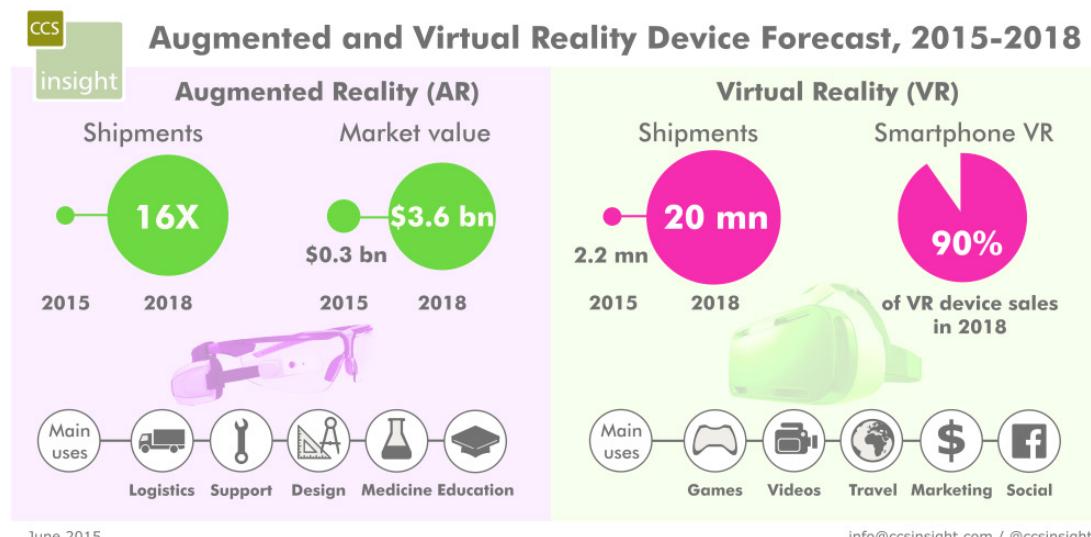
POTENTIAL BEHIND THE VR MARKET

"Each subsequent technology generation has brought various experience, and has also fundamentally changed the approach to gaming. VR is indeed interesting, and I believe it will become a breath of fresh air for the gaming industry,"
John Riccitiello, CEO at Unity3D, former CEO at EA

According to many experts, VR has the potential to become one of the top breakthrough technologies of the next decade. The forecasts of various research centers consistently show that Augmented and Virtual Reality may become a new turning point for the development of multimedia technologies. It is hard to estimate the reliability of data provided by specific research companies and to determine the basis for their long-term market growth forecasts. This is why, later on in this paper, we will present all forecasts we managed to obtain when preparing this content.

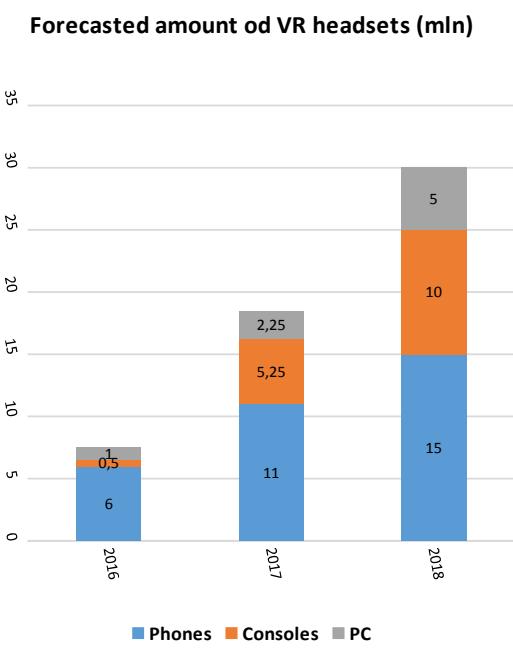
CS Insight expects the number of sold VR and AR devices to grow from 2.5 million (2.2 million VR devices and 0.3 million AR devices) sold in 2015 to 24 million in 2018 (20 million VR devices and 4 million AR devices). According to CCS Insight, in 2018, smartphone-based devices will represent a very large share (as much as 90%) of sold VR devices. The value of the AR market is supposed to grow from USD 300 million at the end of 2015 to USD 3.6 billion at the end of 2018. This means the approximate VR market value would be USD 18 billion.

Forecasted growth of the VR and AR equipment market



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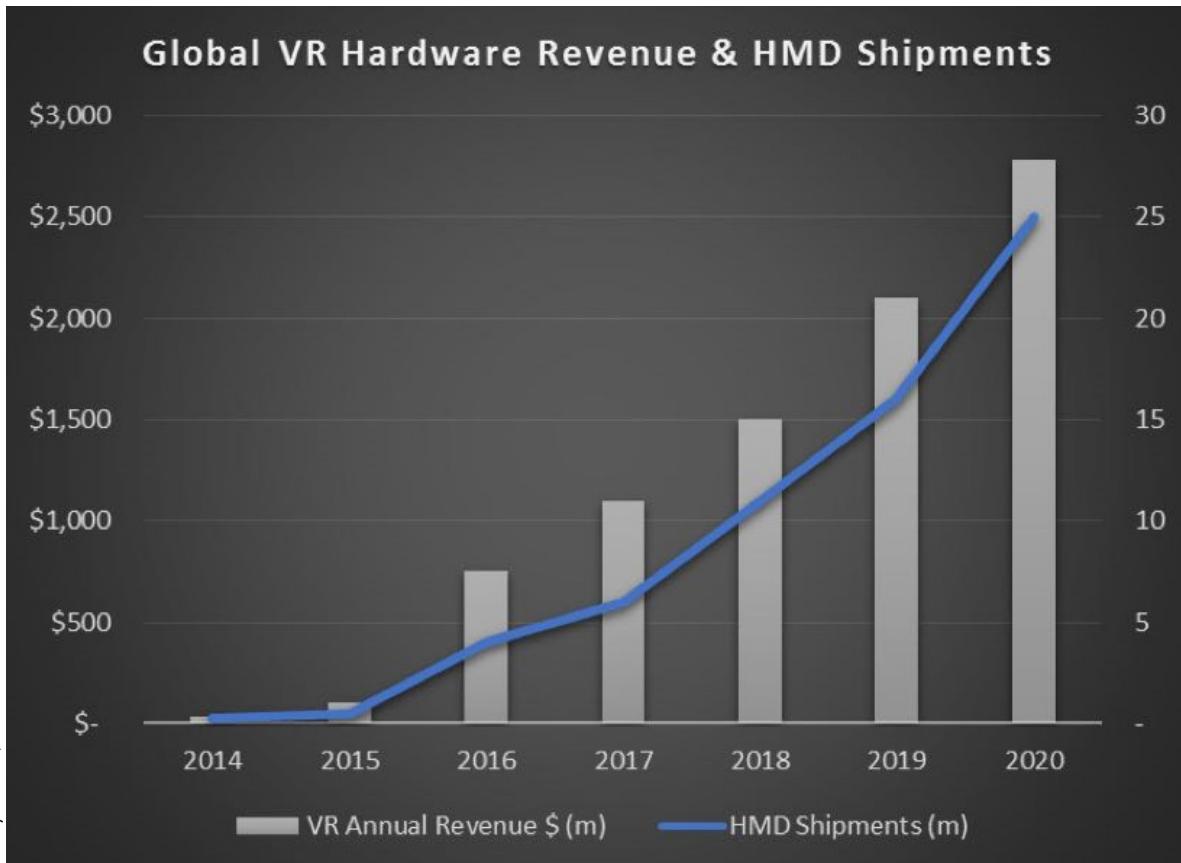
Source: VR Council AMD, <http://www.hypergridbusiness.com/2015/09/and-mobile-will-dominate-vr-headsets-in-2018/>



Above forecast of VR devices in the period from 2016 to 2018 was presented during the VR Council conference organized by AMD. It was assumed that in 2016, smartphone-based goggles will represent 80% of the equipment market (6 million out of the total of 7.5 million). However, in 2018, that share is supposed to decrease to 50% while console-based VR and PC-based VR will stand for 30% and merely 16%, respectively.

So, did Facebook overpay for Oculus?

Source: <http://www.roadtovr.com/tech-industry-heavyweights-debate-the-future-of-vr-at-amd-vr-advisory-council/>



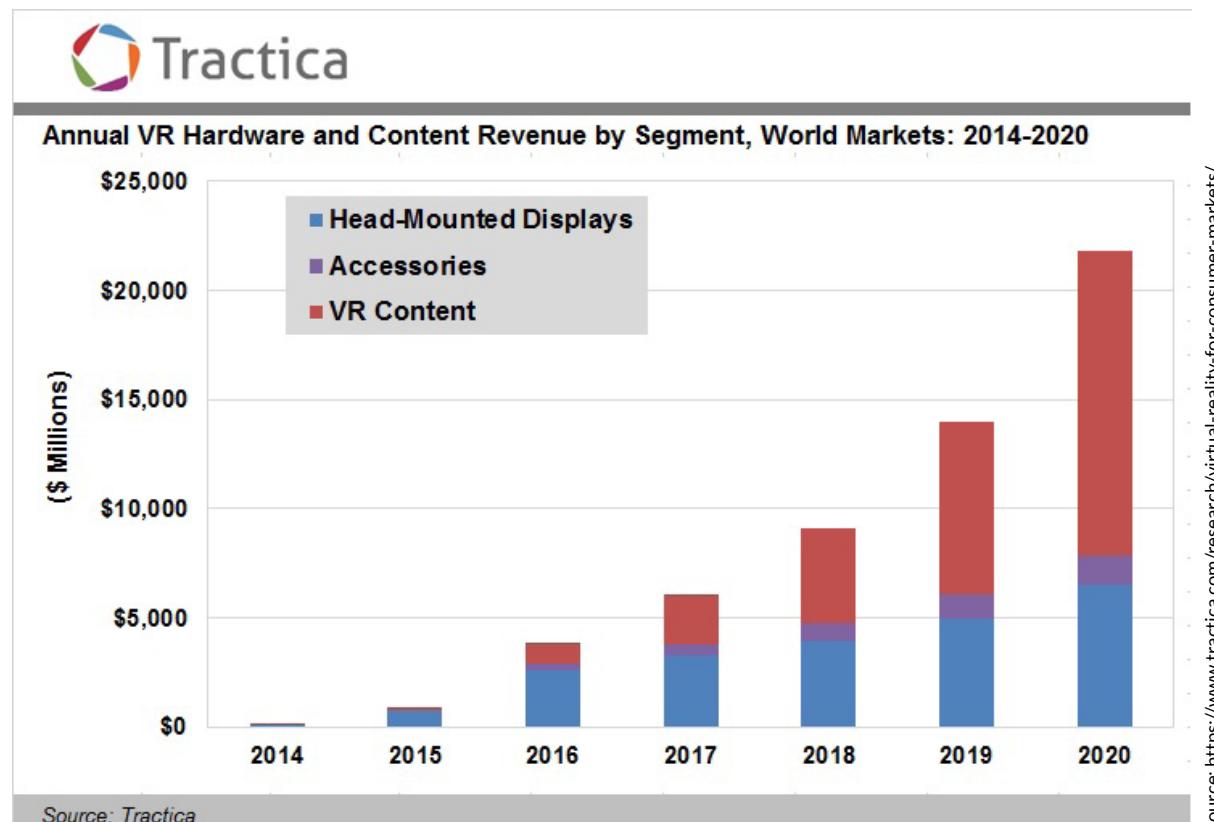
That hypothesis could be confirmed only if the most pessimistic available data, as delivered by BI Intelligence, is treated as probable. A similar number of VR devices on the market

is assumed in the presented forecasts and in information delivered by AMD, i.e. ca. 15 million in 2018 and ca. 25 million in 2020. However, the assumptions provide for very low device

prices (ca. USD 108 in 2020), and therefore the resulting VR equipment market value is only USD 2.8 billion. During that conference, opinions were highly divided as to the market division by devices. A representative of 20th Century Fox pushed hard for the development of PC-based VR. He believed this to be the faster way, and justified his point of view with the underestimated potential behind HTC Vive goggles. In turn, a representative of Unity Technologies (manufacturer of a mobile games engine)

claimed that the share of smartphone-based VR would remain at a level beyond 50%. All of those opinions ultimately boiled down to a sentence which summarizes the conference: "It's all about content,"¹² and the Reality51 team could not agree more with that. The success of the VR or AR market will largely depend on the availability of interesting content that catches the eye of the user for more than a few minutes of using the device out of pure curiosity.

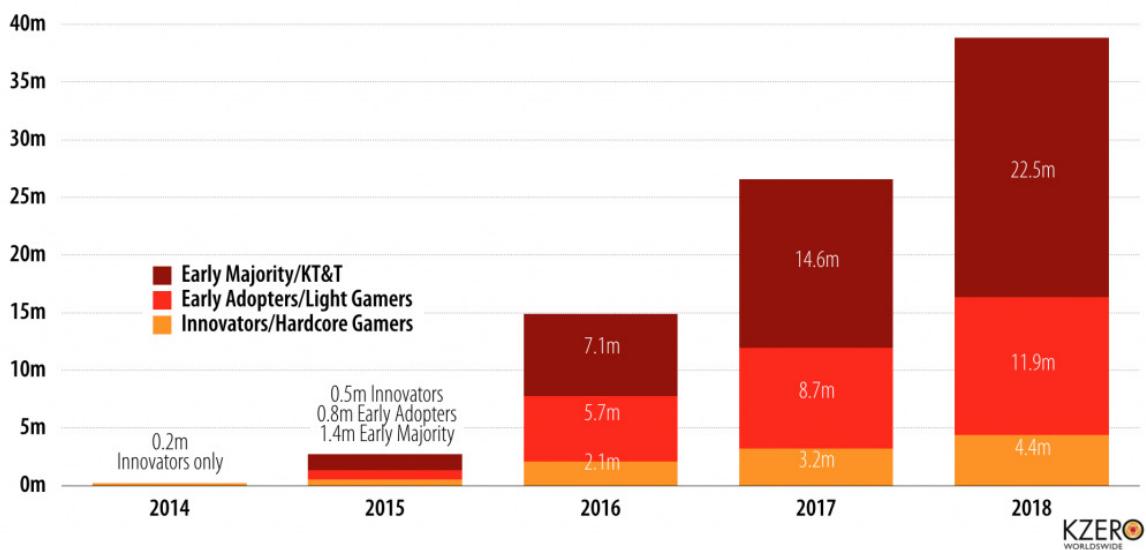
¹² <http://www.roaddtovr.com/tech-industry-heavyweights-debate-the-future-of-vr-at-amd-vr-advisory-council/>



As regards the size of the VR applications market, very optimistic data was presented by Tractica, a research agency. They assume that the VR goggles, accessories and applications market, worth only USD 108.8 million in 2014, will grow at a rate of 142% (CAGR) to reach

USD 21.8 billion in 2020. Meanwhile, the value of the VR applications market will reach as much as USD 15 billion in 2020. Tractica believes the growth will be mainly based on cheap VR devices for smartphones.

HMD Unit Sales

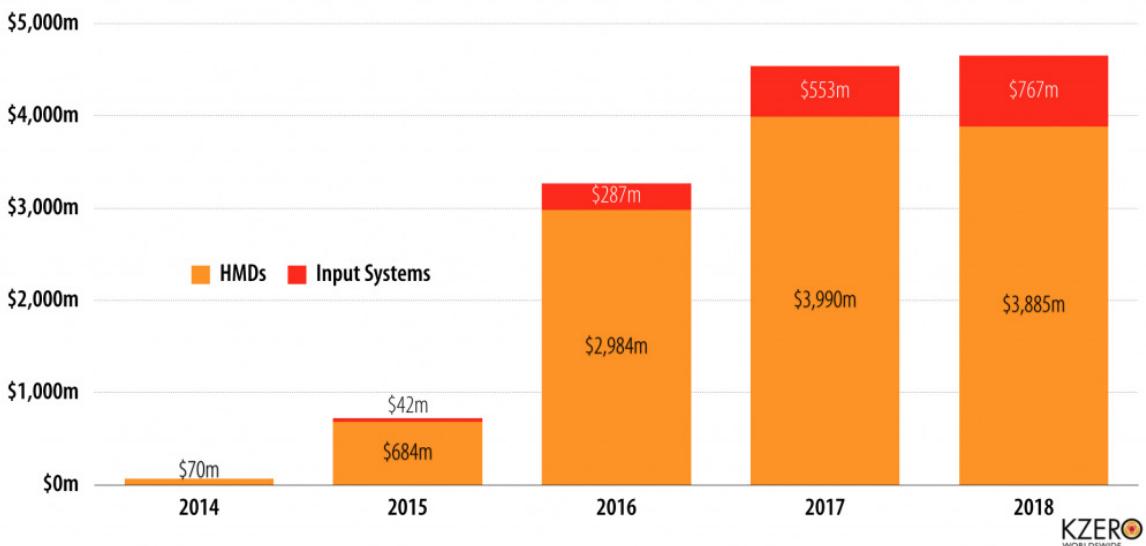


Data delivered by Kzero, a UK-based agency, is also very interesting. They assume that in 2018, 39 million VR goggles will be sold worldwide, and the 5-year aggregate sales will reach a total of 83 million units.

Although the assumed size of the VR goggles market in 2018 is definitely bigger than that forecasted by BI Intelligence (3.8 billion vs. 1.1 billion), the assumptions as to the average price

of devices are similar: the price does not go beyond USD 100. Also, Kzero attempted to specify the assumed number of potential VR equipment users. They believe that in 2014, there was 400 million people throughout the world potentially interested in purchasing such a device. In 2018, that number is supposed to reach 450 million which means the market penetration rate for the devices would be 8.8%.

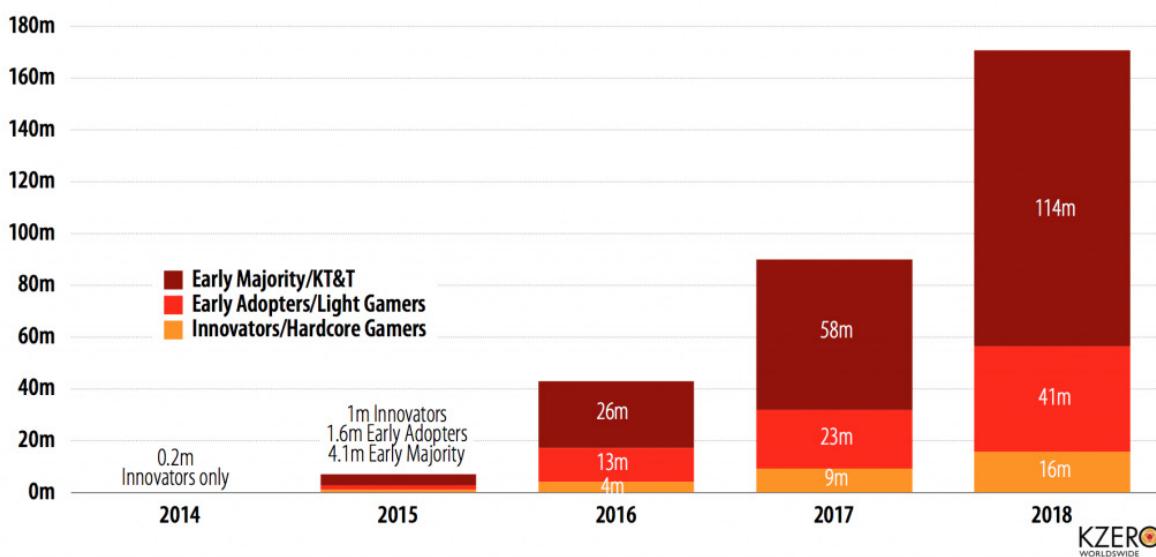
Hardware Revenue Summary





Source: <http://www.kzero.co.uk/blog/virtual-reality-software-revenue-forecasts-2014-2018/>

Active Virtual Reality Users

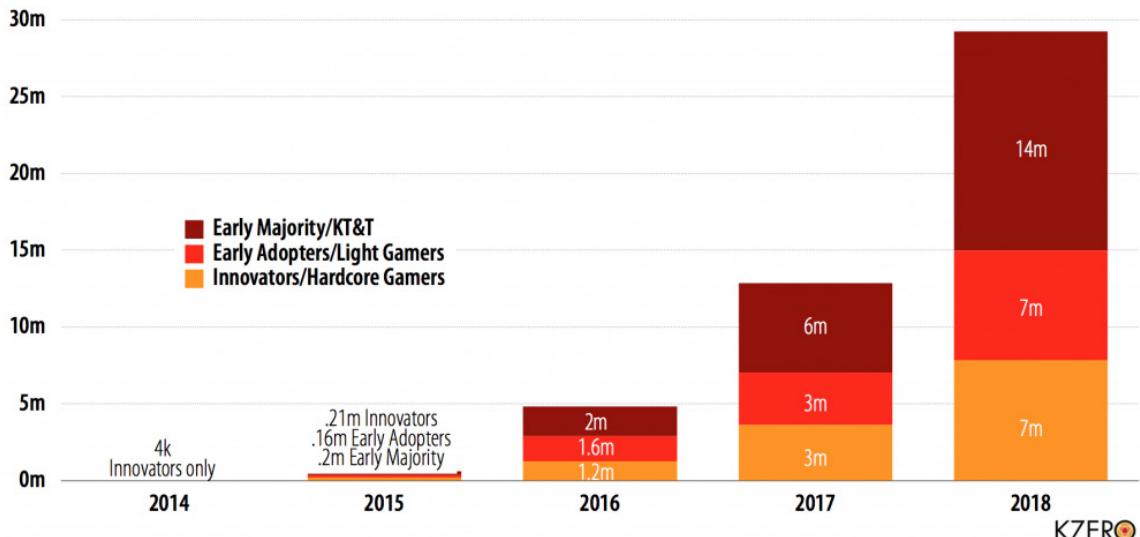


Meanwhile, interesting assumptions were made as to active VR users. The number of active users of VR devices expected by Kzero in 2018 is 171 million (38% of potential users and 2.3% of the entire world population at that time¹³). Previously, they assumed that 39 million devices would be sold on the market. This means that, according to Kzero's forecasts, one device will be used by more than 4 users on average.

The findings from the analysis of assumptions regarding users who will pay for VR applications are even more interesting, especially for VR content developers. It is assumed that the number of paying users of VR applications will grow from 8.5% in 2015 to 17.1% in 2018, which means 0.57 million and 28 million paying users in 2015 and 2018, respectively.

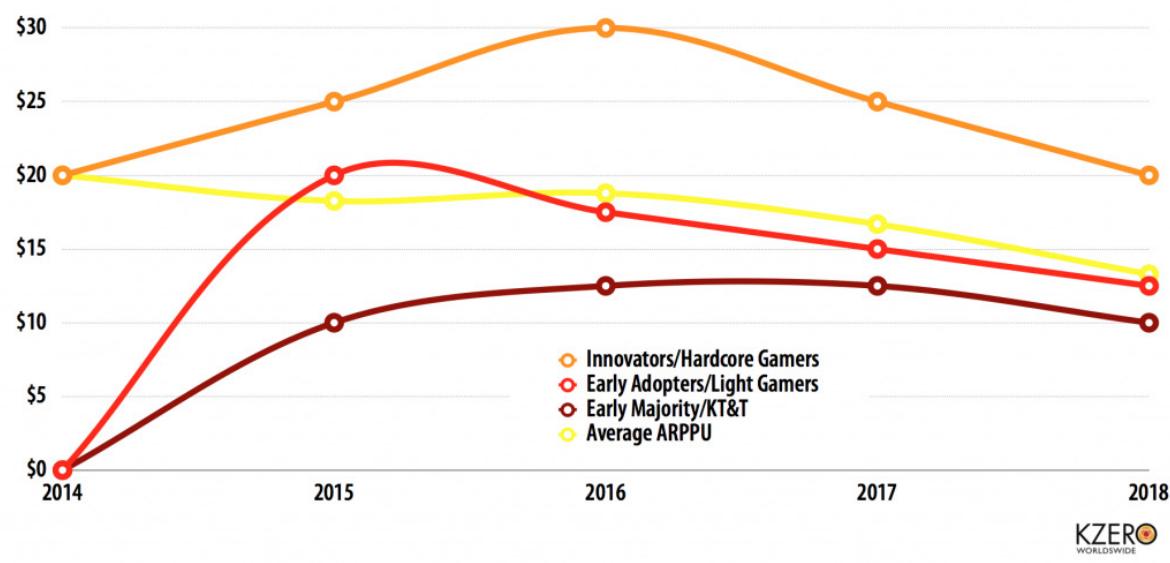
¹³ According to a World Bank forecast, the world population will reach 7,564,518,000 in 2018

Paying Virtual Reality Users



Source: <http://www.kzero.co.uk/blog/virtual-reality-software-revenue-forecasts-2014-2018/>

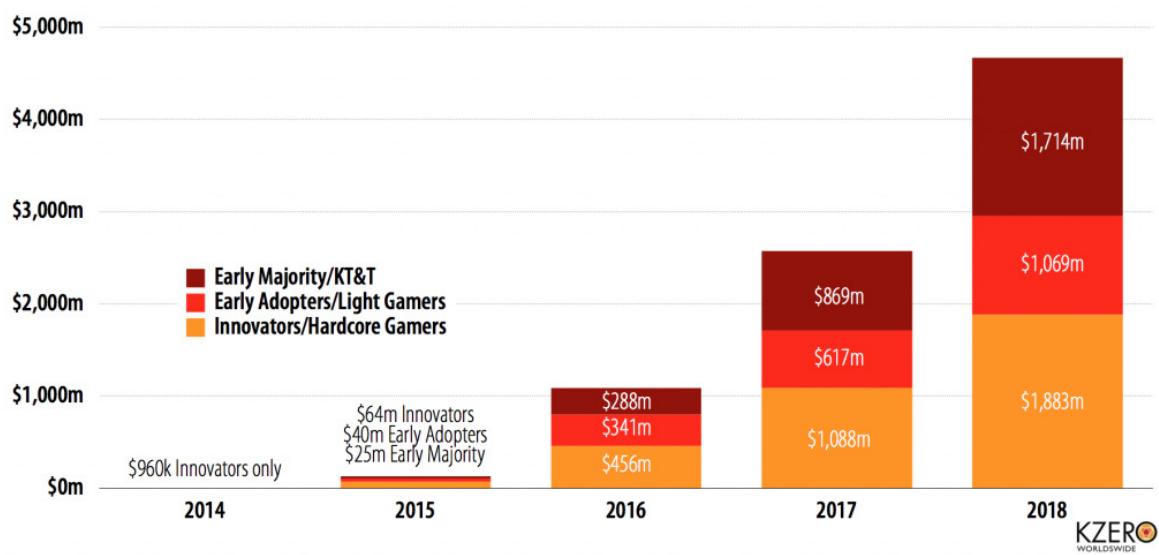
Average Revenues (Monthly) per Paying User (ARPPU)



In order to forecast the ARPPU (Average Revenue Per Paying User), Kzero relied to a large extent on their experience and knowledge in the MMO and social gaming sector. According to the presented assumptions, in the

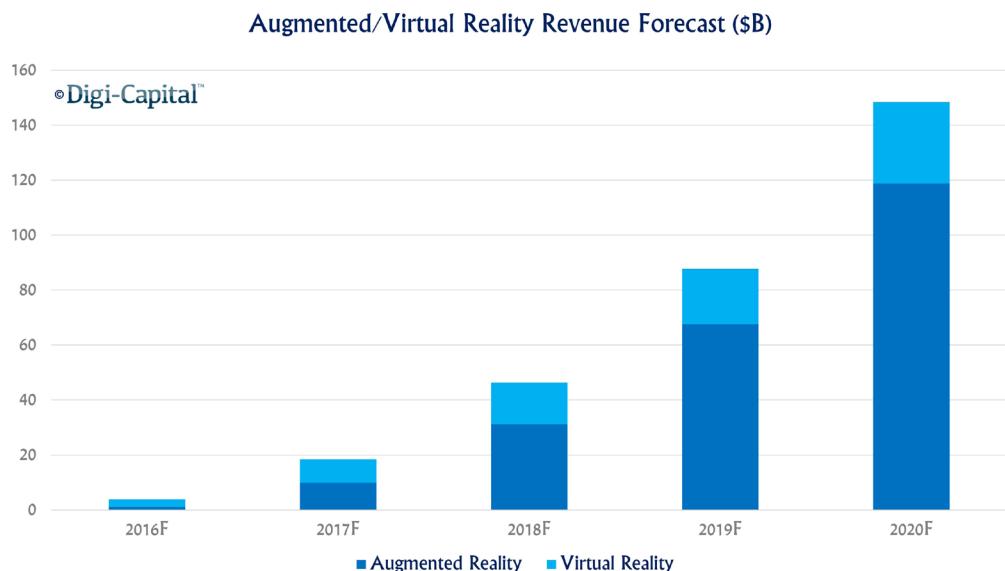
case of the most active users, the peak monthly payment for VR applications will be ca. USD 30, while the average for the entire market will decrease from the initial level of USD 20 to ca. USD 14 at the end of 2018.

Annual Software Revenues



As a consequence of the aforesaid assumptions, the value of the VR applications market in 2015 (when the first commercial games and applications entered the market) is USD 129 million. Kzero expects the software revenue to

reach ca. USD 1 billion in 2016 and USD 4.6 billion in 2018. The cumulative value of the VR applications market from 2014 to 2018 will reach USD 8.4 bln.

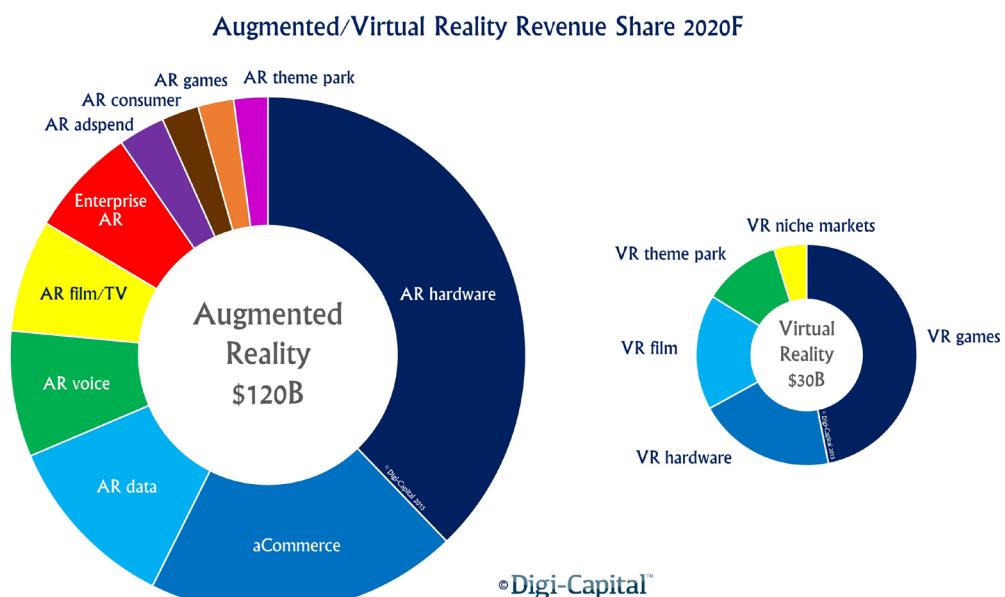


Source: <http://www.digi-capital.com/news/2015/04/augmented/virtual-reality-to-hit-150-billion-disrupting-mobile-by-2020/#VYx4b-qiY>

An incredibly interesting approach was presented by Digi-Capital, a market research company focused on mobile Internet, Virtual Reality and computer games. They assume that the AR and VR market will reach a huge total value of USD 150 billion in 2020, primarily because of the enormous potential behind AR applications, estimated by Digi-Capital at USD 130 billion.

Digi-Capital believes that the VR market will mainly focus on 3D movies and games, and on niche B2B solutions. There may be tens of million VR users, and the hardware prices will be comparable to those of today's consoles.

Meanwhile, according to Digi-Capital, the AR market will become similar to the smartphone or tablet market. Thus, there may be hundreds of million AR users, and the hardware price range will be comparable to that of smartphones and tablets. The economics of AR software and services may be similar to that of today's mobile phone market. A large AR user base will be the primary source of income for the TV, movie and advertising market, and for applications such as Facebook or Uber. According to Digi-Capital, Amazon and Alibaba will operate brand new sales platforms oriented towards a "virtual" mass audience.



Source: <http://www.digi-capital.com/news/2015/04/augmented/virtual-reality-to-hit-150-billion-disrupting-mobile-by-2020/#VYx4b-qiY>



Piper Jaffray, the US-based investment bank, also shared their opinion on the VR market in a report titled “NEXT MEGA TECH THEME IS VIRTUAL REALITY.” They believe the state of virtual and augmented reality today is similar to the state of mobile phones 15 years ago. According to Piper Jaffray, we need to wait a decade for a full commercialization of VR devices (first) and AR devices (afterwards) on the market. They value the VR applications market at USD 5.4 billion in 2025. The forecasted value of the hardware market is USD 62 billion, provided that 500 million devices are sold until 2025. The market is supposed to be primarily driven by games, sport events broadcasting, concerts, 360° movies and new social media.

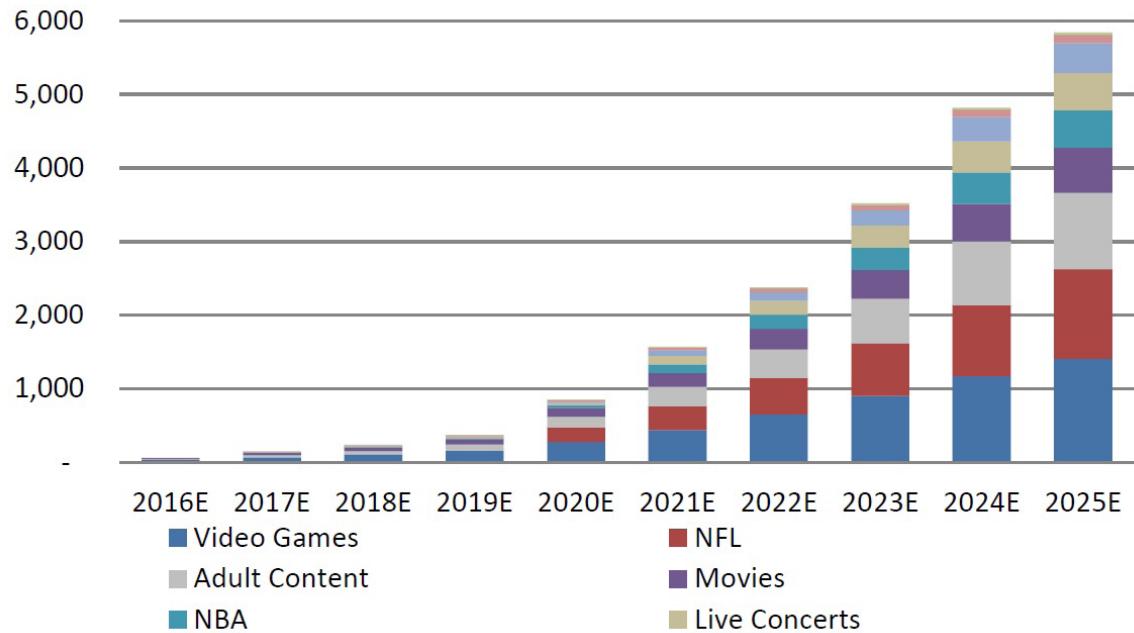
According to a forecast by Travis Jakel, analyst at Piper Jaffray, there will be 12.2 million VR devices on the market in 2016. The sales volume of Oculus Rift will reach 3.6 million while the successful cooperation between Oculus and Samsung will result in selling 5 million Sam-

sung Gear VR units. The forecasted 2016 sales of HTC Vive and Playstation VR are 2.1 million units and 1.4 million sets, respectively.

As a summary of the analytic forecasts, we would like to discuss data delivered by SuperData Research. According to that report, 31% of US console game players plan to purchase a PlayStation VR which means 3.4 million devices (with the current base of PS4 consoles sold). The same report also assumes that 18% PC game players intend to buy an Oculus Rift.¹⁴ According to SuperData Research, the total sales of VR devices is supposed to reach 70 million units by the end of 2017. As a result, the value of the hardware market and of the applications market will be USD 8.8 billion and USD 6.1 billion, respectively. In 2019, the total value of both markets is supposed to attain USD 15.9 billion.

¹⁴ <http://www.ibtimes.co.uk/virtual-reality-analyst-superdata-predicts-vr-install-base-70-million-by-2018-1530030>

VIRTUAL REALITY REVENUE BY INDUSTRY (In Millions)



Source: <http://uploadvr.com/facebook-tolls-apple-vr-and-half-a-billion-units-sold-piper-jaffray-report-on-vr/>

MERGERS AND ACQUISITIONS ON THE VR MARKET

"Gaming in the next two or three years will set this market up, grow it to this USD 5 or 6 billion," Mike Hayes, former CEO at Saga, currently manager at Mercia Fund Management.

According to Greenlight VR estimations, investments made on the VR market within the last 5 years by over 166 investors went beyond USD 765 million¹⁵ (acquisitions excluded). Below, you may see a summary of mergers and acquisitions on the VR and related markets in 2014-2015.

Note that due to the early stage of the VR market development, the acquired companies were mostly start-ups and did not generate any profits or, in some cases, not even any revenue.

¹⁵ <http://uploadvr.com/vr-ar-investment/>

M&A transactions on the market

Buyer	Acquired party	Description of the business	Transaction amount	Transaction date
Facebook	13 th Lab	Manufacturer of 3D sensors	unavailable	Dec 14
Venture capital funds	AltspaceVR	Manufacturer of VR applications	USD 15.7 million	Jul 15
Venture capital funds (including Qualcomm Ventures)	BlippAR	Developer of AR applications	USD 45 million	Mar 15
Venture capital funds (New Enterprise Associates)	CCP Games	Developer of AR applications	USD 30 million	Nov 15
Venture capital funds (including Google Ventures)	High Fidelity	Developer of the VR applications ecosystem	USD 17.5 million	Feb 15
Venture capital funds (including Andreessen Horowitz)	Improbable	Developer of VR-based simulators software	USD 20 million	Mar 15
Venture capital funds (including Google Ventures and Walt Disney Company)	Jaunt	Developer of VR content and applications for 360° movies playback	USD 100 million	Sep 15
GoPro	Kolor	360° movies creation software	unavailable	Apr 15
ALPHAEON Corporation	LensAR	Manufacturer of AR devices intended for medical purposes	USD 169.5 million	Nov 15
Venture capital funds	Leap Motion	Developer of AR applications	USD 44.05 million	Oct 15
Google	Magic Leap	Manufacturer of AR devices	USD 542 million	Oct 14
Venture capital funds (including Qualcomm and AMD Ventures)	Matterport	3D camera for facility modeling	USD 56 million	Jun 15
Venture capital funds	Merge VR	Manufacturer of VR headsets	USD 1.4 million	Dec 14
Apple	Metaio	Developer of AR applications	unavailable	May 15
Venture capital funds (including Robert Bosch Venture Capital)	Movidius	Manufacturer of chips for mobile VR devices	USD 86.5 million	Apr 15
Venture capital funds	Nantmobile	Mobile 360° movie platform	USD 110 million	Oct 14
Venture capital funds (including Time Warner Investments)	NextVR	Developers of applications for live 360° movie broadcasting	USD 35.5 million	Nov 15
Facebook	Nimble VR	Manufacturer of 3D sensors	unavailable	Dec 14
Venture capital funds (including Google Ventures)	Nod	VR control device	USD 13.5 million	Jun 15
Facebook	Oculus	Manufacturer of VR goggles	USD 2 billion	Mar 14
Facebook	Pebbles Interfaces	Manufacturer of 3D sensors	USD 60 million	Jul 15
Apple	PrimeSense	Manufacturer of 3D sensors	360 mln \$	Nov 13
Venture capital funds (including Google Ventures and Bonnier Growth Media)	Resolution Games	Developer of VR games	6 mln \$	Aug 15
Venture capital funds	Reload Studios	Developer of VR computer games	6 mln \$	Oct 15
Facebook	Surreal Vision	Real-time 3D reenactments	brak danych	May 15
Venture capital funds (including Google Ventures)	Virtuix	VR motion device	8,38 mln \$	Jul 15
Venture capital funds	VRideo	Developer of the 360° movie distribution platform	1,8 mln \$	Mar 15
HTC	WEVR	Manufacturer of VR applications	10 mln \$	Jul 15
Venture capital funds	WorldViz	Manufacturer of VR applications	1 mln \$	Apr 15

Source: <https://www.crunchbase.com>

REALITY 51 – POLISH VR

The Farm 51 team is a pioneer in developing VR applications and content. We're using the experience we've gained in developing state-of-the-art computer games in new business sectors. VR is a perfect idea for a modern business. Reality 51 is your tool to effectively implement it.

- ▶ We have our own photogrammetric studio, and use 3D laser scanners, drones, and other solutions that support the development of interactive, 3D graphics, processed in real time.
- ▶ We are able to develop applications tailored to customer needs: from simple 3D object browsers, to large-scale, interactive applica-

tions offering AI solutions, motion controllers, and cross-platform optimization (PCs, browsers, mobiles, consoles).

- ▶ We cooperate with vendors of state-of-the-art hardware and technology solutions (Samsung, Oculus, NVIDIA, Sony, Microsoft).
- ▶ Reality 51 is a highly advanced Research & Development project, conducted in cooperation with the most important academic centres such as Polish Academy of Sciences, University of Silesia, Polish-Japanese Academy of Information Technology oraz Silesian University of Technology.

CHERNOBYL VR PROJECT

Chernobyl VR Project is a very special project by The Farm 51, a software developer from Gliwice, as it combines video games with educational software. It is the very first virtual tour around the Chernobyl and Pripyat area, compatible with multiple VR headsets, such as Oculus, PlayStation VR, Vive, or the mobile Samsung Gear VR solution.

The Farm 51 has already visited the site, preparing the project and collecting visual content. Chernobyl VR Project is a unique combination of video game fun and an interactive documentary describing the history and geography of the polluted zone. We aim to release the application close to the disaster's 30th anniversary (April 2016).

Chernobyl VR Project uses this technology and state-of-the-art graphics solutions, such



as advanced 3D scans, spherical photography, stereoscopic videos and augmented reality. Everything is fully adapted to state-of-the-art VR headsets.

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