

Interactive Media Industry Assessment



Commissioned By:



**Washington
Interactive
Network**

Prepared By:





Community Attributes Inc. tells data-rich stories about communities that are important to decision makers.

Sponsored by

OneRedmond
City of Redmond
City of Bellevue
Economic Development Council of Seattle & King County
City of Kirkland

President & CEO

Chris Mefford

Analysts

Spencer Cohen, PhD
Michaela Jellicoe
Alexandra Streamer
Eric Viola

Design

Maureen McLennon



Community Attributes Inc.
1411 Fourth Ave, Suite 1401
Seattle, Washington 98101

www.communityattributes.com

EXECUTIVE SUMMARY

In 2007, Community Attributes Inc. (CAI) was commissioned to conduct an Interactive Media Industry Assessment. The purpose of the original study was to provide a knowledge foundation that could be used to grow businesses and economic activity within the interactive media cluster throughout Washington state. CAI updated this study in 2012, and again in 2014 to assess the changes that had occurred over time. In 2016 the Washington Interactive Network (WIN) commissioned an update to the previously conducted studies to assess the cluster's growth in jobs and business, as well as new trends in the industry with a particular focus on the growing Virtual Reality (VR) and Augmented Reality (AR) segments of the cluster. This study incorporates quantitative and qualitative analysis of cluster strengths and discusses recent trends and future direction of the industry.

The interactive media cluster relies on a robust support system to fuel its growth, including devices, content and communication systems.

- Devices include mobile, game consoles, laptops, desktops, television platforms and a burgeoning technology market of virtual and augmented reality equipment
- Content includes entertainment, education and training applications
- Communications networks, such as social media outlets, are used to share and promote all forms of media

Cluster support industries include a distribution network to deliver games to the consumer, professional services such as banking, financing, real estate, venture capital, legal advising and information and communications technology (ICT) infrastructure. Most importantly, the cluster is supported by a talented workforce and the education and research institutions that back that workforce.

The cluster is comprised of an estimated 423 companies, including more than 40 companies working in the burgeoning virtual and augmented reality field. Washington's interactive media firms employed an estimated 20,800 people working in interactive media, both at large multi-purpose firms and at small to mid-size firms. An additional 2,400 freelancers work in interactive media as well.

In 2015, Washington's interactive media cluster boasted revenues of \$21.4 billion. A wide range of firms participating within the cluster contribute to total revenue, including Microsoft, Amazon, Bungie, and Valve.

The total economic impacts of the cluster throughout Washington's economy are significant. The cluster supports a total of 94,200 jobs through direct, indirect and induced impacts. Overall, the cluster supports almost \$28 billion in revenue throughout the state and \$7.6 billion in labor income.

Washington's interactive media cluster is supported by a strong backbone of talent throughout the region's

ICT industry, strengthening growth and innovation. As a whole Seattle ranks fourth in terms of employment within interactive media-related occupations, with 107,000 people employed in these occupations. Additionally, Seattle ranks third in the country in terms of average wages among interactive media-related occupations at almost \$109,000 annually.

Experts mentioned that AAA game development, or the development of high quality games with large development and promotion budgets, is expected to see increased budgets, but a slight decrease in the number of projects across the industry. Access to capital is extremely important for these developers and needs to be improved.

Interactive media in Washington continues to evolve and stakeholders interviewed mentioned augmented reality (AR) and virtual reality (VR) as one of the biggest trends within the industry. The development of AR/VR content is bringing in a wider range of talent into the cluster, such as cinematographers, actors and more, and the talent required for this is indicative of the proliferation of interactive media into the entertainment industry overall.

This AR/VR subsector has seen increased venture capital and fundraising successes and experts predict that it will continue to attract investment dollars. Investment is an important concern among AR and VR industry experts. Although funding sources have diversified, access to venture capital is still an important factor in the success of the AR and VR industry.

Another important industry trend continues to be the free-to-play (F2P) market. This market continues to comprise a major portion of the monetization strategies of the game market. With F2P being a difficult model to sustain and grow a company, this market is now seeing increased diversification in strategies. Stakeholders also emphasized the importance of talent for the continued success of the industry. Within an increasingly competitive regional market for talent, this is a continuing challenge for interactive media companies.

One challenge mentioned by industry experts is tax policy. Stakeholders expressed that favorable tax policies are essential for the success of the industry. Among the policy needs mentioned were policies that promote the success of small and mid-size firms, as well as policies that promote the freelance market, such as health benefits and tax incentives. Stakeholders mentioned the challenges associated with paying taxes before they earn revenues on the product they are developing. They mentioned that an environment that promotes investment to develop new intellectual property and products that also allows time for development and release of a project is important to their success.

CONTENTS

Introduction	1
Interactive Media Cluster Overview.....	3
Interactive Media Trends	9
Augmented and Virtual Reality in Washington	12
Measures and Impacts	16
Appendices.....	26

Blank.

INTRODUCTION

Background and Purpose

In 2007, Community Attributes Inc. (CAI) conducted a cluster study of the interactive media industry for the Washington Interactive Network, then a program housed under enterpriseSeattle (now known as the Economic Development Council of Seattle and King County). This initial study highlighted the importance of the cluster to the regional and state economy. The study identified rapidly growing jobs, high wages and exciting career opportunities. The report also identified that the most significant challenge to the industry at the time was attracting talent to support the growth of the Industry.

In 2012, an updated assessment of the interactive media cluster was needed to track the growth of the industry and was funded by a federal grant for the Washington Interactive Media Accelerator run by the Washington Interactive Network. That study gauged economic activity connected to interactive media in Seattle and statewide.

Funded by the same federal grant, the Washington Interactive Network commissioned an update to the previous studies in 2014. The focus of the 2014 study highlighted the rapid and continuing evolution of the industry and discussed opportunities to support the economic development of the industry.

In 2016, the Washington Interactive Network commissioned CAI to provide an update to the three previous Interactive Media Assessments. This study

includes updates and refinement to previous analysis, highlights trends and qualitative findings from interviews with industry leaders. This study also provides a qualitative assessment of the burgeoning augmented and virtual reality subsector in the interactive media cluster.

The Washington Interactive Network (WIN) is a nonprofit organization under the umbrella of OneRedmond whose mission is to advance, cultivate, and grow the interactive media industry in Washington state. WIN works closely with interactive media companies, educational institutions and the interactive media workforce to foster and promote the region as a global leader in interactive media development and intellectual property creation.

Methods

This report relies on secondary data analysis and primary data collection. Secondary data analysis draws from data compiled by public agencies including the Washington State Employment Security Department and Department of Revenue, the U.S. Bureau of Economic Analysis and additional publicly available data.

Companies included in the analysis self-identified as interactive media companies through participation in WIN. Revenue and employment data were collected using participating businesses' Unique Business Identifiers (UBIs).

In order to estimate interactive media revenue and employment totals at large multi-purpose firms, CAI leveraged data on company employment in the state as well as revenue by company division. This company-reported information was combined with secondary reports of employment in the Puget Sound Region to produce detailed estimates of interactive media jobs and revenues in the region.

Primary data were collected through a series of telephone interviews from March to May 2016 with interactive media industry leaders and experts.

Organization of Report

The Interactive Media Industry Assessment includes the following sections:

- **Interactive Media Cluster Overview.** An overview of the interactive media industry in Washington, including history and conceptualization of the cluster.
- **Interactive Media Trends.** Includes findings from interactive media experts and information on recent trends that have affected the cluster.
- **Augmented Reality and Virtual Reality in Washington.** Describes the growing Augmented and Virtual Reality segment of the interactive media cluster in Washington.
- **Measures and Impacts.** Data summaries of businesses, revenues, employment and other metrics that demonstrate the size and relevance of the industry in Washington State.

INTERACTIVE MEDIA CLUSTER OVERVIEW

Interactive Media Definition

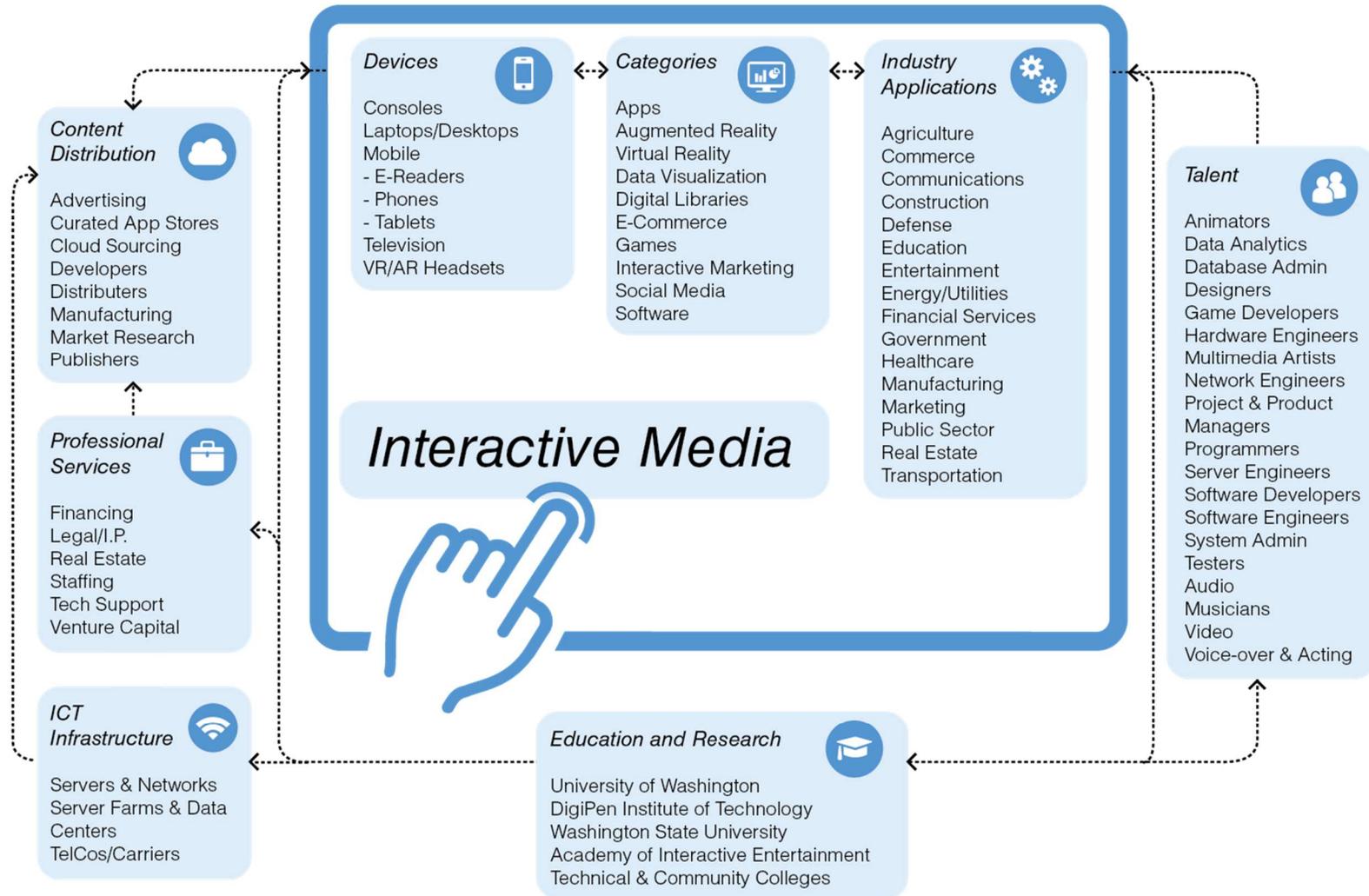
The definition of interactive media (IM) is dynamically evolving. Firms operating within this industry are broadly defined as “companies producing consumer-driven content or providing services through a screen”. As the variety of devices, content delivery and cloud services continue to expand, so does the scope of IM. In the early 2000s, IM activity was largely driven by video games, networked software applications, and digital music distribution. A decade later, the industry’s definition incorporated the distribution of games and applications for mobile devices and tablets, as well as services provided online, including advertisers and retailers. Recent developments in augmented and virtual reality have propelled these technologies into mainstream IM markets.

Many of the aforementioned features are powered by cross-platform delivery, a key development in IM distribution. Consumers interact with content and services on an ever-expanding number of devices, such as smartphones, tablets and smart televisions. The increasing accessibility of IM renders it a ubiquitous part of our current day-to-day existence.

Experts in the industry defined interactive media in a variety of ways. The consensus among the diversity of definitions among interviewees is that interactive media encompasses a broad multiplicity of human technology interaction. In particular this includes experiences in which the viewer or player has agency, or experiences that engage the viewer through their responses.

Exhibit 1 provides a visual delineation of the various components of the IM cluster in Washington, drawing on previous research and interview feedback.

Exhibit 1. Interactive Media Cluster Map



Source: Community Attributes, 2016.

Industry History

Interactive Media is a highly dynamic industry, and has seen important changes since the first cluster study was performed in 2007. The timeline on the sidebar highlights major events since the early 1980s through 2016.

Washington has an impressive timeline for IM achievements and events. Interview participants echoed praise for the region's accomplishments. One interviewee credited the IM advancements to the state's wealth of ICT talent. As a result of this talent, another stakeholder responded, Seattle is poised to be a hub for augmented and virtual reality innovation.

Interactive Media as we know it dates back to the 1960s and early 1970s, with early computer games and flight simulation. The Seattle interactive media industry has early roots, with the involvement of Microsoft and Boeing. Microsoft's first release was Olympic Decathlon, released in 1981 for Apple II computers. Boeing's early IM involvement includes flight simulators for pilot training and aeronautic engineering applications.

Over the years the technology and applications have changed dramatically. The 2007 report highlighted the changing distribution channels and opportunities created by the Internet. This important evolution in the industry allowed multiple users to interface within the same media application from anywhere in the world.

1982 – Microsoft Flight Simulator

1985 – Nintendo of America

1989 – Gameboy Release

1994 – Microsoft DirectX Formed

1995 – RealNetworks introduces RealAudio

1995 – Amazon.com begins online sales

1998 – DigiPen locates in Redmond

2001 – Microsoft launches Xbox

2001 – PopCap Games releases BeJeweled

2001 – Halo: Combat Evolved released

2001 – University of Washington creates the Center for Digital Arts and Experimental Media (DXARTS)

2002 – Big Fish Games founded

2002 – Valve Software invents Steam

2004 – Valve Software releases Counter-Strike

2004 – Google locates offices in Kirkland

2004 – DXARTS begins offering PhDs in New Media Arts, the only program in the United States to do so

In 2012 the Interactive Media Industry Assessment highlighted the mass consumer adoption of smartphones and tablets. This major development in the industry significantly increased game-able devices, and resulted in major market penetration.

The proliferation of the mobile device market continued to have implications for the industry, highlighted in the 2014 report. In 2014, the interactive media industry was typified by companies that develop and distribute games and applications for mobile devices and tablets and provide services online.

Other important changes highlighted in 2013 include cross-platform delivery, new distribution channels and funding models. These new funding models democratized the production and distribution of content. Content creators became able to use a diversity of networks including social media and crowd-source funding to disseminate their content to the market.

Today, IM leaders and experts are focusing on the emerging virtual reality (VR) and augmented reality (AR) applications and technology. These technologies expand the scope of IM from simple interaction to the augmentation of user experience through immersive and simulated realities. Additionally, VR and AR have potential to broaden interactive media markets further into significant commercial markets such as manufacturing and engineering.

2006 – Nintendo launches Wii

2007 – Amazon Kindle introduced

2007 – Google expands, adds office locations in Seattle and Kirkland

2010 – UW’s FoldIt crowd-sources complex scientific problems as a game

2010 – Halo: Reach sets US release records, 3 million copies sold in one day

2010 – Facebook expands to Seattle, first engineering office outside of CA headquarters

2010 – Big Fish Games reaches 1 billion game downloads

2010 – Microsoft Kinect sells 8 million units in 60 days

2011 – Record attendance at Penny Arcade Expo

2011 – Amazon introduces Kindle Fire

2011 – ElectronicArts acquires PopCap Games for \$1.3 billion

2011 – Zynga expands to Seattle

2011 – Forbes ranks Seattle #1 out of 51 metropolitan areas for high-tech job growth

2012 – Merger between AT&T and T-Mobile blocked by the Department of Justice, Federal Communications Commission and antitrust groups

Primary Game Industry Segments

The initial 2007 Interactive Media Industry Assessment defined three distinct, but overlapping segments of the industry. These three segments, along with a fourth identified originally in the 2012 update, continue to comprise the Industry: Core, Casual and Serious Games, and MMOG/Social Networks.

Although IM has evolved over time, video games still comprise the core of Interactive Media. These four segments of the gaming industry have not materially changed since the initial 2007 report, however, their markets and distribution have evolved over time.

- **Core.** Games developed for personal computers, television game consoles (currently led by Microsoft Xbox One, Sony PlayStation and Nintendo's lineage of consoles, particularly Wii U) and handheld video game hardware. These games typically require some experience before the user can engage with all of the features of the game.
- **Casual.** These games are distinguished by their ease of use, including simplicity to learn, play, quit and resume. Casual games are typified by card games, puzzles and relatively simple animated games. These games are also often free or inexpensive. Today the market for these games has expanded dramatically with the proliferation of mobile platforms, and casual games dominate the mobile market.

2012 – Epic Games launches Seattle-area Studio to focus on Unreal Engine 4

2012 – Nintendo releases Wii U

2013 – Microsoft releases Xbox One

2013 – Northeastern University Seattle, Institute for Systems Biology, and the National Girls Collaborative Project launch the GAMES Initiative, which aims to nurture girls' interest in STEM fields through the medium of video games

2013 – WIN hosts the first Indie Game Expo at Power of Play

2013 – Sony releases Playstation 4

2013 – Benaroya Hall hosts Valve's International Dota 2 Championships

2014 – Valve hosts Steam Dev Days, a two-day game developers conference that draws attendance from around the world

2014 – Amazon acquires Double Helix Games and Twitch

2014 – Facebook acquires Oculus VR for \$2 billion

2014 – KeyArena hosts the International Dota 2 Championships for the first time

2014 – Unite 2014 hosted by game platform developer Unity in Seattle

- **Serious.** This term has evolved to include all IM designed for formal learning or training, such as flight simulators. This form of game has contributed to training and education in aerospace, military and medical fields.
- **MMOG/Social Networks.** This newest category of gaming is consistently and rapidly evolving. Together MMOG and social networks are defined by the interactive online community that users create. Social networks, starting with Myspace and Facebook have proliferated throughout the global economy. Facebook dominates the market with more than 1.5 billion users worldwide, but other networks are also significant including Twitter, Instagram, Vine and Snapchat. These networks have also expanded into the professional market, exemplified by LinkedIn. Also included in the category are Massive Multiplayer Online Games which create complex and interactive virtual environments, World of Warcraft is the largest of these. MMOGs initially developed for personal computers have expanded into television game console market and are now breaking into the mobile device market as well.

Virtual and augmented reality are proliferating among all segments of the gaming industry. The release of Pokémon Go has been one of the largest breakthroughs of augmented reality into the casual gaming market and the social medial market. Technology like the HoloLens generate opportunities for AR and VR in the core game market as well.

- 2015** – Oculus VR opens research & development and engineering offices in Seattle and Redmond
- 2015** – AIE hosts iFest for indie game developers
- 2015** – China lifts 14-year ban on video game consoles
- 2015** – SEA VR expo for AR, VR and mixed reality technologies hosted in Bellevue
- 2015** – Valve releases Steam Machine, a pre-built gaming computer
- 2015** – KeyArena hosts Valve’s International Dota 2 Championships, the highest value video game competition in the world with a final prize pool totaling more than \$18 million
- 2016** – Oculus Rift is released
- 2016** – Microsoft makes HoloLens available to developers
- 2016** – HTC Vive is commercially available
- 2016** – KeyArena hosts Valve’s sixth international Dota Championships, with a final prize pool surpassing the 2015 pool at more than \$20 million

INTERACTIVE MEDIA TRENDS

Over the past several years important changes have occurred and new trends are emerging. The expansion of augmented and virtual reality is one of the most significant new trends in the interactive media industry. Many of the trends identified in the last industry assessment continue to be important.

- Multitudes of distribution channels
- User-generated content is powerful
- Consumers are moving to mobile and tablet
- Venture capital is hard to find
- Democratization of talent continues to allow small, medium and large developers to be successful
- Access to high quality talent is essential to success
- Education is paramount
- Washington must continue to innovate

Mobile and Tablets

Recent years have seen some notable emerging trends. According to a 2015 Guardian article, a Nickelodeon study reported that 34 percent of children under 11 have a tablet, and many children are getting smartphones. The first generation of children who grew up playing video games are now old enough to be parents, and they are largely advocates of, or at least neutral toward, gaming in general. Another key trend identified by the Guardian is the increased integration between gaming and social media. Mobile gaming companies in recent years have been producing games

that also serve as social media platforms, connecting players around the world in the game. (The Guardian, 2015)

Business Models

Industry stakeholders noted that free-to-play is becoming the standard business model in the region. Additionally, they noted that the market is beginning to stabilize after experiencing strong growth over the past several years.

Industry stakeholders also described the “democratization of talent” in game development and distribution. Because of the accessibility of social media and iTunes App Store-esque distribution channels, anyone can create a widely successful game or app without the backing of a large, established developer company. As a result, there is an increased number of games and applications entering the consumer market.

ESports, a growing area of competitive, live gaming, is another relatively new feature of the interactive media landscape. Currently, viewers can enjoy eSport content for free through streaming services like YouTube and Twitch, which has allowed for a large audience to develop quite quickly. Gaming companies like Nintendo and Activision are trying to find ways to monetize eSports, trying to tap into the popularity of YouTube celebrity gamers. Game market research firm newzoo estimates that roughly 40 percent of eSport viewers do not play any of the top eSport franchises, indicating that eSports are becoming more similar to

spectator sports. Globally, the company estimates that more than 470 million people worldwide watch online gaming content on a regular basis. (The Guardian, 2015; newzoo, 2015)

Experts mentioned that AAA game development, or the development of high quality games with large development and promotion budgets, is expected to see increased budgets, but a slight decrease in the number of projects across the industry. Access to capital is extremely important for these developers and needs to be improved.

Augmented and Virtual Reality

Gaming and other forms of entertainment were traditionally the primary forces driving AR and VR development, but in recent years, the technology has been applied to a wide variety of other fields and sectors. Virtual reality has been on the forefront of healthcare advancements and discoveries. Surgeons can use diagnostic images from CAT scans or ultrasounds to create 3-D renderings of their patients' anatomies. These virtual models can assist doctors in identifying which surgical approach to take, and allow them to practice difficult procedures ahead of time. Virtual reality also has patient care applications, such as helping stroke or brain injury victims to practice everyday activities during rehabilitation (Sheikh, 2016).

The development of AR and VR content is bringing in a wider range of talent into the cluster, such as cinematographers, actors and more, and the talent required for this is indicative of the proliferation of

interactive media into the entertainment industry overall.

This AR and VR subsector has seen increased venture capital and fundraising success, and experts predict that it will continue to attract investment dollars.

Investment is an important concern among AR and VR industry experts. Although funding sources have diversified, access to venture capital is still an important factor in the success of the AR and VR industry.

The education industry has also been strengthened by AR and VR advancements. Mobile hardware in museums can provide augmented reality overlays of exhibits that allow children to further interact with them. In the classroom, students can view photos, maps, and diagrams in 3-D, immersing them in virtual reality lessons that increase engagement and understanding (Smithsonian, 2016).

AR and VR have extensive potential in commercial activities. Automotive and aerospace manufacturing have seen significant advancements in recent years. VR technology allows engineers to view full 3-D representation of a product model, closely review individual elements, and spot potential issues before they arise. Virtual reality also makes it possible for designers, manufacturers, and engineers to review the same components and make alterations in real time from different parts of the world (Sheikh, 2016).

Challenges

When asked what components interactive media firms need to thrive in Washington, interviewees repeatedly mentioned access to capital, a highly connected IM cluster, and improved laws and regulations. Industry stakeholders emphasized the need for a favorable tax system for small and medium firms in particular. It is especially important to have a regulatory environment that allows developers to invest in research and development and the release of a product that will become profitable over time. It was acknowledged that it is challenging for policymakers to keep up with the needs of the industry as technology continues to advance rapidly and that is not their area of expertise.

Networking within the IM Industry is also crucial to startup success. Several stakeholders reported that their company sources talent through referrals because recruitment efforts are cost and time prohibitive to new companies. Recruitment for talent has continued to become increasingly challenging given the growing competition for talent within the Washington state ICT industry as a whole.

AUGMENTED AND VIRTUAL REALITY IN WASHINGTON

Description of Technologies

Augmented and virtual reality employ very similar technologies, but differ significantly in user experience: VR allows the user to be submerged in an entirely different reality while AR technology adds layers of enhancement to consumers' current physical experience. VR effectively untethers users from the present, completely immersing them in and guaranteeing their focus on specific content. AR overlays interactive computer graphics and sounds on the user's experiences in real time (Forbes, 2016).

The AR and VR sphere was popularized in the 1990s, but the industry required major technological advancements in mobile phones and smart gaming devices for mass market appeal to be possible. Competition in the smartphone market to create high resolution screens, GPS connectivity, internet accessibility, and smaller batteries with longer lifespans fueled innovation in AR and VR hardware. The mass production of smartphones also markedly lowered the cost of mobile processing and image sensors. Furthermore, improvements in 3-D gaming technology powered AR and VR software development. These components operating in tandem primed the virtual market for a robust resurfacing (Bullinger, 2016).

Interviewees also explained the importance of recent improvements in ameliorating video latency. Users of immersive virtual reality are "on-railed," meaning they can't control where they're going or how fast they're moving. The human brain can't reconcile the

discrepancy between images of propulsion in the visual field when the legs are stationary, and as a result, users become nauseous. Video latency exacerbates this effect. A significant portion of interviewed companies reported maintaining full-time cognitive scientists on staff to provide guidance and combat nausea in virtual reality systems.

One stakeholder explained that, because of latency, advancements in AR technology trail behind VR development by about 18 months. If latency exists, it isn't as noticeable in VR because the user is tethered to a different reality with no expectations for how the alternate world should appear. In contrast, latency in AR is much more obvious and disturbing to users.

Institutional Research and Development

Advancements in the application of augmented and virtual reality technology is notably dependent on university research and development. Washington State University's Virtual Reality and Computer Integrated Manufacturing Laboratory (VRCIM Laboratory) performs fundamental and applied research in computer-aided design and virtual reality, among other pursuits. The VRCIM Laboratory produced the Virtual Assembly Design Environment (VADE), a VR-based engineering application, which engineers can utilize to plan, analyze, and assess the assembly of mechanical systems. Within the virtual environment, VADE users can interact with a mechanical assembly landscape where the components are in the same locations as they

are in the real assembly plant. The user can then virtually assemble the mechanical system, and make design changes at any point. Each VADE session is recorded and stored so design changes can be finalized in real life (Washington State University, 2016).

WSU researchers at VADE also developed a highly specialized automated calibration system to be used during virtual prototyping, manufacturing and assembly. After electromagnetic sensors are placed at a site in the real world, the program tracks the users motions within the space, and then replicates them in the virtual program. These sensors can also measure surface error¹ and the maximum height for each electromagnetic grid point. Both of these factors are duplicated in the virtual universe, preventing collisions during the real world assembly of mechanical equipment (Washington State University, 2016).

The University of Washington also executes sophisticated virtual and augmented reality research in its Human Interface and Technology Lab (HITLab). A notable portion of HITLab research is closely linked with medical pursuits. One research team at the lab is working to improve akinesia—difficulty in initiating and sustaining walking—in patients suffering from Parkinson’s Disease. The use of Virtual Vision Sport Eyewear on patients with mild akinesia can trigger normal walking behavior. Patients are virtually shown objects and barriers in their path accompanied by visual cues while physical objects are placed at their feet in

¹ Surface error is the measurement of the deviation of the component’s or device’s actual shape and its intended shape.

the real world. These components in combination elicit regular motor movement at standard speeds (University of Washington, 2016).

In addition to medical advancements, HITLab researchers are developing educational virtual and augmented reality tools to enhance classroom learning. One project surrounds oceanography education, referred to as Virtual Puget Sound. Immersive virtual reality technologies and augmented desktop simulations depict the physical oceanography of Puget Sound, and can be used for students spanning fourth grade to university undergraduates. This program is particularly advantageous for students with learning disorders, such as Dyslexia or ADHD. The simulations can relay concepts that would be difficult for students with disabilities to contextualize through textbook reading, and the interactive nature of the program helps students to maintain focus on the subject (University of Washington, 2016).

Commercial Activities

In early 2016, Microsoft made the first wave of its HoloLens technology available to developers. The HoloLens is the first completely untethered augmented reality headset that overlays holographic images on the user’s surroundings in real time. Microsoft released the source code for HoloLens with the purpose of allowing app developers to cultivate platform usability (Microsoft, 2016).

In addition to entertainment and other leisure applications, HoloLens could transform the manufacturing industries. The technology allows the user to see an exact 3-D translation of their product, which could eventually reduce or remove the need for physical design prototypes. 3-D printing is currently the most effective way to augment product development, but it's not particularly efficient. Component prototypes can take multiple days or hours to print—the HoloLens would allow users to make design changes in real time and in different locations without delay (Microsoft, 2016).

The augmented reality technology can also overlay potential design changes on top of the existing physical product. Volvo is presently using HoloLens in its vehicle design processes. Designers can virtually strip a car by removing components layer by layer to observe and make changes to structural and safety features in the vehicles. HoloLens also allows Volvo to test safety performance through virtual testing. Simulated tests operate under the same physics laws as physical testing—and are informed by physical tests themselves—but remove the need to crash a model multiple times after virtually tweaking design elements (Microsoft, 2016).

In June 2015, California-based Oculus VR opened a research and development office for its Oculus Rift technology in Redmond. The company's Oculus Rift virtual reality headset project is led by former Valve engineer Atman Binstock. Prior to joining Oculus VR, Binstock worked with his team at Valve to integrate the Oculus Rift into the company's games and Steam

platform. The Oculus Rift headset is full-immersion virtual reality, allowing its users the ability to play VR games, watch VR movies and spend time with their friends in a virtual environment. The establishment of the Seattle-area research and development office was motivated by the large ICT talent pool in the greater Puget Sound region (GeekWire, 2015).

Similarly, HTC and Valve partnered in March 2015 on the Vive virtual reality headset. Both HTC's North American division and Valve are headquartered in Bellevue, so the partnership is advantageous from a geographical standpoint. Vive will be the first virtual reality headset to provide “room-scale experience” virtual gaming—the device will use 70 sensors to transform any physical space into an immersive virtual environment. The user is able to walk around the virtual space as opposed to using a controller to navigate it. The headset works in conjunction with two detached sensors and two wireless controllers to deliver precise representation of the gamer's movements in the virtual world (HTC, 2016).

Startup Activity

In addition to established technology companies branching into the augmented and virtual reality marketplace, there are several recent startups entering the AR and VR sphere. Madrona Venture Group, a Seattle-based venture capital firm, announced a new \$300 million fund for ICT startups in mid-2015, and explicitly noted that virtual reality was a growing area of interest for the firm as a whole. One startup to receive funding was Envelop VR, a VR software developer headquartered in Bellevue. The company

accepted \$4 million in funding from Madrona Venture Group in 2015 (Venture Beat, 2015).

Envelop's software, Envelop Virtual Environment, will allow users to view almost all digital content in virtual reality. Users on e-commerce sites, for example, could view and inspect a 3-D, scaled representation of a product. Similarly, home buyers could take a 3-D virtual tour of an existing or designed home without visiting the physical location. Businesses in a variety of sectors will also be able to immerse themselves in data and analytics, creating a customized virtual representation of their operations. The software is designed to run simultaneously with other programs to enhance productivity. Envelop will unveil its software when Oculus Rift and HTC Vive are rolled out in the mass market in late 2016 (Envelop VR, 2016).

Pixvana, short for "pixel nirvana," is a Seattle startup creating cloud video processing and transport software that will assist in delivering high-quality, 360-degree virtual reality video from the cloud. Pixvana is the first company to produce this type of software, which will work with a variety of cloud platforms, including Microsoft Azure and Amazon Web Services. This software platform will also integrate with AR and VR hardware, such as HTC's Vive and Samsung Gear (Pixvana, 2016). Pixvana's recently completed its first round of funding, also led by Madrona Venture Group, and raised \$6 million in 2015 (Fortune, 2015).

Challenges and Barriers

Interviewees explained that one of the most prominent barriers to the success of AR and VR technology is lack of consumer awareness. The technology is much more advanced than it was in the early 1990's, but as one stakeholder explained, if someone had a poor VR experience, they won't revisit the platform without considerable persuasion. Additionally, AR and VR are still perceived as gaming technologies, and many non-gamers are unaware of the multitude of other industry applications. As a result, consumer demand for AR and VR products is uncertain, and startups in this subsector are essentially betting their company on its success.

One interviewed AR company opted to relocate to California to be close to investors. Several other interviewed startups agreed that there is more venture capital available to AR and VR firms in California—one participant explained that funding is often difficult to find unless you have previous connections to investors, making it difficult for new companies to launch.

MEASURES AND IMPACTS

Businesses and Jobs

The number of interactive media businesses in Washington² has increased from 150 in 2007 to 423 in 2016. This is due to two key driving factors: growth in the industry itself that results in the establishment of new businesses, and increased participation in the Washington Interactive Network that results in improved measurement of the number of active IM companies in the state. (**Exhibit 2**)

Since 2007 the total number of interactive media businesses has increased by more than 180 percent, or a compound annual growth rate (CAGR) of 12 percent between 2007 and 2016.

² These figures are based on past Interactive Media Industry Assessments and data from the Washington Interactive Network. Unique Business Identifiers (UBIs) were shared with the Washington State Employment Security Department and Department of Revenue to cross-check firms with reported employment and revenue data.

³ Employment estimates were compiled from a combination of data mining and stakeholder interviews. Data mined resources

Exhibit 2. Interactive Media Businesses, Washington, 2007-2016

	2007	2012	2014	2016
Number of Companies	150	304	330	423

Sources: Washington Interactive Network, 2016; Community Attributes Inc., 2016.

Between 2013 and 2015, total employment³ in Washington's interactive media cluster has shown a CAGR of almost 16 percent. Between 2013 and 2015, not only has employment at firms identified as interactive media companies increased, but the number of firms participating in the cluster has increased.

Several forces interact to generate this growth. IM employment in the state's largest firms⁴—Microsoft and Amazon—has increased from an estimated 6,400 employees in 2013 to an estimated 13,000 in 2015 (**Exhibit 3**). In addition to experiencing strong growth, these large firms are increasingly participating in interactive media activities, and virtual and augmented reality. This is exemplified by the rapid growth of

included publicly traded companies' reports and Washington State Employment Security Department employment data for the many smaller companies.

⁴ Interactive media employment at large multipurpose firms were estimated based on a combination of financial statements and company employment across the region.

Amazon Game Studios through the purchase of Double Helix Games and Twitch in 2014, as well as Microsoft's development of the HoloLens and continuing development of the Xbox line.

The second factor in the growth of the cluster between 2013 and 2015 is an increasing number of firms located within the state, both in-state and out-of-state firms. Google and Facebook are among the firms locating in Washington. Overall employment at Google reached 1,400 employees in Washington in 2014. Although a large portion of these employees are focused on Google's web and cloud services, the firm is increasingly participating in the mobile and entertainment markets, both key areas of growth within the interactive media cluster.

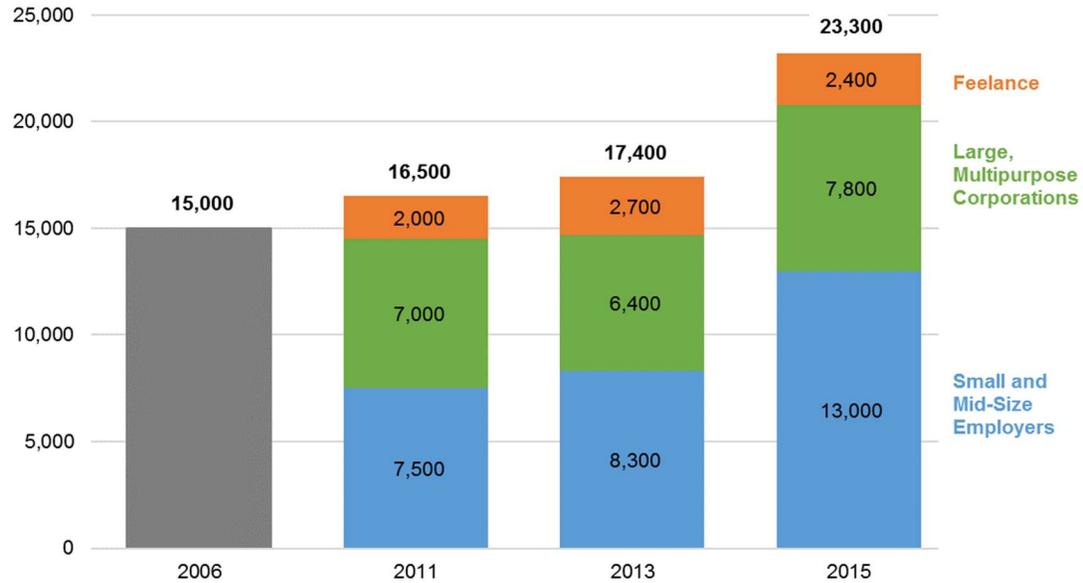
Between 2013 and 2015 the number of firms participating in the Washington Interactive Network has seen a sharp increase. Since 2013, 93 new firms have joined WIN, self-identifying as IM companies. More than 40 of the 423 total companies are working or providing services in the virtual or augmented reality

field, including Envelop VR, Microsoft, Amazon, Oculus, VREAL and many more. Overall employment in small and mid-size employers in the interactive media cluster has increased from 8,300 in 2013 to 13,000 in 2015 (**Exhibit 3**). This represents a compound annual growth rate of more than 25 percent. A large portion of this growth is attributable to the 93 new firms participating in the cluster.

Interactive media also includes freelance employment working in IM. Freelance workers in IM include partnerships and sole proprietorships. Between 2013 and 2015 freelance employment has decreased slightly from 2,700 workers to 2,400 workers. This represents an annual decrease of 5.7 percent. (**Exhibit 3**).

Total employment in the interactive media cluster has increased from 17,400 in 2013 to 23,300 in 2015 (**Exhibit 3**). This represents annual growth of almost 16 percent. The largest share of this growth is among small and mid-size firms, due primarily to the combination of strong growth among firms, and strong increases in firms participating in the cluster.

Exhibit 3. Comparative Interactive Media Cluster Employment, Washington



Sources: Washington Interactive Network, 2016; Washington State Employment Security Department, 2016; Washington State Office of Financial Management, 2016; Microsoft Corporation, 2016; Amazon, 2016; T-Mobile US, 2016; Zillow Group, 2016; Puget Sound Business Journal, 2011, 2014, 2015; Seattle Times, 2013; Forbes.com, 2011; Bellevue Reporter, 2008; Geekwire, 2013; Community Attributes Inc., 2016

Revenues

Between 2011 and 2015 revenues in Washington's interactive media cluster increased 6.1 percent annually. Revenues increased from \$16.9 billion in 2011 to \$21.4 billion in 2015 (**Exhibit 4**). Revenues in **Exhibit 4** represent historic revenue between 2011 and 2015 among firms identified in 2016 as interactive media companies.

Washington's interactive media cluster is composed of a variety of firms including small start-ups with very little revenue and very large firms such as Microsoft, Amazon, Google and PopCap Games. Both Microsoft and Amazon have diverse business activities, making IM just one element of a companywide portfolio of offerings. At Amazon, for example, IM includes activities around the Kindle as well as Amazon Game Studios. At Microsoft, IM spans software development and video game development.

Exhibit 4. Interactive Media Firm Revenues, Washington, Billions of 2015 Dollars, 2011-2015



Sources: Washington Interactive Network, 2016; Washington State Department of Revenue, 2016; Community Attributes Inc., 2016.

Microsoft's Entertainment and Devices Division includes Xbox, Xbox Live, Windows Phone and more. According to Microsoft, the Xbox division is working to make its games accessible across all devices, and is also focusing on making Windows a premiere platform for virtual reality development (Day, 2016). Microsoft's revenues⁵ in this division have increased by three percent annually between 2011 and 2015 from more than \$9.2 billion in 2011 to almost \$12 billion in 2015.

In 2013 Microsoft reorganized its divisions, breaking the Entertainment and Devices Division into two separate divisions, "Devices and Consumer Hardware" and "Devices and Consumer Hardware, Other." These new units include Xbox and related activities, but may also include additional activities and products previously housed in other segments and reported separately in previous financial statements. Additionally, in 2014 Microsoft again updated their divisions, now Xbox and other computer gaming activities are listed under "Computer and Gaming Hardware."

⁵ Microsoft reports revenue on a fiscal year calendar. Calendar year totals are estimated based on fiscal year totals as reported by Microsoft.

Economic Impacts

The full economic impact of the interactive media cluster extends beyond the direct jobs and revenues created by IM companies. Local suppliers to member companies benefit from increased business-to-business sales, and consumer industries throughout the area benefit from the household purchases made by employees of member companies.

Economic impacts refer to the direct, indirect and induced impacts of the 423 IM companies in Washington. Direct impacts include jobs in IM companies in Washington as well as estimated IM jobs in large multipurpose companies and freelance IM jobs. Direct impacts also include the revenues and labor income from IM jobs. The interactive media cluster in Washington employs an estimated 23,300 people and generates an estimated \$21 billion in revenue. **(Exhibits 3 and 4)**

Indirect jobs, revenues and labor income are created by the business-to-business transactions that come into existence due to the output of workers in direct jobs. Additionally, IM in Washington supports jobs, revenues and wages through induced impacts. Induced impacts are the jobs, revenues and labor income that are supported by the spending of wages throughout the Washington state economy from the direct and indirectly supported jobs.

Washington’s interactive media cluster supported 100,900 jobs throughout Washington’s economy in 2015. Total revenue impacts associated with the interactive media cluster are more than \$32.1 billion, and almost \$8.0 billion in labor income is supported throughout the Washington economy. (**Exhibit 5**)

Exhibit 5. Economic Impacts of Interactive Media, Washington, 2015

	Total Economic Impacts
Jobs	100,900
Labor Income (mils 2015 \$)	7,955.4
Revenues (mils 2015 \$)	32,107.7

Sources: Washington Interactive Network, 2016; Washington State Employment Security Department, 2016; Washington State Department of Revenue, 2016; Washington State Office of Financial Management, 2016; Microsoft Corporation, 2016; Amazon, 2016; Community Attributes, Inc., 2016.

Occupations and Wages

Interactive media relevant occupations⁶ are an important part of the state’s economy. These occupations are identified as being the core occupations within the interactive media industry, but employment within these occupations include workers employed in industries outside of IM, including workers in the large software publishing industry in Seattle.

In 2015, just under 125,000 people were employed in IM relevant occupations. Overall, they had an average wage of \$104,100, significantly higher than the national average wage in IM relevant occupations of \$86,600. In total, 4.2 percent of the state’s jobs were in these occupations, compared to 2.4 percent at the national level. Wages in these occupations are significantly higher than the national average wage for all occupations, which is \$48,320. (**Exhibit 6**)

⁶ Interactive media relevant occupations were defined in the 2014 update to the Interactive Media Industry Assessment.

Exhibit 6. Interactive Media Occupations, Employment and Wages, Washington, 2015

Interactive Media Occupation	Jobs in Occupation	Annual Median Wages	Top 10% Wages
Software Developers, Applications	49,980	\$118,350	\$165,950
Computer Systems Analysts	16,740	\$90,270	\$138,640
Computer Programmers	13,260	\$119,540	\$171,030
Software Developers, Systems Software	12,160	\$114,060	\$156,130
Computer User Support Specialists	14,200	\$52,320	\$92,290
Network and Computer Systems Administrators	7,740	\$84,080	\$121,930
Computer Occupations, All Other	5,880	\$77,790	\$136,800
Database Administrators	2,230	\$92,290	\$129,310
Multimedia Artists and Animators	1,540	\$77,260	\$129,650
Computer and Information Research Scientists	1,050	\$130,970	NA
Total	124,780		

Sources: Bureau of Labor Statistics, 2016; Community Attributes Inc., 2016.

In the Puget Sound Region, the same trends are present. A total of 86.1 percent of Washington’s jobs in IM relevant occupations can be found in the Puget Sound Region. These jobs are even more concentrated in the region than they are in the state as a whole: 5.9 percent of the region’s jobs are in IM relevant occupations. (Exhibit 7)

The concentration of IM talent is extremely important to the success of the industry for two reasons. Firstly, it allows software and hardware developers to interact

closely in product development. Nearly all interviewed industry representatives mentioned collaborating with other IM companies to create content and products. Developers are a crucial component of hardware technology—devices won’t attract consumer interest without content to run on the platform. Secondly, the Washington interactive media cluster’s proximity to highly-regarded institutions, such as the University of Washington and DigiPen Institute of Technology, is vital to cultivating new talent. Stakeholders reported sourcing interns for beta projects from these institutes.

Exhibit 7. Interactive Media Occupations, Employment and Wages, Puget Sound Region, 2015

Interactive Media Occupation	Jobs in Occupation	Annual Median Wages	Top 10% Wages
Software Developers, Applications	46,770	\$119,670	\$167,280
Computer Systems Analysts	12,850	\$97,310	\$144,340
Computer Programmers	12,270	\$122,160	\$173,090
Software Developers, Systems Software	10,720	\$116,250	\$157,360
Computer User Support Specialists	10,400	\$55,030	\$100,010
Network and Computer Systems Administrators	5,820	\$88,290	\$125,890
Computer Occupations, All Other	4,640	\$78,810	\$142,790
Database Administrators	1,840	\$97,090	\$131,100
Multimedia Artists and Animators	1,370	\$78,600	\$131,880
Computer and Information Research Scientists	780	\$143,830	NA
Total	107,460		

Sources: Bureau of Labor Statistics, 2016; Community Attributes Inc., 2016.

Clusters of Interactive Media Occupations

The United States is home to several cities which have high employment among IM relevant occupations. To a large degree, these are also the nation's most populous cities. However, many of these cities also exhibit a high concentration of employment in IM relevant occupations, like San Jose and Washington DC, the first and third-highest cities by share of jobs in IM relevant occupations nationwide. Other cities also have high average wages among these occupations. San Francisco, for example, has the second-highest average wage in IM relevant occupations. New York, though not known for its interactive media cluster, has a large number of IM companies, like High 5 Games, Arkadium, and Take-Two Interactive. High 5 and Arkadium develop web and mobile games, while Take 2 is best known for console games like NBA 2k15 and Grand Theft Auto V. **(Exhibit 8)**

Exhibit 8. Top Cities, Ranked by Total Jobs in Interactive Media Relevant Occupations, 2015

City	Total Jobs in Interactive Media Occupations
New York, NY	178,340
Washington, DC	145,430
San Jose, CA	112,810
Seattle, WA	107,460
Chicago, IL	100,490
Dallas, TX	94,840
Atlanta, GA	89,340
Los Angeles, CA	84,710
Boston, MA	77,290
San Francisco, CA	70,450

Sources: Bureau of Labor Statistics, 2016; Community Attributes Inc., 2016.

Ranking these cities by share of occupations relevant to IM illustrates the concentration of IM relevant occupations in each city. San Jose is home to Disney Interactive and Zynga Games, and has total IM relevant occupational employment topping 112,000 in addition to having the highest share of IM relevant occupations. The San Jose metropolitan area includes Palo Alto, an area with a large number of IM companies. Across the US, 2.4 percent of jobs are in IM relevant occupations; all of the cities identified in **Exhibit 9** except one have higher-than-average concentrations. Los Angeles has a slightly lower-than-average concentration of IM relevant jobs, however, it has a very high absolute number of jobs. There are also several small cities throughout the nation with very

high concentration in these occupations. Framingham, a Massachusetts city with 172,000 total jobs, has a very high concentration of these occupations: 8 percent in 2015. This is largely thanks to a group of software companies headquartered in the city.

Exhibit 9. Top Cities Ranked by Relative Employment Concentration in Interactive Media Relevant Occupations, 2015

City	Total Jobs in Interactive Media Occupations	Interactive Media Occupations Share of Total Jobs
San Jose, CA	112,810	11.1%
San Francisco, CA	70,450	6.9%
Washington, DC	145,430	6.0%
Seattle, WA	107,460	5.9%
Boston, MA	77,290	4.4%
Dallas, TX	94,840	4.1%
Atlanta, GA	89,340	3.6%
Chicago, IL	100,490	2.8%
New York, NY	178,340	2.8%
Los Angeles, CA	84,710	2.1%

Sources: Bureau of Labor Statistics, 2016; Community Attributes Inc., 2016.

Relatively high wages are a distinctive feature of IM relevant occupations, and one that is strongly exhibited by cities with interactive media clusters. San Jose has the highest average wage in IM relevant occupations at just over \$130,000, followed by San Francisco at \$111,500. Across all IM relevant occupations in the U.S., the average wage is \$86,600, almost twice as high

as the average wage for all occupations in the U.S., \$48,320. (Exhibit 10)

Exhibit 10. Top Cities Ranked by Highest Wages in Interactive Media Relevant Occupations, 2015

City	Average Wage in IM Occupations
San Jose, CA	\$130,095
San Francisco, CA	\$111,472
Seattle, WA	\$108,810
Washington, DC	\$102,894
New York, NY	\$98,188
Boston, MA	\$97,853
Los Angeles, CA	\$91,012
Dallas, TX	\$86,942
Atlanta, GA	\$83,400
Chicago, IL	\$82,995

Sources: Bureau of Labor Statistics, 2016; Community Attributes Inc., 2016.

APPENDIX A. STAKEHOLDERS

The following firms, organizations and individuals were engaged as a part of this analysis to provide general perspectives on the interactive media industry as a whole and in Washington. Interviews were conducted over the phone.

- Bungie
- castAR
- Ed Fries
- Envelop VR
- FlowPlay
- Hidden Path Entertainment
- International Game Developers Association (IGDA)
- Microsoft
- Pokémon
- Vectorform
- VREAL

APPENDIX B. WORKS CITED

- Bullinger, J. (2016, March 29). *Solving the VR problem*. Retrieved from 425Business: <http://425business.com/solving-the-vr-problem/>
- Day, M. (2016, March 1). *Xbox chief says game's on for Microsoft across all devices*. Retrieved from The Seattle Times: <http://www.seattletimes.com/business/microsoft/xbox-chief-says-games-on-for-microsoft-across-all-devices/>
- Duryee, T. (2014, September 16). *Google's 1,400 Washington employees donate to local schools through crowdfunding campaigns*. Retrieved from GeekWire: <http://www.geekwire.com/2014/googles-1400-washington-employees-donate-300k-local-schools-crowdfunding-campaigns/>
- Envelop VR. (2016). *Envelop Virtual Reality*. Retrieved from Envelop VR: <https://www.envelopvr.com/solutions>
- Forbes. (2016, March 28). *A Beginner's Field Guide to Augmented and Virtual Reality*. Retrieved from Forbes Tech: <http://www.forbes.com/sites/tiriasresearch/2016/03/28/beginners-guide-to-ar-and-vr/#8828b5f2af46>
- Fortune. (2015, December 14). *How This Startup Hopes to Improve Virtual Reality Video Delivery*. Retrieved from Fortune Tech: <http://fortune.com/2015/12/14/pixvana-vr-video-delivery/>
- GeekWire. (2015, June 10). *Oculus inks big lease in Seattle's stadium district*. Retrieved from GeekWire: <http://www.geekwire.com/2015/oculus-inks-big-lease-in-seattles-stadium-district/>
- HTC. (2016). *Vive: The Global VR Accelerator*. Retrieved from HTC: <https://www.htcvive.com/us/>
- Microsoft. (2016). *Microsoft HoloLens*. Retrieved from Microsoft HoloLens: <https://www.microsoft.com/microsoft-hololens/en-us/hardware>
- newzoo. (2015, June 11). *The eSports Economy*. Retrieved from http://www.igamingbusiness.com/sites/igamingbusiness.com/files/Newzoo_eSports_iGaming_Webinar.pdf
- Pixvana. (2016). *Meet Pixel Nirvana, in the cloud*. Retrieved from Pixvana: <http://www.pixvana.com/>
- Sheikh, K. (2016, January 19). *Beyond Gaming: 10 Other Fascinating Uses for Virtual-Reality in Tech*. Retrieved from Live Science: <http://www.livescience.com/53392-virtual-reality-tech-uses-beyond-gaming.html>
- Smithsonian. (2016, February 3). *How Can Schools Use Virtual Reality?* Retrieved from Smithsonian.com: <http://www.smithsonianmag.com/innovation/how-can-schools-use-virtual-reality-180957974/?no-ist>
- The Guardian. (2015, July 23). *16 trends that will define the future of video games*. Retrieved from <http://www.theguardian.com/technology/2015/jul/23/16-trends-that-will-change-the-games-industry>

University of Washington. (2016). *Parkinson's Project*. Retrieved from UW HITLab:
<http://www.hitl.washington.edu/projects/parkinsons/>

University of Washington. (2016). *Virtual Puget Sound*. Retrieved from UW HITLab:
<http://www.hitl.washington.edu/projects/iproject.php?id=5>

University of Washington. (2016). *VR Treatments for Post-Traumatic Stress Disorder*. Retrieved from UW HITLab:
<http://www.hitl.washington.edu/projects/ptsd/>

Venture Beat. (2015, October 28). *Virtual reality enterprise software startup Envelop VR raises \$4M*. Retrieved from Venture Beat:
<http://venturebeat.com/2015/10/28/virtual-reality-enterprise-software-startup-envelop-vr-raises-4m/>

Washington State University. (2016). *Virtual Reality and Computer Integrated Manufacturing Laboratory*. Retrieved from Washington State University:
<http://vrcim.wsu.edu/>

Zillow Group. (2015). *Zillow Group 2015 Annual Report*. Seattle.