Benchmarking the

Creative Technology Ecosystem

in British Columbia

Research by the Information and Communications Technology Council in Partnership with DigiBC

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Preface

ICTC is a not-for-profit, national centre of expertise for strengthening Canada's digital advantage in a global economy. Through trusted research, practical policy advice, and creative capacity-building programs, ICTC fosters globally competitive Canadian industries enabled by innovative and diverse digital talent. In partnership with a vast network of industry leaders, academic partners, and policy makers from across Canada, ICTC has empowered a robust and inclusive digital economy for over 25 years.

DigiBC (the Interactive and Digital Media Industry Association of British Columbia) is a member-supported, non-profit organization based in Vancouver, BC. Incorporated in 2010, DigiBC represents BC's creative technology cluster, which is made up of the video games and interactive, visual effects, animation, and augmented reality/virtual reality industries. DigiBC helps to ensure that the creative technology sector grows and thrives in the province, with the goal of making BC the world's leading centre for interactive and digital media.

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Abstract

This paper utilizes extensive research to offer a first-of-its kind analysis of the creative technology sector in British Columbia. Leveraging in-depth primary research consisting of interviews with experts from industry and post-secondary institutions across the province, this report highlights the creative technology sector as a central driver of economic growth and employment in British Columbia.

This study began in January 2020, with research methods and tools finalized in February 2020. As this predates COVID-19 lockdowns, the study does not directly investigate the impacts of COVID-19 on the creative technology sector. Yet, due to widespread shifts witnessed across the global economy during this period, secondary research is included on the pandemic's impacts, along with insights from naturally emerging discussions encountered in interviews. Generally, the creative technology sector has remained remarkably resilient in the face of COVID-19 lockdowns. Despite projections of double-digit negative growth in the Canadian economy for 2020, industries like animation and video gaming have seen a surge in business, and thereby a continued demand for talent. The visual effects industry has been the most adversely impacted in the short term, due to the slowdown in live-action film. Despite these initial findings, longer-term implications of COVID-19 are not well understood or predictable. Further research is required to understand the varying impacts of the pandemic on BC's creative technology sector.

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Glossary of Terms

Augmented reality (AR): Interactive real-life experiences enhanced by digital elements—such as visual overlays or other sensory projections. The purpose of AR is to expand a user's understanding of, or interaction with, his or her environment.

Virtual reality (VR): Simulated experiences that can resemble—or differ completely—from the real world. Virtual reality typically takes the form of 3D simulations, presented by way of a headset and motion sensors.

Mixed reality (MR): The combination of AR and VR, which allows users to see both the real world and virtual objects simultaneously.

Extended reality (XR): The umbrella term for augmented reality, virtual reality, and mixed reality. XR, AR/VR, and VR/AR are often used interchangeably.

Digital Technology Supercluster: One of five Canadian "Innovation Superclusters" funded by Innovation, Science, and Economic Development Canada. The superclusters were developed to support business-led collaboration in the digital technology industry. The Digital Technology Supercluster is based in British Columbia.

Computer-generated imagery (CGI): Visual content created solely by way of computer graphics. CGI often refers to 3D content, but it can be used for purposes ranging from 2D animation to manipulating live footage.

Visual effects (VFX): Imagery that is created, manipulated or enhanced using digital technology. This can be done for film, TV, video games, and other media. An integration between live footage and manipulated imagery, VFX workers often use computer-generated imagery to create realistic-looking environments or characters.

Live-action filming: Visual content created with traditional film technology (rather than computer imagery) to record live scenes and actors. Increasingly, live-action film, CGI, VFX, and animation are used in conjunction.

Cloud technology: Also referred to as cloud computing, technology that makes data, software, servers and networking available to multiple users over the internet.

Work-Integrated Learning (WIL): A variety of practices designed to provide students with experiential learning throughout their studies. These often take the shape of co-ops, internships, apprenticeships, and capstone projects.

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Executive Summary

The creative technology sector in BC is primarily characterized by three key sub-sectors: video games, animation, and visual effects (VFX). A fourth emerging sub-sector, extended reality (XR) is one that shows notable promise for technological, economic, and labour market growth in the years to come. The three main sub-sectors of creative technology in BC are underpinned by approximately 135 businesses[1] located across the province, which together are significant contributors to the provincial economy. 49 studios were interviewed in this study, and collectively they were responsible for nearly 10,000 jobs in 2019. 2020 data was captured until late summer, but despite the devastating economic impacts brought on by COVID-19 across the general economy, hiring projections for 2020 showcase that the creative technology sector has emerged resilient. By late summer, many industry interviewees relayed that their employment projections were on par with those of the year prior.

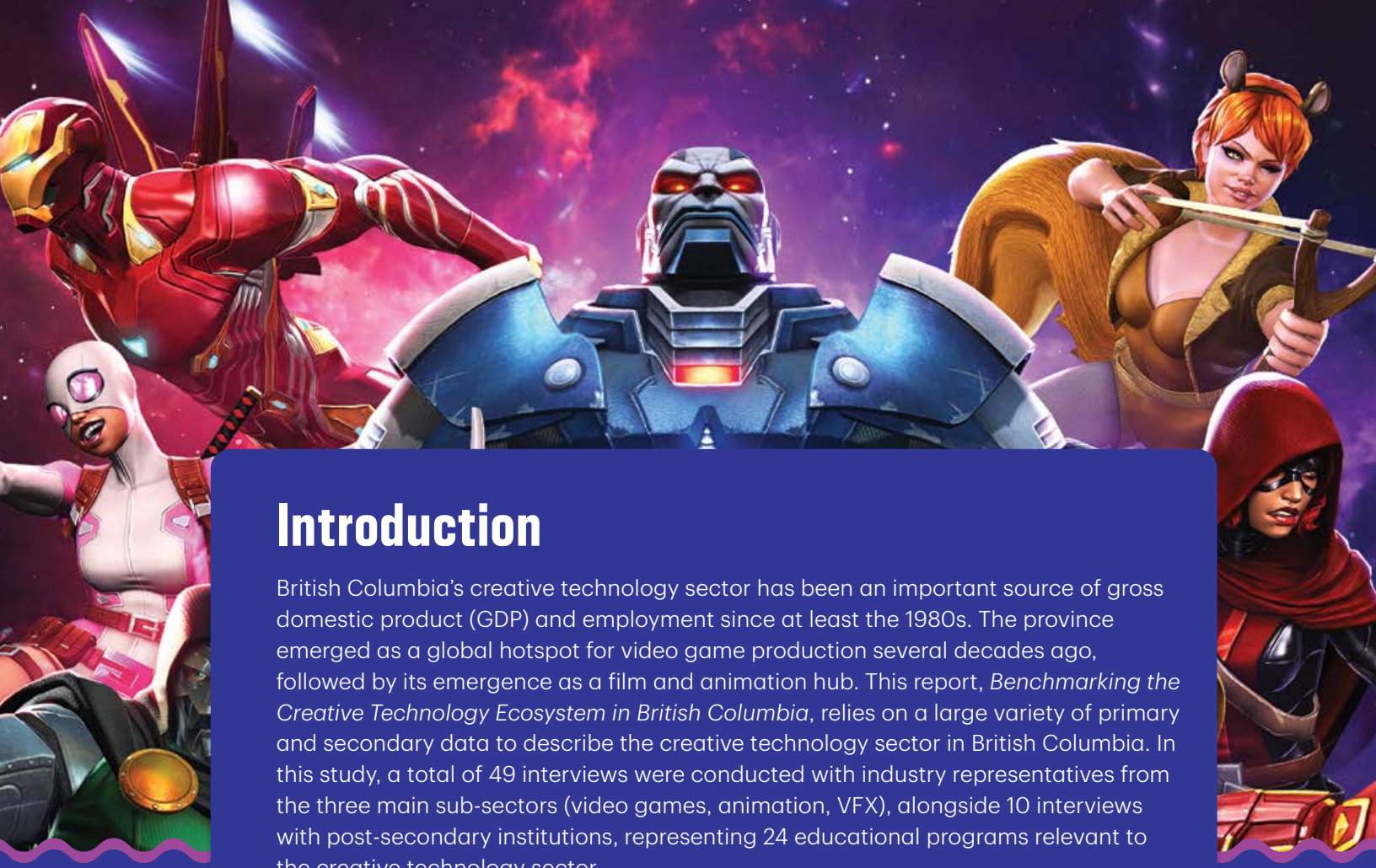
The job-development potential of this sector has been steadily increasing year over year, alongside the demand for talent. Over 90% of businesses interviewed in this study asserted that demand has either stayed constant or increased over the last three years, with key creative and digital roles seeing noticeable growth. BC-based talent is also regarded to be of high quality, able to meet many of the technical, digital, and creative needs of the sector. The quality of local talent was particularly high at mid and senior levels, with over 85% of industry interviewees rating it as good or excellent. Although some room for improvement was noted for junior talent, nearly 50% of industry interviewees regarded this talent stream as good or excellent, and work integrated learning was considered a crucial resource for further skill development.

1 ICTC, DigiBC, 2020. See Appendix III for breakdown.

Image: © 2020 Electronic Arts Inc.

However, while the quality of talent in BC was well regarded, quantity was highlighted as a significant challenge. The nature of the creative sector is characterized by periods of ramp up and ramp down, across sub-sectors. Among larger studios (which are disproportionately located in BC, vs. other provinces), ramp up periods can equate to the need to fill thousands of roles at a time. These realities, most present in the animation and VFX sub-sectors, mean that the crunch for talent is especially acute in the creative technology sector. Numerous occupations fall under this category: FX artists, animators, gameplay programmers, compositors, and many others are roles that require a steady stream of talent to ensure that studios can meet business needs. Software engineers are also in high demand, yet come with an added feature of being in demand not just in the creative technology sector, but across the entire BC and Canadian economy. While heightened multi-sector competition is a reality for software engineers, roles like riggers or pipeline technical directors (TDs) are unique in that they are both highly in demand and difficult to fill locally. Creative technology studios in BC tend to source much of their talent locally, yet, for roles like riggers, pipeline TDs, and a handful of others, an insufficient volume of local talent requires them to expand their search beyond provincial borders.

Ensuring the continued success of this sector is dependent on timely and robust access to skilled talent needed to fill key in-demand roles at all levels. This investment comes with other essential considerations, including enhanced visibility, financial support measures, and growing collaboration between industry and post-secondary institutions—all of which can help the creative technology sector source, train, and grow its talent pool. These foundational pillars will ensure that the birthplace of the Canadian creative technology sector (it was in BC that Canada's creative technology ecosystem was founded and flourished) can scale and compete in an increasingly global economy. With support, it can continue to produce internationally successful Canadian anchor companies and provide high-quality employment opportunities for British Columbians.



Introduction

British Columbia's creative technology sector has been an important source of gross domestic product (GDP) and employment since at least the 1980s. The province emerged as a global hotspot for video game production several decades ago, followed by its emergence as a film and animation hub. This report, *Benchmarking the Creative Technology Ecosystem in British Columbia*, relies on a large variety of primary and secondary data to describe the creative technology sector in British Columbia. In this study, a total of 49 interviews were conducted with industry representatives from the three main sub-sectors (video games, animation, VFX), alongside 10 interviews with post-secondary institutions, representing 24 educational programs relevant to the creative technology sector.

Section I leverages secondary research and a robust literature review to define the sector, including its three main sub-sectors: video games, animation, and visual effects (VFX). Although still a nascent industry in Canada and BC, an overview of the extended reality (XR) sub-sector, comprising of Augmented Reality (AR), Virtual Reality (VR) and Mixed Reality (MR) is offered, with the understanding that in a few years this industry may contribute significantly to the overall sector. While XR is considered one of the future verticals of the overall creative technology sector in this report, the research collected and displayed for this sub-sector is secondary in nature.

Section II offers an overview of creative technology talent in BC. It provides a look at sector demographics, the distribution of seniority and domestic versus international talent, diversity and inclusion practices, training and other opportunities for learning development, as well as insights on the current impacts of COVID-19.

Section III describes the demand for talent within the sector in BC. With 49 studios interviewed in this study responsible for nearly 10,000 jobs in the province during 2019, many experienced employment growth of 20% since 2017. Apart from the VFX industry, which has been negatively impacted by COVID-19 primarily due to the shutdown of live-action film, employment prospects are expected to remain strong for the creative technology sector in the coming year.

Image courtesy of Kabam

About 55% of industry interviewees anticipated employment growth in 2020, despite the large-scale downturns evident and anticipated across the overall economy. This section also identifies relevant jobs for the sector, the most in-demand jobs, as well as the skills and competencies associated with those roles.

Section IV moves from the quantitative elements of BC's creative technology talent pool to the qualitative. It offers an analysis of industry intervewees' perceptions of talent quality in BC.

Section V discusses the role of international talent. Given the notable need for international talent, namely for very specific roles that are linked with volume shortages in BC, this section also provides a glimpse into top source countries for international talent and the most commonly used immigration channels. At the same time, it showcases that the sector's approach to immigration is a strategic one: the end goal of sourcing international talent on temporary work permits is to turn them into Permanent Residents who can continue to strengthen the sector in BC.

Section VI offers a deep dive on recruitment and retention, highlighting the biggest barriers to both, and areas of opportunity.

Section VII explores the education system relevant to the creative technology sector. This section offers insight on top schools and programs, enrolment, student demographics, and diversity and inclusion initiatives.

Section VIII utilizes the insights gained from previous sections and new data from interviewees to address the issue of one key talent stream: junior talent. It highlights educational program outcomes, minimum education requirements, and offers an in-depth look at work-integrated learning.

Section IX provides an overview of perspectives from outside of the main city centres responsible for creative technology activity. Regional focus groups were conducted with representatives from Northern BC, Vancouver Island, and the Interior.

Lastly, **Section X** goes beyond immediate talent needs to investigate the policy measures and instruments that can help BC's creative technology sector continue to thrive and grow its competitive footprint in a global economy. Visibility of the sector, tax incentives, financial support, immigration, and greater collaboration between industry and post-secondary institutions are some of the critical levers that will propel the success of the sector going forward.

This comprehensive report is a first-of-its-kind analysis for BC, and for the creative technology sector as a whole. Responsible for thousands of high-quality jobs in British Columbia, the creative technology sector is a pillar of the provincial economy, and a national success story that warrants visibility and continued support to thrive and compete on a global scale.

SECTION I

The Creative Technology Sector 101

What is Creative Technology?

Image courtesy of Charm Games

Image courtesy of Hyper Hippo

Starting With the Basics:

The Technology Sector in BC

The information and communications technology (ICT) sector is widely recognized as an impactful and growing area of the global economy. The story is no different for Canada, where the technology sector is a powerful contributor to Canada's GDP and employment. From 2009 to 2019, Canada's tech sector saw a growth of 37% in GDP, reaching $92.6B. By July 2020, the Canadian tech sector employed nearly 1 million workers[2].

BC's technology sector has also seen considerable growth over the years, and the province boasts one of Canada's fastest growing tech ecosystems. Using custom data tabulations from Statistics Canada's Labour Force Survey for ICT, ICTC finds that from 2009 to 2019, BC's technology sector grew 44% in economic output, reaching $11.5B. Similarly, employment in this sector also scaled rapidly, eventually employing 138,000 in July 2020. Although Vancouver has been an established hub for tech talent for years, other regions like Vancouver Island and Thompson-Okanagan have shown signs of growth in recent years. From 2014-2018, tech employment in Victoria and Kelowna grew by over 4% and over 8%, respectively.[3]

Figure 1: 2009-2019 Canada and BC technology sector GDP

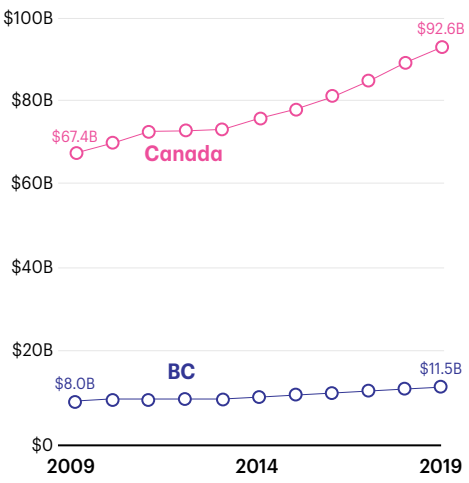
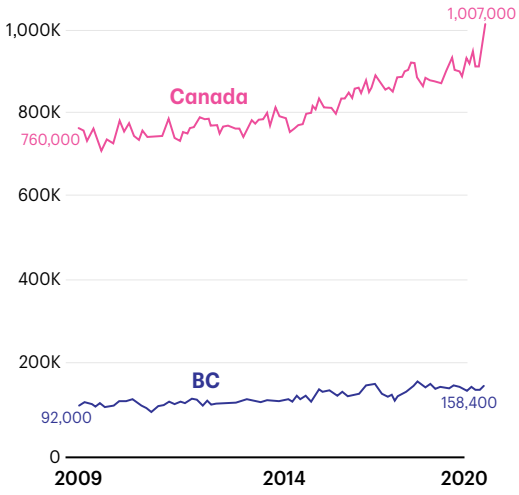


Figure 2: 2009-2019 Canada and BC technology sector employment



Source: Statistics Canada Labour Force Survey, ICT NAICs; analysis by ICTC

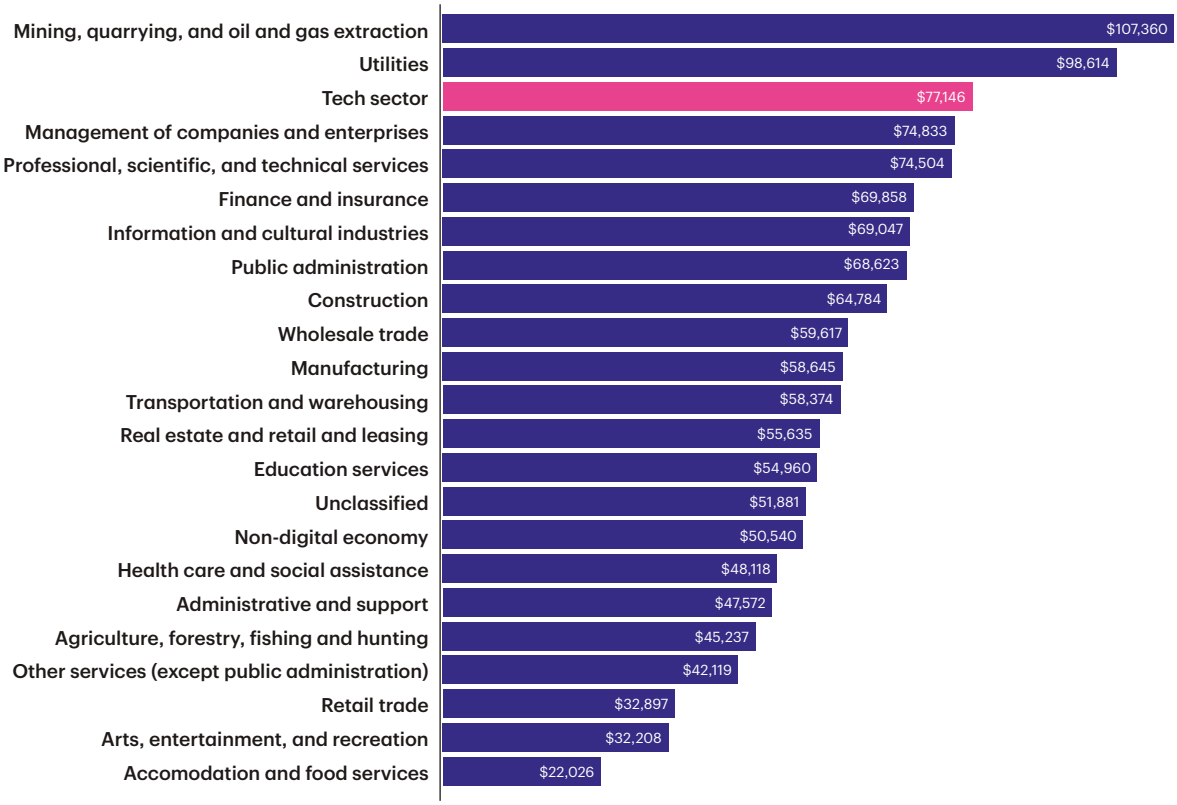
2 *Maryna Ivus, Akshay Kotak, Ryan McLaughlin, "The Digital-Led New Normal: Revised Labour Market Outlook for 2022", ICTC, August 2020, https://www.ictc-ctic.ca/wp-content/uploads/2020/08/Outlook-ENG-FINAL-8.24.20.pdf. P.35.*

3 *Ilya Brotzky, "The Top Canadian Tech Hubs You Don't Know About", BetaKit, October 18, 2019, https://betakit.com/the-top-canadian-tech-hubs-you-dont-know-about/*

The success of the sector has also influenced technology updates in other more traditional sectors—key examples include the increasing leveraging of technology in natural resources, healthcare, and finance—while bringing forth high-quality, high-paying jobs for British Columbians.

Figure 3 below showcases the average annual average wages for various sectors of the BC economy. At an average annual wage of over $77,000, compensation for jobs in BC's technology sector are 48% higher than average wages in the overall economy, surpassing average wages in nearly every other sector. Pan-Canadian wage data collected by ICTC during 2020 suggests even higher wages in the animation, VFX, and video game subsectors, than the technology sector overall. For example, ICTC research found that the average wage for an intermediate (someone with 3-5 years of experience) Pipeline TD (role to be explained later on) was over $83,000 annually in Vancouver during 2020. Intermediate game developers ranked slightly higher, with average salaries in Vancouver during 2020 totaling $87,500.

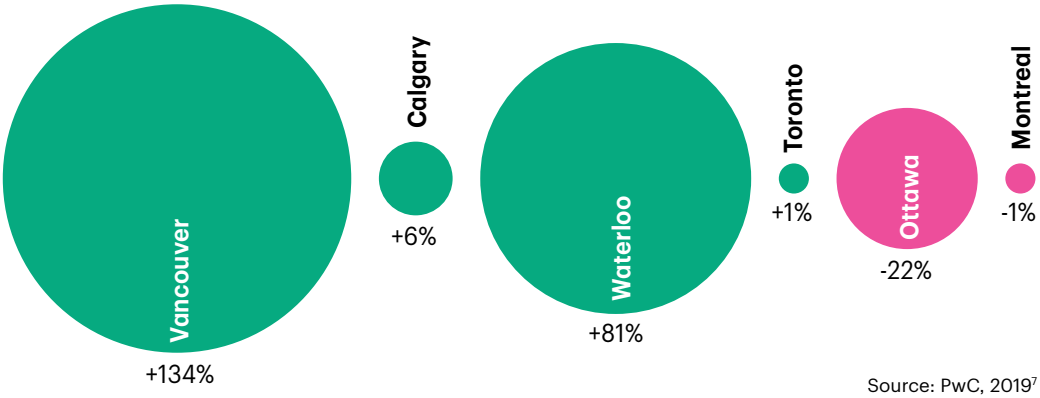
Figure 3: Wages by sector in British Columbia in 2020



Source: Statistics Canada LFS, custom grouping for "Tech Sector", analysis by ICTC

In recent years, BC's technology sector has experienced substantial growth, both in the local startup ecosystem (i.e., expansion of homegrown businesses) and via foreign direct investment (FDI) attraction (i.e., expansion via mergers, acquisitions, or the establishment of foreign subsidiaries). According to the most recent stats available from the province of British Columbia (2019), the number of homegrown tech businesses in the province totalled over 10,900.[4] BC has also successfully attracted well-known industry heavyweights such as Microsoft, Sony, and Amazon, acting as the Canadian headquarters of some of the top tech companies in the world.[4] Venture capital investment in the province's scaling tech sector has seen steady growth 2016 onward. In 2019, Venture capital (VC) investment in Vancouver-based startups hit a six-year high, raising $924 million—more than double the value of investments seen the previous year, 2018.[6]

Figure 4: Venture capital growth in Vancouver and other Canadian cities 2018-2019



Source: PwC, 2019[7]

Geographically, the Lower Mainland is the main base of tech operations in the province, but increasingly robust technology hubs have bloomed in other regions, particularly the Okanagan and Vancouver Island.[8] Partly in response to this continued success and expansion, BC was named home to the Digital Technology Supercluster in 2017, sharing the spotlight with four other superclusters (advanced manufacturing, protein, AI, oceans) located across Canada.[9]

With technology increasingly an integral part of the world economy, BC's tech sector has recorded notable gains in GDP, revenue, employment, and wages over the last few years.

4 *"Profile of the British Columbia Technology Sector: 2019 Edition," BC Stats, May 2020, https://www2.gov.bc.ca/assets/gov/data/statistics/business-industry-trade/industry/tech_profile_report.pdf*
5 *Ibid.*
6 *"PwC MoneyTree Canada H2 2019," PwC, 2019, https://www.pwc.com/ca/en/industries/technology/money-tree/money-tree-h2-2019.html*
7 *Ibid.*
8 *"Profile of the British Columbia Technology Sector: 2019 Edition," BC Stats, May 2020, https://www2.gov.bc.ca/assets/gov/data/statistics/business-industry-trade/industry/tech_profile_report.pdf*
9 *"BC Tech 2018: Advancing Technology," Business in Vancouver, 2018, https://biv.com/magazine/bc-tech-2018*

Of course, it too has faced challenges related to the pandemic. In reaction to COVID-19, 90% of BC tech companies have implemented measures to cut costs, while 80% have seen a negative revenue impact.[10] Nonetheless, recent ICTC research suggests that companies in the digital economy have inherent characteristics—including a workforce that in many cases, is well-suited for remote work—making them more resilient to large-scale economic shocks like COVID-19.[11] Perhaps understanding this inherent ability to weather the economic storm and transition to recovery, the federal government announced in July 2020 that it would provide $3 million in COVID-19 response funding for companies in BC's tech sector, as part of a BC Technology Sector Resiliency Program.[12]

The Creative Technology Sector in BC

The creative technology sector continues to be an essential component of BC's overall tech ecosystem. It all started in the early 1980s when Don Mattrick and Jeff Sember—then still in high school—pioneered Canada's first homegrown computer game, *Evolution*.[13] BC's creative technology sector has expanded and gained international attention since then. Today, more than four decades later, BC's creative technology sector has evolved to a diverse blend of companies, workers, and products, and is increasingly seen as a robust sector with strong wealth generation potential.[14] In 2019, provincial success stories spanning areas that include mobile applications, augmented and virtual reality, visual effects, and interactive marketing contributed over $2.3 billion to the provincial economy.[15]

Creative Technology: A Definition

What exactly is creative technology? Although definitions vary, depending on jurisdiction, in this study the creative technology sector is defined by its four central contributors:

10 *"COVID-19 Resource Centre," BC Tech Association, 2020, https://wearebctech.com/covid-19-updates/*

11 *Maryna Ivus, Akshay Kotak, Ryan McLaughlin, "The Digital-Led New Normal: Revised Market Outlook for 2022," ICTC, August 2020, https://www.ictc-ctic.ca/wp-content/uploads/2020/08/Outlook-ENG-FINAL-8.24.20.pdf*

12 *Tyler Orton, "Feds pledge $30m for B.C.'s small businesses, tech sector," Business in Vancouver, July 2020, https://biv.com/article/2020/07/feds-pledge-30m-bcs-small-businesses-tech-sector*

13 *Blaine Kyllo, "Vancouver's video game family tree," Georgia Straight, January 28, 2009, https://www.straight.com/article-198534/video-game-family-tree*

14 *"Opportunity BC 2020: Creative Sector: Report for the Business Council of BC," PwC, 2009, https://bcbc.com/dist/assets/publications/opportunity-bc-2020-creative-sector/2020_200910_Mansfield_Creative.pdf*
**Note: In some cases, industries that form part of larger aggregations were estimated using ratios of available data and, in other cases, suppressed data was estimated using ratios and annualized growth trends.*

15 *"Creative BC Announces 10 BC Digital Media Companies to Receive $680,000 in Grants through BC Interactive Fund," T-Net, April 10, 2019, https://www.bctechnology.com/news/2019/4/10/Creative-BC-Announces-10-BC-Digital-Media-Companies-to-Receive-680000-in-Grants-through-BC-Interactive-Fund.cfm*

Why Is BC a Creative Technology Hub?

The official birthplace of Canada's creative technology sector is BC. However, even without these historic roots, there exist numerous reasons for why BC continued to remain a key hub for the sector over the last 40 years.

Conveniently accessible to a variety of leading global tech hubs. BC provides a gateway to many central tech hubs around the world. Sharing the Pacific Corridor and California's time zone, there is an easy and convenient link to large technology hubs in the US. Vancouver also offers easy access via direct flights to other international locations relevant to the creative technology sector, such as Asia, Europe, and Australia.

Well-known and established expertise. With roots dating back to the 1980s, BC is one of the world's largest clusters for interactive entertainment. It is home to both a growing and thriving local industry as well as a range of international actors.

Skilled talent and strong educational institutions. BC is home to highly skilled creative technology talent, and top-notch educational institutions that train talent for relevant creative, digital, production, and design roles.[16]

Industry-supporting resources are available. BC is home to many established industry associations and organizations that support the creative technology ecosystem. Examples include DigiBC, Creative BC, Women in Animation, Women in Games, the Animation & VFX Alliance, the BC Tech Association, Accelerate Okanagan, VIATECH, and the Innovation Island Technology Association.

Globally competitive industry. The combination of the convenient location providing easy access to world-leading creative clusters like Los Angeles coupled with the attractive Canadian dollar has led to numerous world-class creative technology companies, primarily from the US, setting up in BC. Examples include Sony Pictures Imageworks, Industrial Light & Magic, and Method Studios.

Image courtesy of Charm Games

16 *"Play to Learn Program," DigiBC, February 20, 2020, https://www.digibc.org/blogs/digibc-education-updates-1*

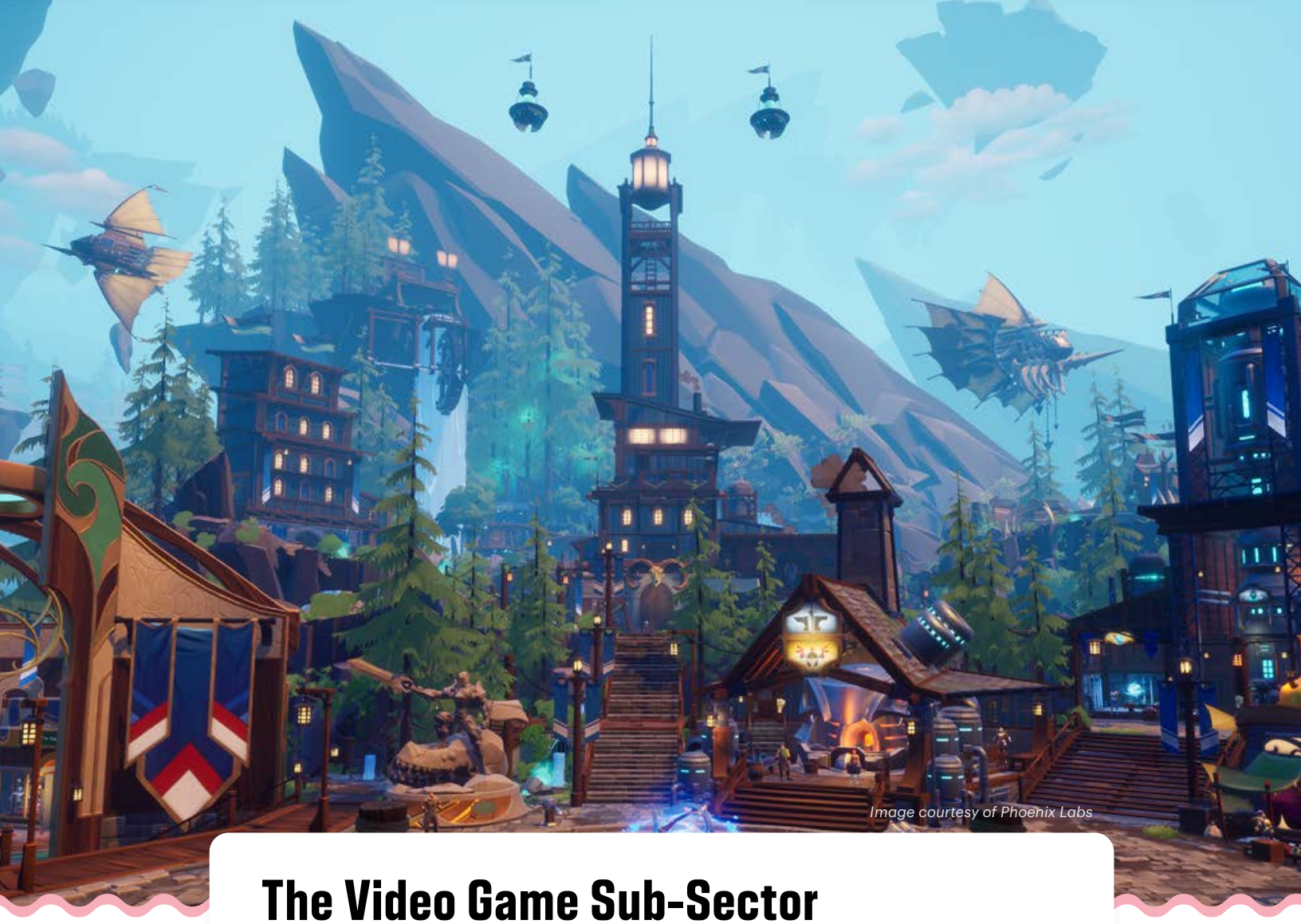


Image courtesy of Phoenix Labs

The Video Game Sub-Sector

Video games can be played via a computer, game console (like Xbox or PlayStation), smartphone or tablet. According to the Entertainment Software Association (ESA), the most common devices for game play in 2019 were smartphones (used by 60% of players), PCs (used by 52% of players) and dedicated consoles (used by 49% of players).[17] Video games come in different types and genres, including Action and Shooter games to Puzzle and Strategy. During 2019, the popularity of video game genres differed among Canadians depending on generation and gender. For male millennial gamers, the most popular genres were Action, Shooter, and Sports games; for female boomer gamers, the most popular genres were Card, Puzzle and virtual board games.[18] With so many genres and options, video games cater to a diversity of users.

As a result, the Canadian video game sub-sector has been rapidly growing. In 2019, the ESA estimated the existence of 692 active video game companies in Canada, representing a 16% increase since 2017.[19]

17 *"2019 Essential Facts About the Computer and Video Game Industry," Entertainment Software Association, May 2019, https://www.theesa.com/esa-research/2019-essential-facts-about-the-computer-and-video-game-industry/*

18 *Ibid*

19 *"The Canadian Video Game Industry 2019," Entertainment Software Association, November 2019, http://theesa.ca/wp-content/uploads/2019/11/CanadianVideoGameSector2019_EN.pdf*

Table 1: Number of video game companies per region in Canada

	2013	2015	2017	2019
Quebec	97	139	198	218
Ontario	96	108	162	235
British Columbia	67	128	139	116
Rest of Canada (Atlantic Canada and Prairies)[20]	69	97	68	124
Atlantic Canada	-	-	-	38
Prairies	-	-	-	86
Total	**329**	**472**	**596**	**692**

Source: The Canadian Video Game Industry 2019, ESA

Although business models and structures are changing (to be described in more detail below), Canada's video game sub-sector is lucrative and largely export-driven.[21] The success of video game exports is a unique characteristic for this industry and presents a clear opportunity for sustainable economic growth in BC and Canada.[22]

Economic Impacts

In 2019, the sub-sector contributed a total of $4.5 billion ($2.6 billion in direct activity; $1.9 billion in indirect activity[23]) to the Canadian economy, a figure that represents a 20% growth since 2017.[24] By comparison, the total Canadian economy grew by just 5% over the same period.[25]

According to the Entertainment Software Association, video game companies in Canada also generated $3.6 billion in revenue from all sources in 2019, an increase of 15% from 2017. Due to the strength of this sub-sector's export capacity, over three-quarters (76%) of this revenue was derived from export markets outside of Canada.[26] "In-game/in-app sales" made up 13% of the total revenue, while tax credits and game unit sales each accounted for 11% of total revenue.[27]

20 *The report does not identify studios outside of Quebec, Ontario, BC, Atlantic Canada, and the Prairies.*
21 *Ibid, p. 29*
22 *Idem*
23 *The "Canadian Video Game Industry 2019" report defines "indirect" GDP contributions as those made by industries supplying goods and services to the video game industry, and includes what is known as "induced GDP" which is economic activity attributable to re-spending of labour income within an economy.*
24 *Ibid, p.4*
25 *Idem*
26 *Ibid, p.3*
27 *Ibid, p.29*

BC's video game sub-sector has been a notable contributor to both the provincial and federal economy, and COVID-19 has underscored its continued—and possibly heightened—relevance in an increasingly online future. According to Statistics Canada, during the first month of the pandemic (March to April 2020), time spent playing video games increased by more than 35% for Canadians aged 15 to 49, and another 7% by Canadians aged 50 and older.[28] During this period, many Canadian gaming studios have also reported record sales.[29] COVID-19 and its impacts may be the catalyst that forever boosts and highlights the vast earning potential of gaming.

In this study, ICTC estimated the existence of 79 video game companies across the province in 2020 (see Appendix III for details). It contacted 66 for interviews, and completed 26 interviews with companies representing nearly 4,600 employees. This figure represents over 33% of all video game studios in BC and a significant portion of employment (as the companies interviewed were some of the largest in the province).

Industry Trends:
New Business Models in Video Games

Historically, the video game sub-sector has seen three primary ways publishers and developers work together:

A **"first-party"** developer is internal to the publisher, either by direct hire or acquisition of a team. An example of this model is Electronic Arts.

"Second-party" development agreements are quite rare and deeply collaborative. An example of a second-party relationship is between Nintendo and Next Level Games, which has created the Luigi's Mansion games on Wii and Switch. In second-party development agreements, there may be ownership of IP and "back end" revenue models that are generally more beneficial to the developer than in third-party agreements.

"Third-party" development agreements are the most prevalent. In these agreements, a publisher owns the intellectual property, creative vision and business plan for the development and marketing of their product. Third-party developers create the products to the specifications of the publishing partners and are paid upon successful delivery of each milestone of the project. The developer may or may not participate in revenue sharing once the product is in the market.

N.B. Any of these models may also use external developers to create assets for their property.

28 *"Change in weekly habits as a result of COVID-19, March and April 2020," Statistics Canada, April 8, 2020, https://www150.statcan.gc.ca/n1/daily-quotidien/200408/t002c-eng.htm*

29 *Bonnie Allen, "Video games, esports 'skyrocket' in popularity during pandemic," CBC News, June 16, 2020, https://www.cbc.ca/news/canada/saskatchewan/video-games-and-esports-fill-void-in-pandemic-1.5612488*

Traditionally, game development in BC has primarily been rooted in third-party development, with some notable successful exceptions such as Klei Interactive and Next Level Games. In the last decade, a series of digital trends have brought forward profound changes to this standard business model, introducing both new opportunities and challenges. Three key changes are: digital downloads, mobile cloud and social gaming, and data analytics.

Described below, each of these new contexts expand the traditional boundaries of the video game sub-sector.

Digital Downloads

In recent years, there has been a rapid, significant trend away from physical media products such as CDs, toward direct digital downloads. To support the sale of games, video game publishers and console manufacturers have increasingly created their own platforms for digital distribution, which provide centralized mechanisms for customers to purchase and download digital content. Examples include digital marketplaces like Steam that source content from multiple publishers or platforms like Origin and Xbox Live Marketplace, populated with proprietary (publisher-created) content only.

As the digital distribution of video games has become increasingly common, major publishers and retailers are paying more attention to digital sales. In 2013, 90% of console game sales were completed through physical media sales. In 2018, this type of sale accounted for only 65% with digital sales accounting for the rest.[30]

According to a study conducted by SuperData Research, the volume of digital distribution of video games worldwide was $6.2 billion per month in February 2016[31] and reached $7.7 billion per month in April 2017.[32] For many game developers—and namely developers of PC and mobile app games—direct downloads can provide higher margins than physical sales, but they are not without their challenges.[33] For PC and mobile game developers, the shift to digital downloads concentrates power with digital and online distributors like Steam or Apple Arcade. These online distributors, with increasing influence over consumer purchasing behaviour, now have much stronger bargaining power, which can put publishers at a disadvantage.

Digital downloads have brought profound changes to the typical video game business model. Now, after game is completed and "shipped," a team needs not downsize or dissolve and can continue to create content as well as manage analytics, moving toward a Games-as-a-Service (Gaas) model.

30 *"Rethinking the Video Game Business Model," Digital Initiative, April 24, 2018, https://digital.hbs.edu/platform-digit/submission/rethinking-the-video-game-business-model/*

31 *"Digital Games Worth $6.2 Billion a Month," WholesGames, March 24, 2016, https://wholesgame.com/news/digital-games-worth-6-2-billion-month/*

32 *"Digital games revenue grew by 9% worldwide," WholesGame, May 29, 2017, https://wholesgame.com/news/digital-games-revenue-grew-by-9-worldwide/*

33 *"Rethinking the Video Game Business Model," Digital Initiative, April 24, 2018, https://digital.hbs.edu/platform-digit/submission/rethinking-the-video-game-business-model/*

Impact of Digital Downloads:

Video Game as a Service Model ("GaaS" Model)

The "games-as-a-service" (Gaas) model in the video game sub-sector has led to significant changes in player habits. Primarily, instant availability of digital games has pushed players away from traditional boxed products and toward online versions. Digital delivery has also changed the market in other ways: with GaaS, developers can update games on the go and release as many updates as needed, with players receiving them directly when they connect onto the server. As of 2019, Sony had 36.4 million PlayStation Plus subscribers, Microsoft Live had 64 million monthly users, and Nintendo had over 10 million Nintendo Switch Online subscribers.[34] Rather than operating solely by number of "games sold," these firms can also operate by acquisition and retention of subscribers. Under the subscription-based business model, games are turned into services, with constant upgrades and virtuous feedback loops.[35] In 2019, Sony announced in its 2019 Q1 financials that the sales of its digital games had surpassed those of physical copies for the first time. Sony believes that digital copies of games are expected to continue to overtake the sale of physical copies.[36]

This model opens opportunities for game developers. With the ability to roll out regular updates and changes, developers are not tied to a colossal annual release, which can force hard decisions about cutting and editing.

Developers and publishers can extend the game's life by adding new content ("downloadable content" [DLC]), which can be either free or purchasable.[37] Here, the new imperative is to turn initial popularity from a hit into a reliable, growing base for subscription revenue.

Mobile, Social, and Cloud-based Gaming

Another trend is the shift away from console and PC gaming toward mobile gaming. In recent years, mobile gaming has exploded, while PC and console growth has slowed to the low single digits.[38] In order to succeed on the mobile medium, companies must deploy a different set of creative and commercial capabilities. Whereas older models depended largely on "blockbuster games" that consumers play for many hours on end, mobile success relies more on casual games that users repeatedly come back to for short amounts of time.[39] By the end of 2019, the global mobile gaming market was estimated at $68.5 billion, out of the total $152 billion gaming market.[40]

34 *Tien Tzuo, "Why video games are shooting down the Hollywood model," Venture Beat, August 17, 2019, https://venturebeat.com/2019/08/17/why-video-games-are-shooting-down-the-hollywood-model/*
35 *Ibid*
36 *Tushar Sonal, "Cloud Gaming is Becoming The Norm of the Gaming Industry," Media Nova, December 25, 2019, https://www.medianova.com/en-blog/2019/12/25/cloud-gaming-is-becoming-the-norm-of-the-gaming-industry*
37 *Fanny Vaudour, Aleksej Heinze, "Software as a service: Lessons from the video game industry," Wiley Periodicals, 2020, https://onlinelibrary.wiley.com/doi/pdf/10.1002/joe.21982*
38 *"Rethinking the Video Game Business Model," Digital Initiative, April 24, 2018, https://digital.hbs.edu/platform-digit/submission/rethinking-the-video-game-business-model/*
39 *Ibid*
40 *Omer Kaplan, "Mobile gaming is a $68.5 billion global business, and investors are buying in," Tech Crunch, August 22, 2019, https://techcrunch.com/2019/08/22/mobile-gaming-mints-money/*

Another notable change is the shift to social gaming. Where gaming was once an individual activity, today's internet speed and bandwidth has enabled massive multiplayer online games to thrive, and many of the most popular current games have significant social features.[41] In response to COVID-19, the World Health Organization and the video game industry established a campaign – #PlayApartTogether – that strives to encourage social distancing by promoting social gaming.[42] Social games have strong network effects, meaning that people play for longer periods, and also that content must be updated more regularly (more than producing new editions each year).[43]

Cloud technology has also disrupted gaming in the past decade by introducing subscription models that enhance the elements and ease of use, and accessibility to consumers. With cloud-based subscription models, users can "log in to their subscription, fetch a game directly by surfing through a library of available games and start streaming the game right away."[44]

Cloud-based services are behind the rise of the new subscription-based video game business model, with the global cloud gaming market expected to surpass $450 million by 2023—up from $45 million in 2017, a 900% increase.

Recently, Sony announced a partnership with Microsoft Azure to explore the joint development of future cloud solutions on the Azure platform, for both game and content streaming.[45] In November 2019, Google launched its cloud gaming service Stadia, which has the capacity to stream video games up to 4K resolution at 60 frames per second. Electronic Arts, too, launched a trial of its cloud gaming service, Project Atlas, in 2019.[46]

Image courtesy of Metalheadz Software

41 *"Rethinking the Video Game Business Model," Digital Initiative, April 24, 2018, https://digital.hbs.edu/platform-digit/submission/rethinking-the-video-game-business-model/*

42 *Dean Takahashi, "WHO and game companies launch #PlayApartTogether to promote physical distancing," Venture Beat, March 28, 2020, https://venturebeat.com/2020/03/28/who-and-game-companies-launch-playaparttogether-to-promote-physical-distancing/*

43 *"Rethinking the Video Game Business Model," Digital Initiative, April 24, 2018, https://digital.hbs.edu/platform-digit/submission/rethinking-the-video-game-business-model/*

44 *Tushar Sonal, "Cloud Gaming is Becoming The Norm of the Gaming Industry," Media Nova, December 25, 2019, https://www.medianova.com/en-blog/2019/12/25/cloud-gaming-is-becoming-the-norm-of-the-gaming-industry*

45 *"Sony and Microsoft to explore strategic partnership," Microsoft, May 16, 2019, https://news.microsoft.com/2019/05/16/sony-and-microsoft-to-explore-strategic-partnership/*

46 *Maggie Tillman, "EA launches beta for cloud gaming service: How to join the trial," Picket-lint, September 9, 2019, https://www.pocket-lint.com/games/news/ea/149292-ea-launches-beta-for-cloud-gaming-service-how-to-join-the-trial*

Data Analytics

Data analytics tools provide a treasure trove of information for video game developers and publishers. It is a development that has brought profound changes to the traditional video game business model. With the dramatic growth in social and multiplayer online games, there has been an explosion in the availability of user data and real-time information on player activity. Publishers now have the capacity to track individual gamer behaviours in order to optimize games (developing better content, improving gameplay experience, and increasing player loyalty).

One example of the importance of data analytics for gaming comes from the game *World of Tanks*, which has over 100 million registered users online. Available for free on any Windows, Mac, console or mobile platform, millions of individuals play World of Tanks each day. Herein lies another potential challenge related to the use of data and concept of privacy. In this case, the developer, Wargaming, has generated billions by monetizing the "free-to-play" gaming structure through the use of analytics.[47] Wargaming collects data on players from the moment they log on until the moment they log out, capturing each move made online, as well as game chat logs, mentions of the game on social media or on online game discussion communities.[48] Collecting and analyzing this data, the company can improve and enhance player experiences and create models to best "retain customers, cross-sell other games and convert players into paid users."[49] Considerations about the monetization of user data aside, this shift has also led to the increasing need for data analytics roles—and in cases where model building is required, data science roles as well—in the video gaming industry.

Image courtesy of Smoking Gun Interactive

In examples like the above, data analytics software platforms collect real-time data on the actions and activities of millions of players. This includes data on how gamers are using the games, how they respond to different levels, how much time they spend playing, as well as when and why. Game developers can use this data to tailor games, improving gameplay and fixing mistakes such as bottlenecks in levels, all with the end goal of maintaining and growing player engagement.[50] Access to this kind of data can move game developers and publishers away from short-term profit strategies toward long-term business models and help them build longer-term employment capacity.[51]

47 *Alison Bolen, "Industrialized modeling helps free-to-play video games earn big profits," SAS Insights, https://www.sas.com/en_us/insights/articles/big-data/industrialized-modeling-helps-monetize-free-to-play-video-games.html*

48 *Ibid*

49 *Ibid*

50 *Ari Vivekanandarajah, "How data analytics software is changing the video game industry," Selerity, December 14, 2018 https://seleritysas.com/blog/2018/12/14/data-analytics-software-video-game-industry/*

51 *Ibid*

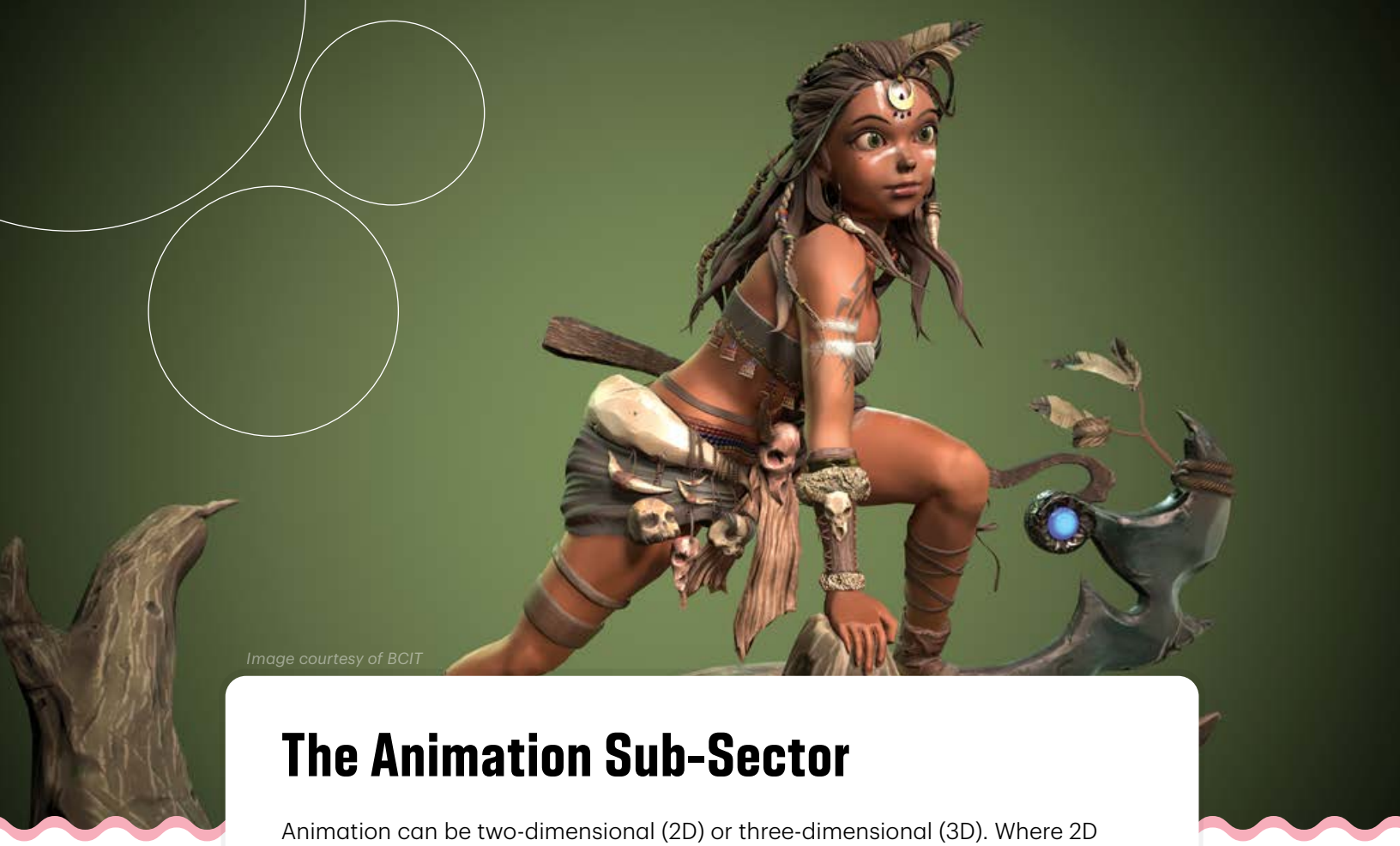


Image courtesy of BCIT

The Animation Sub-Sector

Animation can be two-dimensional (2D) or three-dimensional (3D). Where 2D animation is comprised of characters or objects that can only be represented in height and width, 3D animation includes a third element of depth. In 2018, One Light VFX and Animation estimates the existence of over 300 animation, VFX and post-production studios in Canada.[52] That same year, the Vancouver Economic Commission (VEC) estimated that Vancouver alone was home to over 60 studios in the VFX and Animation industry.[53]

In popular culture, VFX and animation is often combined—in part because many studios do both—and as a result, reliable data on the number of VFX-only and animation-only companies in Canada is unclear. In this study, ICTC estimates the existence of 25 animation studios across BC (see Appendix III for more details). It performed 13 interviews with animation studios in BC, and with another three that perform both animation and VFX. All studios contacted participated in an interview (bringing the total to 16, or 64% of all animation studios). Combined, these studios represented over 2,340 jobs in in BC.

ICTC research finds that the majority (80%) of animation studios in BC are located in Vancouver. When including studios in the Greater Vancouver Area (GVA), this figure jumps to 92%. For more details on location of animation studios in BC, please refer to Appendix III.

52 *"Complete List of 2D/3D Animation, Post Production, and VFX Studios in Canada", One Light VFX & Animation, August 18, 2018, https://onelightvfx.com/studio-list/complete-list-of-2d-3d-animation-post-production-and-vfx-studios-in-canada/*

53 *"VFX and Animation," Vancouver Economic Commission, https://www.vancouvereconomic.com/vfx-animation/*

Economic Impacts

National research and data on the economic impacts of the animation sub-sector (and the VFX sub-sector) is sparse; few estimates exist to quantify this impact in Canada, and it is often grouped together with film, television, and post-production. One study quantifies the impact of employment and economic activity within the animation and VFX sub-sectors (combined), suggesting that together, they total $1 billion CAD.[54]

The most substantial clusters of animation and VFX in Canada are in BC (specifically Vancouver), Ontario (Toronto), and Quebec (Montreal). Once again, estimates of economic impact across jurisdictions rely on varying definitions of the sector, and are often lumped in with other industries. As a result, it is very challenging to identify the economic impact of just animation—or even animation and VFX. For example, according to the Vancouver Economic Commission, the total direct spend[55] of the VFX, animation and the film and TV industries (the latter two are excluded from this study) totalled $3.8 billion (CAD) in 2017. Unfortunately, no reliable disaggregated data on the economic impact of this sub-sector is available to inform this research.

Industry Trends:
Animation Business Models

The immense recent rise of streaming networks and services has breathed "new life into the animation industry"[56] and brought potentially significant changes to the traditional animation business model. With the growth of streaming services such as Netflix, Amazon Prime Video, Hulu, and Disney+, which are ordering, purchasing and presenting season after season of animated shows for both children and adults, there has been a growing and urgent demand for original content. This accelerated demand has led to a surge in employment at various levels of production.[57] According to estimates from the firm Loup Ventures, streaming companies "are rapidly increasing their spending on animated content." By 2022, Netflix is forecasted to spend around $5 billion (USD) of its content budget on animation and Amazon Prime Video is expected to spend $1.86 billion (USD).[58]

54 *Trevor Hogg, "Bright Northern Lights: The Evolution of the Canadian VFX Industry," VFX Voice, March 20, 2019, https://www.vfxvoice.com/bright-northern-lights-the-evolution-of-the-canadian-vfx-industry/*

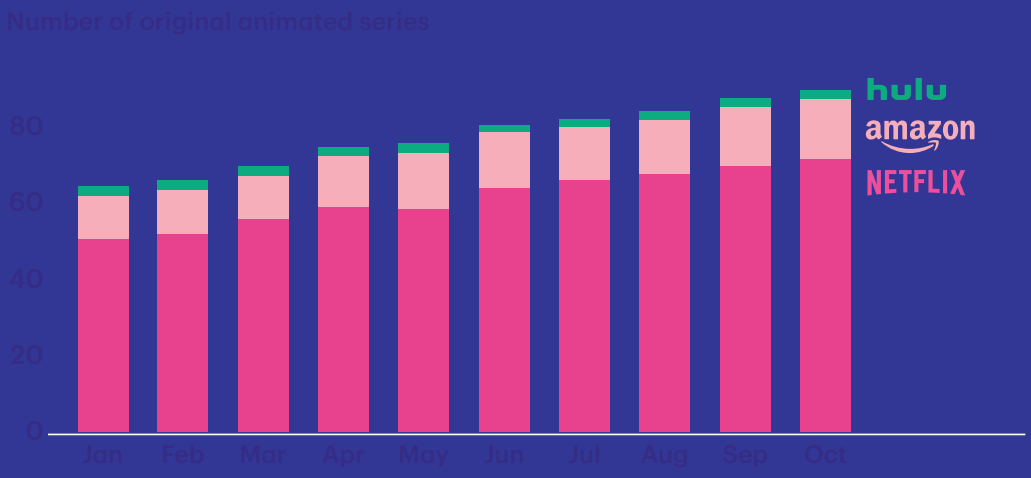
55 *Purchases of goods and services directly related to a product*

56 *Wendy Lee, "Netflix and Amazon spark animation revival, spending heavily in quest for binge-worthy shows," Los Angeles Times, November 18, 2018, https://www.latimes.com/business/hollywood/la-fi-ct-animation-streaming-20181118-story.html*

57 *Calum Marsh, "Surge in Streaming Services Leads to Animation Job Boom," Variety, July 26, 2017, https://variety.com/2017/artisans/production/netflix-amazon-animation-jobs-1202506357/*

58 *Wendy Lee, "Netflix and Amazon spark animation revival, spending heavily in quest for binge-worthy shows," Los Angeles Times, November 18, 2018, https://www.latimes.com/business/hollywood/la-fi-ct-animation-streaming-20181118-story.html*

Figure 4: Growth in streaming animation

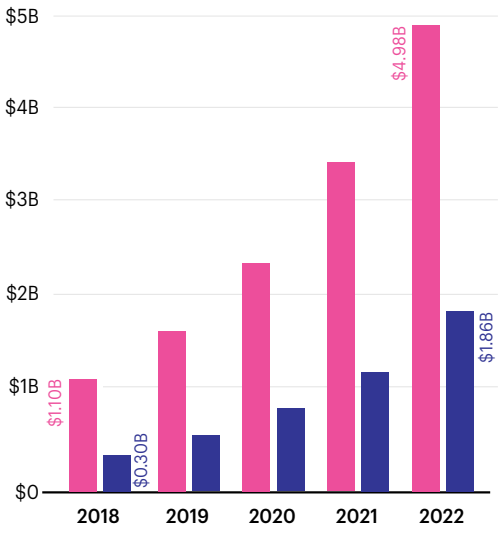


Source: Parrot Analytics, Hulu, as cited in LA Times on November 18, 2018

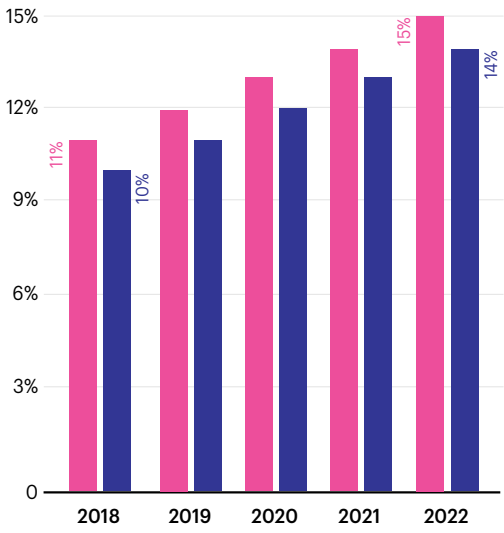
Images courtesy of Kickstart Entertainment and Atomic Cartoons

Figure 5:

Projected spending on animated original content



% of original content budgets spent on animation



Source: Parrot Analytics, Hulu, as cited in LA Times on November 18, 2018.

Streaming networks are taking on both animated shows oriented toward adults as well as cartoons for children.[59] In 2018, Netflix added 21 original animated series between January and October; during the same period, Amazon added four new original animated shows, bringing its total to 15.[60] In 2018, nearly 60% of Netflix's subscribers consumed kid's and family content each month,[61] with Netflix outspending its rivals in marketing dollars for animated shows.[62] Amazon is also aggressively seeking to expand its animation content, launching new children-friendly shows and in 2018, added five new animated specials.[63]

This spending and interest has been a boon to the sub-sector, expanding opportunities for animators and artists while creating new business opportunities for industry veterans and giving new life to animated shows that previously struggled to find a place on network TV.[64]

In BC, the 2019 launch of Disney+, alongside Netflix, Amazon, Apple, Hulu, HBO and Peacock, has provided more opportunities for the province's animation sub-sector. Streaming platforms are demanding ongoing fresh content for binge-watching audiences and, with technology continuing to advance, local BC producers expect to see content numbers grow.[65] Already, Vancouver animators have contributed to several of the Marvel Cinematic Universe and Star Wars productions now available on Disney+.[66]

59 *Ibid*
60 *Ibid*
61 *Ibid*
62 *Ibid*
63 *Ibid*
64 *Ibid*
65 *Simon Little, "The streaming wars have begun in earnest, and the B.C. film industry hopes to cash in,"*
66 *Global News, November 12, 2019, https://globalnews.ca/news/6160956/b-c-film-streaming-wars/*
Ibid

COVID-19 has altered business models and the demand for animation; however, its long-term effects remain uncertain. Where a slump in live action has arisen, animation has been able to fill some of the void. With people spending more time at home than usual, massive increases in TV viewing has been observed, and some early indications suggest that increased viewing hours may remain, even when lockdown restrictions are fully removed.[67] The animated film *Trolls World Tour* marked the biggest digital debut in history, earning nearly $100 million in rentals during its first three weeks.[68] Further, Disney's decision (amid pandemic-response cinema closures) to turn to a digital-first release of expected blockbuster film *Mulan* has been cited as a possible turning point for the traditional film-release business model.[69]

The Vancouver Economic Commission notes that animation studios in Vancouver have been able to work remotely and respond to high streaming service demand during the pandemic, calling them "a boon to the creative economy."[70] BC's Bron Media launched an animation department in direct response to COVID-19: "Animation has been the only area of Bron capable of being in production during this pandemic as our production team is set up remotely," said Bron's CEO Aaron Gilbert.[71] Animators, cartoonists, and voice actors have all been able to transition to work-from-home (WFH) more easily than many professionals.

67 *Sarah Perez, "Nielsen finds connected TV viewing remains higher than pre-COVID-19 levels, despite lockdowns lifting," Tech Crunch, June 4, 2020, https://techcrunch.com/2020/06/04/nielsen-finds-connected-tv-viewing-remains-higher-than-pre-covid-19-levels-despite-lockdowns-lifting/*

68 *Scott Mendelson, "'Trolls World Tour': A Promised Game-Changer Which Changed Absolutely Nothing," Forbes, July 7, 2020, https://www.forbes.com/sites/scottmendelson/2020/07/07/universal-dreamworks-trolls-world-tour-starring-anna-kendrick-justin-timberlake-rachel-bloom-was-a-box-office-game-changer-that-changed-absolutely-nothing/#5927654632eb*

69 *Mark Sweney, "Disney opts for digital-first release of Mulan, shocking cinema owners," The Guardian, August 5, 2020, https://www.theguardian.com/film/2020/aug/05/disney-opts-for-digital-first-release-of-mulan-shocking-cinema-owners*

70 *"British Columbia's Blockbuster Motion Picture Industry is Back in Business Under Phase 3 of the BC Restart Plan," Vancouver Economic Commission, June 30, 2020, https://www.vancouvereconomic.com/blog/news/british-columbias-blockbuster-motion-picture-industry-is-back-in-business-under-phase-3-of-the-bc-restart-plan/*

71 *Carolyn Giardina, "Studios Ramp Up Virtual Production Efforts Amid Pandemic-Era Filming", Hollywood Reporter, August 13, 2020, https://www.hollywoodreporter.com/behind-screen/studios-ramp-up-virtual-production-efforts-pandemic-era-filming-1306924*

The Visual Effects (VFX) Sub-Sector

Visual Effects (VFX) describes imagery that is created, manipulated or enhanced using digital technology. This can be done for film, TV, or any other type of media even including video games. An integration between actual footage and manipulated imagery, VFX workers often use computer-generated imagery and different types of software to create realistic-looking environments or characters.

BC's creative technology sector includes many thriving Visual Effects (VFX) businesses. Since the 1990s, Vancouver has established itself as a world-leading centre of VFX talent and technology. Examples of Vancouver's VFX sub-sector in action include work on *The Joker, Rise of Skywalker, Game of Thrones* famous "The Bells" episode, and the *Mandalorian* to name just a few.

Economic Impacts

Similar to the animation industry, data on the economic impact of the VFX industry is not available at the national or regional level. Once again, a best estimate may be that from the Vancouver Economic Commission, stating that the direct spend[72] of the VFX, Animation *and* Film and TV industries totalled $3.8 billion (CAD) in 2017. Unfortunately, reliable disaggregated data on economic impact of this industry is available to inform this research.

In 2018, the Vancouver Economic Commission listed a total of 34 VFX companies in or around the city of Vancouver.[73] During this study, ICTC research highlighted the existence of 31 studios across the province. ICTC performed a total of six (6) interviews with VFX companies, and another three (3) with studios that perform both VFX and animation. ICTC's interviews cover approximately a quarter of all estimated VFX companies in the city. Representing nearly 2,500 jobs, the nine studios interviewed represent 30% of all VFX businesses in BC and a significant portion of employment.

Disaggregating the data by city shows that, overwhelmingly, BC's VFX studios are located in major city centres. 29 (94%) of all VFX studios are located in Vancouver, with the remaining two (6%) based in Victoria.

72 *Purchases of goods and services directly related to a product*
73 *"VFX and Animation," Vancouver Economic Commission, https://www.vancouvereconomic.com/vfx-animation/*

Industry Trends:
VFX business models

The typical production model of VFX entails footage from live-action shots being manipulated by way of computer-generated imagery. With COVID-19 leading to the halting of most live-action filming, the VFX supply chain has been severely disrupted. Further, some VFX studios face extensive challenges to establishing remote work due to robust IP protection processes and protocols.

Nonetheless, many studios have adapted and moved to work-from-home (WFH) models, often with the help of virtual desktops and remote access to office computers. This disruption has had varying impacts on studios, disproportionately harming those without already-existing secure work-from-home structures in place. However, one reason for optimism are advances in technology that may soon make VFX more capable of producing content that does not require live-action film. Such technologies range from fully computer graphics (CG or virtual) actors to digital engines that allow for virtually created environments rather than green screens.[74]

74 *Alexandra Cutean, "BC's Creative Tech Sector Drives Economic Growth and Jobs in Canada," Digital Think Tank by ICTC, June 30, 2020, https://medium.com/digitalpolicysalon/bcs-creative-tech-sector-drives-economic-growth-and-jobs-in-canada-6a34449bdceb*

Image courtesy of Centre for Digital Media.

Extended Reality: Augmented Reality, Virtual Reality, Mixed Reality

Extended Reality (XR) refers to businesses in the Augmented Reality, Virtual Reality, and Mixed Reality fields.

AR refers to interactive real-life experiences enhanced by digital elements—such as visual overlays or other sensory projections. The purpose of AR is to expand a user's understanding of or interaction with his or her environment. VR, on the other hand, refers to completely simulated experiences that can resemble—or differ completely—from the real world. AR and VR can also be combined, and when they are, it is often referred to as mixed reality (MR). MR allows users to see both the real world and believable virtual objects at the same time.

Although the XR sub-sector holds high potential for future growth in BC, its relatively nascent nature—in Canada as a whole—rendered it challenging to include reliable primary research on employment and talent needs at this time. As a result, a more robust secondary analysis of the sub-sector, including potential talent realities and needs, is provided below.

Economic Impacts

Worldwide, with increasing visualization, industrial and training applications, the VR/AR market is forecasted to reach US $814.7 billion by 2025. The VR/AR sector is expansive and versatile, with workers in this space creating anything from apps to virtual reality games.[75]

75 *"Impact Report 2018/2019," Creative BC, 2019, https://www.creativebc.com/about-us/research-and-reports/index/sb_expander_articles/247.php*

Recent data from ICTC finds that Canada's XR sub-sector is comprised of approximately 350 companies,[76] across numerous provinces. There are three main hubs of activity: Vancouver, Toronto, Montreal. According to Statista, Canadian XR was valued at approximately $0.6 billion in 2018 and is projected to grow to approximately $8 billion by 2022, with AR accounting for much of this growth.[77] To date, there are many more VR companies developing commercial products for external use in Canada than there are companies developing products internally for their own use.[78]

At the federal level, XR falls under the jurisdiction of Innovation, Science, and Economic Development Canada as a core component of the Digital Technology Supercluster, and under Canadian Heritage due to its dominant use as a cultural medium.

Several developments have taken place in the last number of years to boost the economic imprint of the XR sub-sector in BC. For example, in 2019, Finger Food Studios (now Unity), a VR company whose clients and partners included Microsoft, Hootsuite, and Cirque du Soleil, was integral in securing $1.4 billion in government funding to boost Vancouver's digital technology footprint.

Size and Structure

In terms of industry use cases, Canadian VR companies tend to develop products largely for entertainment and educational purposes.[79] With respect to entertainment, approximately 60% of Canadian VR companies develop products for general entertainment purposes, and 29% for live events. Other significant industries include tourism, healthcare, and real estate.

BC's XR ecosystem is one of the largest in Canada, composed of approximately 127 companies, representing nearly half of all XR companies in the country.[80] Among companies dedicated specifically to VR, most develop content for the entertainment sector (58%) , with about the same percentage of companies also developing content for education (K-12), live events, professional development, tourism and hospitality, health care and real estate.[81] In Vancouver specifically, the VR/AR ecosystem comprises diverse content providers in gaming, 360 capture, audio, film, etc.; some are VR/AR hardware companies while others have found niches in tool development or training.[82]

76 *Tyler Farmer, Mairead Matthews, "Spanning the Virtual Frontier: Canada's Immersive Technology Ecosystem," ICTC, September 2020, https://medium.com/digitalthinktankictc/spanning-the-virtual-frontier-9381c1da2395*

77 *"Forecast augmented (AR) and virtual reality (VR) market size in Canada in 2018 and 2022," Statista, 2020, https://www.statista.com/statistics/866903/canada-augmented-virtual-reality-market-size/*

78 *"Key Insight Sources" (products developed), Pulse on VR, http://pulseonvr.ca/source-embed/?post=265&resource=1*

79 *"Key Insight Sources" (industry use cases), Pulse on VR, http://pulseonvr.ca/source-embed/?post=265&resource=4*

80 *Tyler Farmer, Mairead Matthews, "Spanning the Virtual Frontier: Canada's Immersive Technology Ecosystem," ICTC, September 2020, https://medium.com/digitalthinktankictc/spanning-the-virtual-frontier-9381c1da2395*

81 *Ibid.*

82 *Kris Morash, "VR/AR companies make it real in British Columbia," Trade and Invest British Columbia, September 30, 2019, https://www.britishcolumbia.ca/global/trade-and-investment-british-columbia-blog/september-2019/vr-ar-companies-make-it-real-in-british-columbia/*

In September 2017, only two hubs were specifically incubating such businesses in Vancouver (Axiom Zen and Launch Academy), however, by 2018 seven more organizations formed to promote local talent in this space, helping the industry to grow by 54%.[83] Many new startups took shape in 2018, and the city's ecosystem also saw immense victories among more mature companies.[84] A testament to the immense growth and presence of the sub-sector, Vancouver has hosted the VRAR Association's Global Summit in 2018 and 2019. It also hosts the Virtual Reality Film Festival—the only film festival dedicated to VRAR in the world—on an annual basis.[85]

Employment Impacts

While BC is home to a relatively large number of AR/VR companies, the employment impacts for this sub-sector are still in early stages when compared to more well-established counterparts of the creative technology sector, such as animation, video games, or VFX. Recent research by ICTC on this sub-sector suggests that the majority of XR companies in BC are small, and many, while promising, are still in the process of solidifying their IP and commercializing their products.[86] ICTC research finds that 63% of XR companies in Canada have between two and 10 employees.[87]

The very early-stage nature of the majority of XR companies in Canada (and BC) will require time to pass before analyzing employment impacts. Primary research was, therefore, not collected in this study pertaining to the XR industry.

Industry Trends:
The AR/VR Sub-Sector

Between 2014 and 2017, more than 100 Canadian companies offering immersive technology services or products were founded. The sub-sector is also expanding beyond its initial entertainment-based focus, with new companies being developed across a range of areas. The sub-sector saw a "startup peak" in 2016, after which it began to consolidate. But 98% of Canadian companies in the sub-sector are small and medium sized enterprises (SMEs), suggesting that the ecosystem is still maturing.[88] While young, growth has been driven by releases of increasingly affordable and portable hardware, and could see continued growth with the development and release of yet more advanced hardware.

83 *Kate Wilson, Dan Burgar, "Vancouver Is Now One Of The Largest VR AR Hubs In The World with over 200 Companies," June 4, 2018, The VR/AR Association. https://www.thevrara.com/blog2/2018/6/4/vancouver-is-now-one-of-the-largest-vr-hubs-in-the-world*

84 *Ibid*

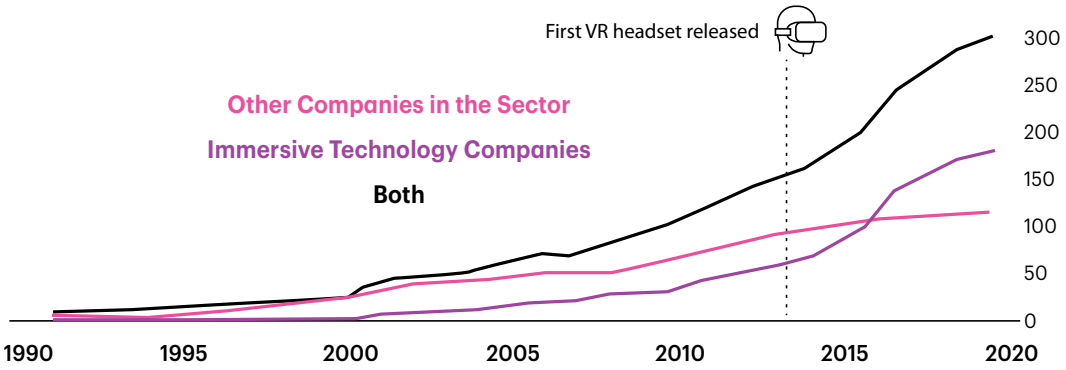
85 *Kate Wilson, Dan Burgar, "Vancouver is Now One of the Largest VR Hubs in the World," VR Scout, June 3, 2020, https://vrscout.com/news/vancouver-second-largest-vr-hub/#*

86 *Tyler Farmer, Mairead Matthews, "Spanning the Virtual Frontier: Canada's Immersive Technology Ecosystem," ICTC, September 2020, https://medium.com/digitalthinktankictc/spanning-the-virtual-frontier-9381c1da2395*

87 *Ibid*

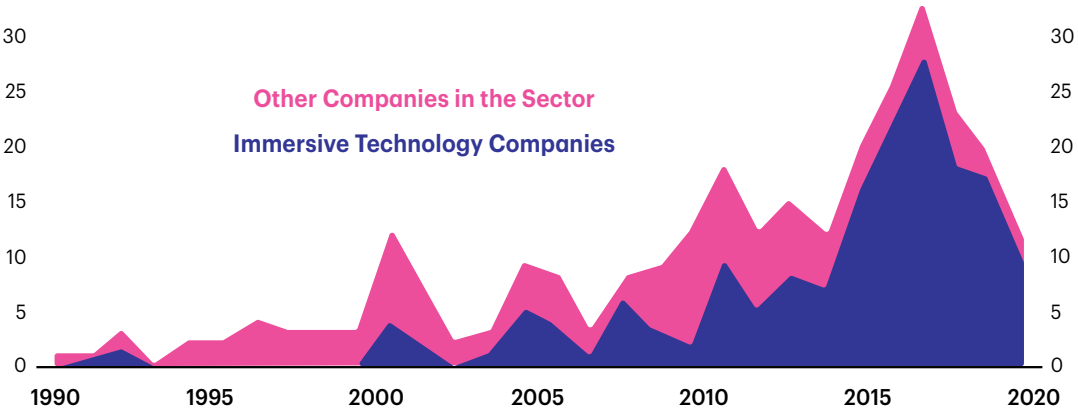
88 *Ibid*

Figure 6: Total XR companies in Canada over time



Source: Spanning the Virtual Frontier: Canada's Immersive Technology Ecosystem, ICTC, August 2020

Figure 7: Total XR companies in Canada over time

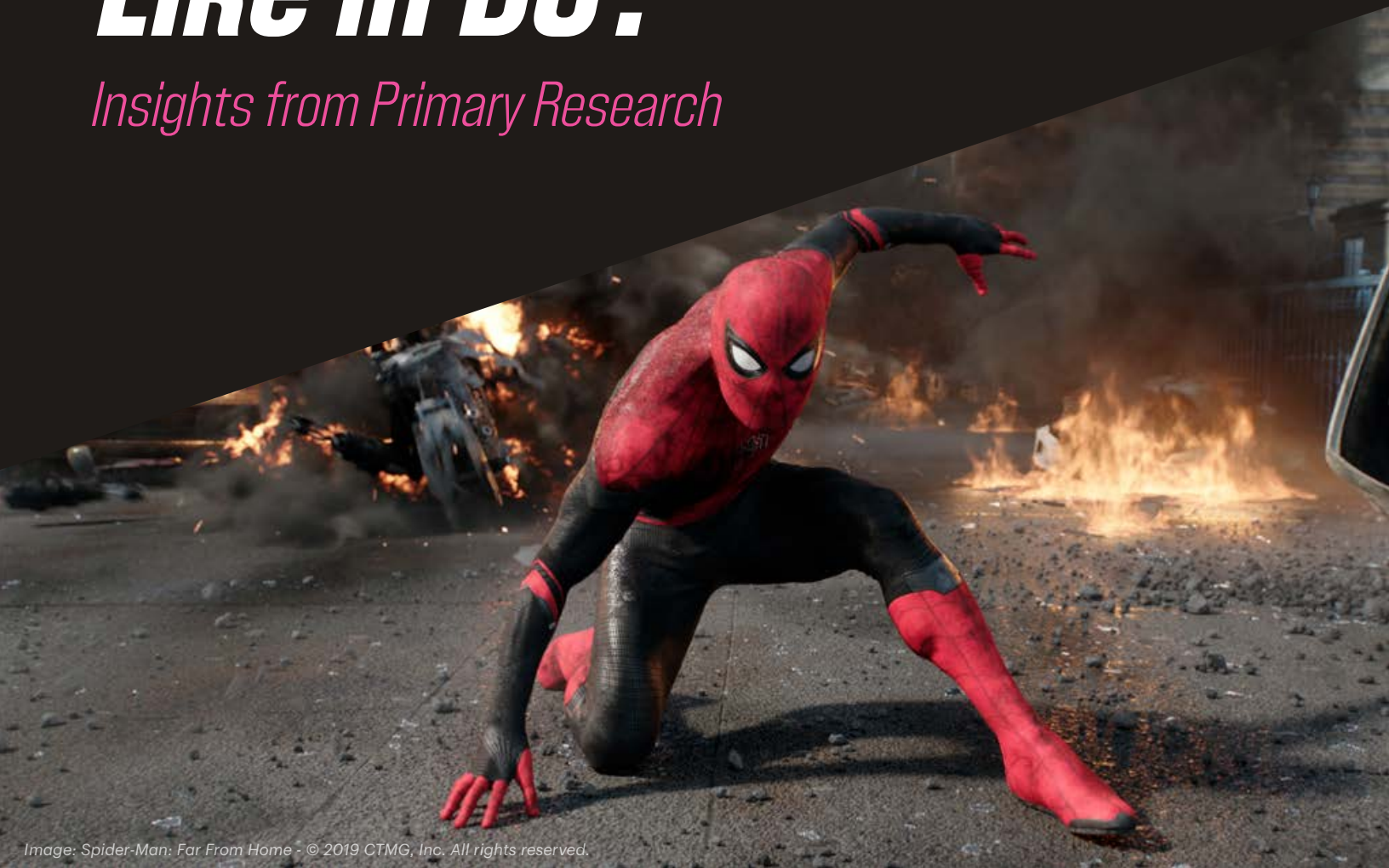


Source: Spanning the Virtual Frontier: Canada's Immersive Technology Ecosystem, ICTC, August 2020

SECTION II

What Does the Creative Technology Ecosystem Look Like in BC?

Insights from Primary Research



Study Overview

To support the primary research component of this study, a list of approximately 125 studios was developed by DigiBC, leveraging membership data and supplemental information from sources including the ESA and the Vancouver Economic Commission. This list was validated by select members of the advisory committee and believed to represent a fulsome picture of known studios in BC's creative technology sector at the time. All companies on the list were contacted for an interview, and a 40% acceptance rate was received. A total of 49 one-on-one, structured interviews with BC creative technology companies (26 with video game companies, six with VFX companies, 13 with animation companies, three with animation and VFX companies, and one with a consulting company) were completed. These interviews provided in-depth and unique data of both a qualitative and quantitative nature that was used to shape the crux of this study. According to data collected by ICTC on the total number of creative technology studios based in BC (see Appendix III), the 49 industry interviewees in this study represent more than 36% of all creative technology companies in the province, and a significant portion of employment.

Although the study was largely centred on gathering industry insights into talent realities and needs, ICTC also conducted largely one-on-one[89] structured interviews with representatives from 10 post-secondary institutions across BC. These interviews provided relevant information pertaining to 24 different post-secondary training and educational programs relevant to the creative technology sector.

Owing to the unique characteristics of many sub-sectors in the creative technology sector, and the resulting uneven periods of production (i.e., periods of ramp up, peak activity, ramp down, low periods of activity) in each calendar year, ICTC conducted an online survey with industry interviewees to collect information on employment fluctuations by sub-sector. 33 creative technology employers responded to this survey (67% of interviewees).

The primary and secondary research collected during this study was used to inform webscaping and text analysis that was used to extract valuable data and insights for this study. This data includes the number and location of creative technology studios in the province, the number of postings for in-demand jobs per month, the specific competencies, skills, and relevant applications associated with top in-demand jobs, and the skill profiles of BC talent vs. talent in the Los Angeles and Bay Area of California.

Lastly, regional focus groups were conducted to ensure that overall research findings reflected province-wide realities and needs. Online focus groups were hosted by DigiBC, capturing insights from stakeholders[90] in Northern BC, the BC Interior, and Vancouver Island. Elaborated on in a later section, topics discussed in the focus groups included talent and skill availability, educational pathways, local market conditions, remote work, and connectivity infrastructure.

89 *Some interviewees brought additional team members to interviews. The largest "group" interview comprised of five people.*

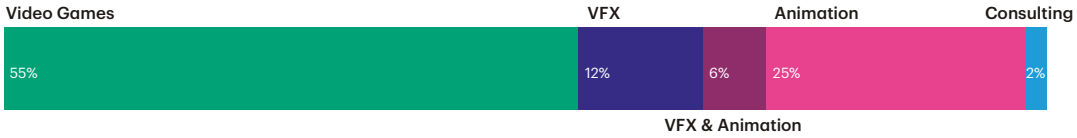
90 *Stakeholders represented industry, educational institutions (secondary and post-secondary) and local government.*

Combined, this robust primary and secondary research was leveraged to develop an accurate and timely picture of the creative technology sector in British Columbia. It incorporates elements related to employment trends, workforce composition, talent development and skill needs, recruitment and retention, and even broader considerations related to the ongoing health and competitiveness of the sector. For more details on the research methodology utilized in this study, please see Appendix I and II.

Sector Breakdown:
The Nuts and Bolts

The majority of companies interviewed in this study represent studios that create video games, although a significant volume of studios are also involved in VFX and animation.

Figure 8: Creative technology subsectors of industry interviewees



Studios interviewed in this study are mostly located in the Lower Mainland, and in particular the city of Vancouver. Another significant portion are in the Greater Vancouver Area (New Westminster, Anmore, West Vancouver, and Burnaby), followed by the Okanagan (Kelowna) and Vancouver Island (Victoria). All VFX and animation companies, and roughly 68% of video game companies interviewed are in the city of Vancouver.

Figure 9: Locations of Interviewed Firms

*Excluding City of Vancouver

Although a significant portion of studios interviewed are based in the Lower Mainland, province-wide insights were captured via the regional focus groups. Stakeholders from Northern BC, the BC Interior, and Vancouver Island shared their unique experiences regarding market demand, talent availability, and potential future growth opportunities, among other topics.

The overall size of studios interviewed varied, although nearly three-quarters of studios were medium or large. These findings align with those of the Entertainment Software Association, where BC had a lower total number of studios than Ontario and Quebec, but a higher representation of large studios. Although both small and large businesses are important to the overall creative technology ecosystem in the province, the relatively robust presence of medium and large studios in BC suggests the overall maturity of the sector. Again, the majority of studios in more nascent sub-sectors like XR often employ fewer than 10 people, whereas among more established sub-sectors like animation, video games, or VFX, the representation of micro-sized companies is only 10%.

Figure 9: Studio size of interviewed companies

Industry interviewees also provided staff numbers for their BC operations. While answers ranged from as low as two to nearly 2,000, the below figure shows the distribution of studio size within each sub-sector, and the average. Video games studios have an average current headcount of 169, animation studios an average headcount of 195, VFX an average headcount of 223, and animation and VFX studios where highest, with an average headcount of 383. While variance exists and, in some cases, headcounts fluctuate depending on project cycles (to be described in more detail later on), businesses in the creative technology sector have notably higher employment prospects for British Columbians than many other sectors. According to Statistics Canada, nearly 75% of businesses in BC employ under 100 people.[91]

91 *"2.1 How Many people work for SMEs?" Key Small Business Statistics – January 2019, Innovation, Science and Economic Development Canada Small Business Branch, January 2019, https://www.ic.gc.ca/eic/site/061.nsf/eng/h_03090.html#point2-1*

Figure 10: Comparison of size and subsector of interviewed firms

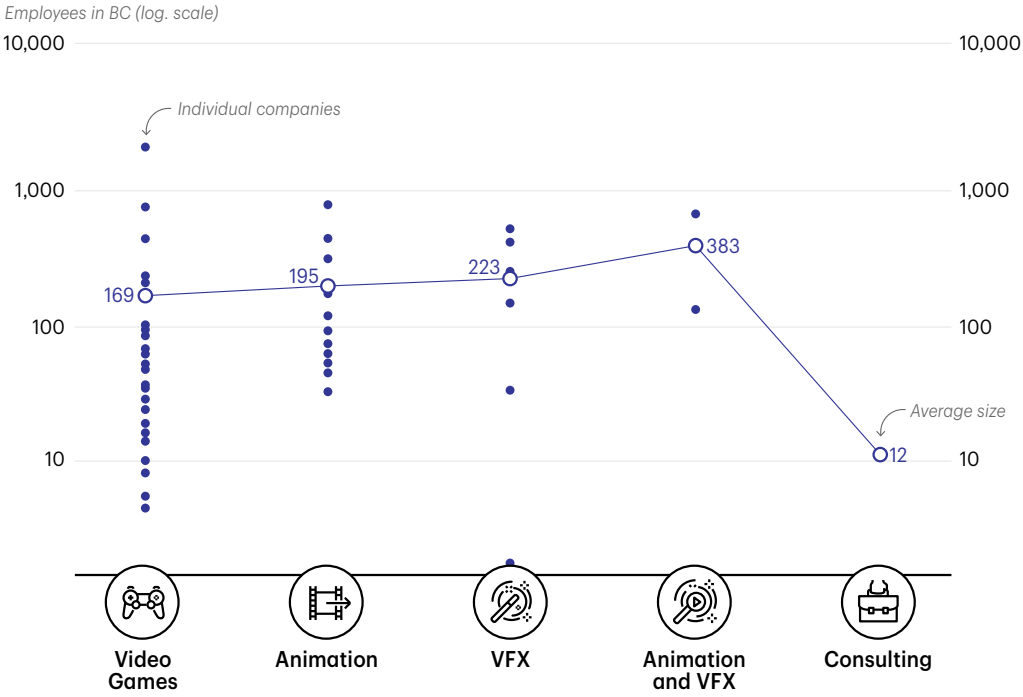


Image courtesy of Centre for Digital Technology

Workforce Characteristics:

The Who and How

Demographics

BC's creative technology sector is a significant source of high-quality employment for the province, but who does it employ? The following analysis details the demographic composition of the sector, including gender, the representation of Indigenous peoples, persons with disabilities, as well as diversity, and inclusion measures and processes.

Creative Technology Needs More Women

For creative, technical, or digital roles within the sector, the majority of studios reported between 20% and 25% representation for women. Although a small handful of studios proudly highlighted that they had reached gender parity (or close to it, with representation ranging from 40% to 50%), the majority were near or below the one-quarter mark.

While largely mirroring the representation of women in the overall technology sector, where women make up roughly 25% of traditional technology-focused roles in Canada in 2019,[92] a few notable distinctions exist in the creative technology sector. First, larger studios tend to have a greater proportion of their creative, digital, and technical workforce filled by women. Second, animation studios were also much more likely to have a greater portion of women among their creative, digital or technical roles. Although the reasons for this difference are unknown, is it likely that larger studios have greater access to resources, enabling them to undertake the hiring of diversity and inclusion (D&I) managers, offer D&I training, or forge partnerships with equality-seeking groups. These resources can be critical for creative technology leaders to actively encourage the inclusion of women and underrepresented groups in the sector.

Nonetheless, industry interviewees expressed the general sentiment that "more needs to be done," and all interviewees showcased a strong desire to support greater participation of women in the creative technology sector.

92 *Alexandra Cutean, Rosina Hamoni, Ryan McLaughlin, Zhenzhen Ye, "Canada's Growth Currency: Digital Talent Outlook 2023," ICTC, October 2019, https://www.ictc-ctic.ca/wp-content/uploads/2019/11/canada-growth-currency-2019-FINAL-ENG.pdf*

Figure 11:
Gender in digital technical roles at companies interviewed, **by subsector**

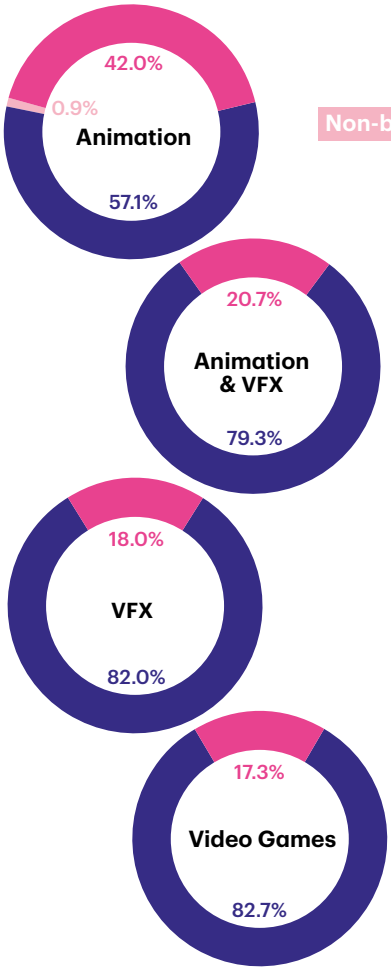
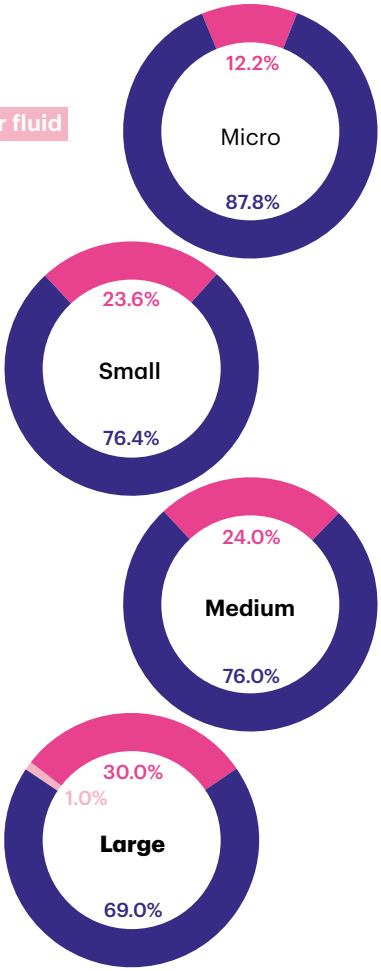


Figure 12:
Gender in digital technical roles at companies interviewed, **by size**



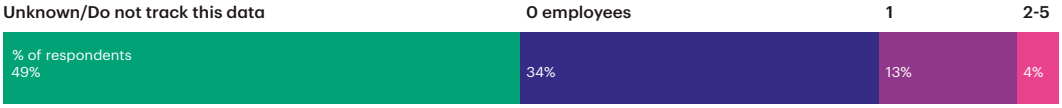
Indigenous Peoples Are a Target Group for Inclusion, But Studios Are Unsure Where to Look

Gaining an understanding of ethnic or cultural diversity within a business requires self-identification (in British Columbia, employers are not permitted to ask questions that do not pertain to the job, such as questions about race or religion).[93] As a result, nearly half of all employers interviewed in this study were not able to identify whether any of their workforce self-identified as Indigenous. Of the remaining interviewees that had some level of awareness on this topic, two-thirds stated having no Indigenous employees. With "two to five employees" being the highest number of Indigenous workers among creative technology studios, fewer than 10% found themselves in this category (the rest were 0% or unknown).

93 *"Know Your Rights as a Job Applicant," WorkBC, 2020, https://www.workbc.ca/jobs-careers/find-jobs/your-rights-as-a-job-applicant.aspx*

Despite low levels of representation, several interviewees expressed a strong desire to engage with Indigenous groups and actively encourage and train Indigenous peoples seeking employment in the sector. Some studios had successfully formed relationships with groups that support other underrepresented groups in creative technology (largely pertaining to women or newcomers), but when it came to Indigenous peoples, many studios expressed having little idea of where, how, and with whom to even start meaningful discussions.

Figure 13: Portion of Indigenous peoples employed in digital/technical roles at companies interviewed



People with Disabilities: **Largely Unknown Territory**

Like the representation of Indigenous peoples, more than half of industry interviewees were unaware of whether they had any employees with disabilities. Of the studios that did have knowledge on this topic, more than three-quarters reported having no employees with disclosed disabilities.

One interviewee mentioned having "dozens" of employees with mental health challenges as well as several with physical disabilities. Although this information remains unvalidated, mental illness was described by interviewees as an area they are paying particular attention to. Some articulated a sense of apprehension regarding the fallout of COVID-19, believing it has increased instances of anxiety and depression among the workforce.

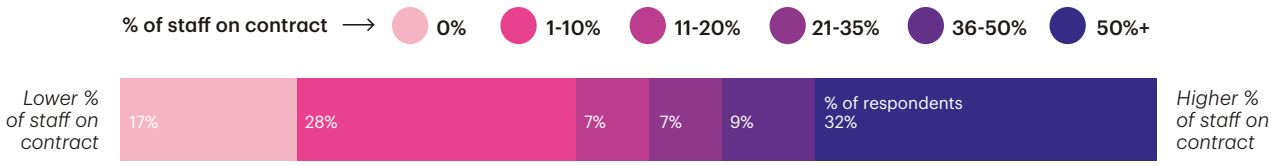
Figure 14: Portion of people with disabilities in digital/technical roles among companies interviewed

Contract Type and Seniority

According to the OECD, in 2019 12.8% of the Canadian workforce was employed on a temporary (contract) basis, with another 19% employed part-time, and 8.2% were self-employed.[94] Only 60% of the Canadian workforce was employed on a full-time and indefinite (permanent) basis. While certain sectors are more likely to have indefinite employees versus temporary employees, the mainstays of the creative technology sector (notably animation and VFX) rely heavily on temporary workers on fixed-term contracts. Some interviewees even dubbed this sector as being one of the "*pioneers of the gig economy*."

As a result, each studio had a certain portion of employees that were indefinite, but many are heavily project based, with a large contract-based workforce. Overall, the portion of employees on contracts varied according to company type and size, but approximately one-third of studios interviewed expressed that more than half of their workforce is employed on fixed-term contracts.

Figure 15: Employment characteristics of the workforce at companies interviewed

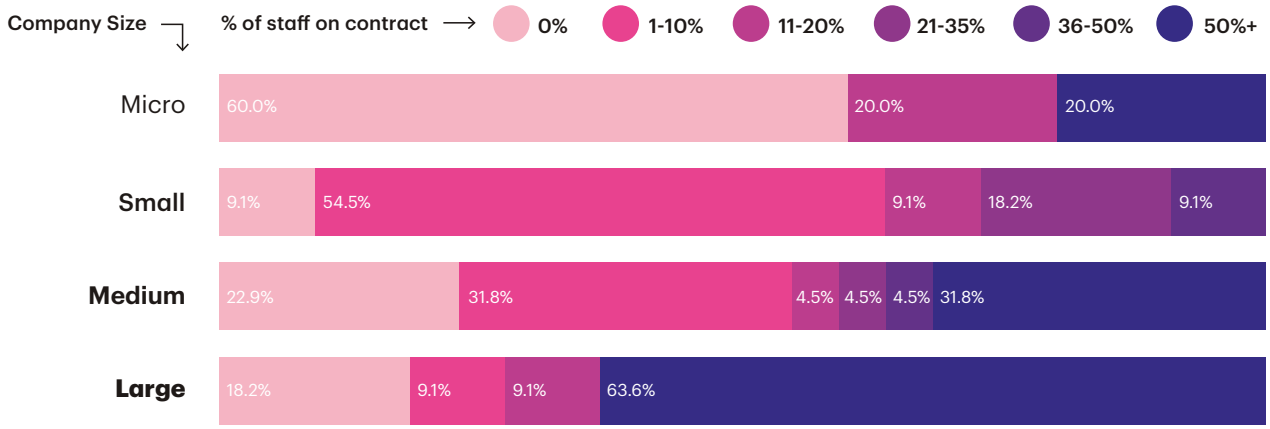


Broken down by size, large companies have the highest volume of employees employed on temporary contracts. Over 60% of studios in this category stated that more than half of their workforce are on temporary contracts. Given the sheer size of these companies, temporary-contract workers can range from as few as 150 workers to more than 300. Notably, for the majority of large companies (employing more than 250) in the VFX and animation space, fixed contracts are the industry standard.

Despite this high representation of contract work, all interviewees said that contract workers were nearly always hired on a full-time basis (i.e., 40h+/week), and often had the ability to go from contract to contract without interruption, due to heightened demand within and across studios. Hiring someone on a part-time basis was a highly uncommon practice, with no interviewees noting having done so for creative/artistic, or digital/technical roles.

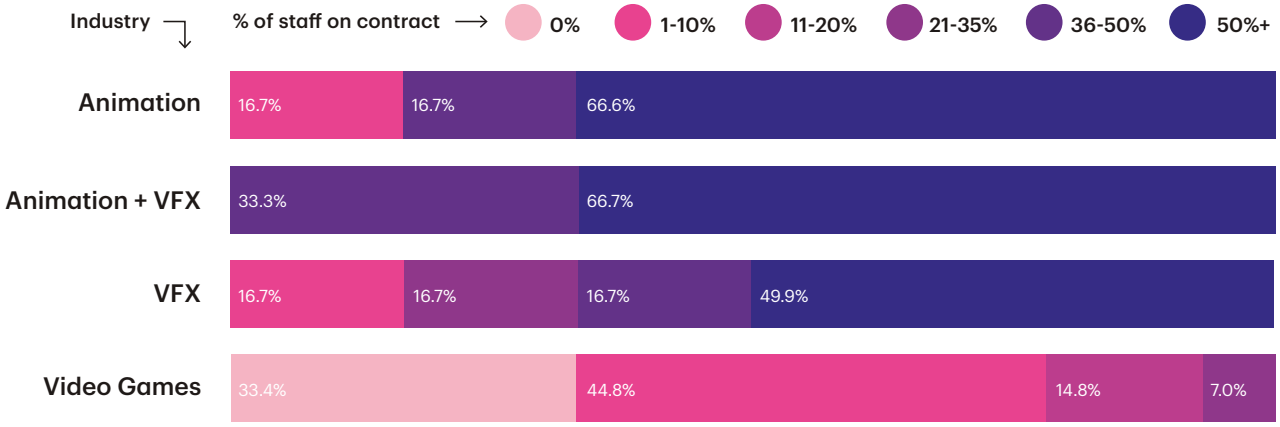
94 *"Employment data in the OECD" (Part-time, temporary, self-employment," OECD Data, 2020, https://data.oecd.org/emp/part-time-employment-rate.htm#indicator-chart*

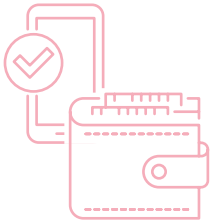
Figure 16: Contract type at companies interviewed, by company size



Video game companies have the highest representation of permanent workers. Nearly 80% of interviewees said that only 10% or less of their workforce is hired on a temporary basis. Although video game companies also have production cycles, many tend to come equipped with a higher level of overall long-term financial stability than animation and VFX. This may be due to the reality that games typically have longer production periods than film—many console games require more hours of content than film, making for longer production cycles and thus longer contracts. Some video game interviewees suggested studios that develop their own IP (versus work-for-hire studios) are more likely to support a higher volume of permanent staff, while others added that they *preferred* to offer permanent contracts (and hire fewer people) in an effort to boost morale.

Figure 17: Contract type at companies interviewed, by sub-sector





VFX, Animation and Gig Work: What's the Relationship?

The VFX and animation sub-sectors, like many others in the arts, have traditionally relied on the availability of temporary workers on fixed contracts, and in some cases, gig workers. According to interviewees in this study, contracts in these sub-sectors can range anywhere from two weeks to six months on average, while some businesses are able to offer contracts of up to one year.

The "gig" nature of the jobs has been a well-known reality of the industry since its inception. It can offer significant flexibility for workers, however, in economic climates such as the current one, job stability is highly coveted and contract work may be considered a deterrent by some.

According to industry interviewees in this study, highly specialized creative/artistic roles like animators, VFX artists, riggers, lighters, etc. are more likely to be available as short-term gigs than digital roles like programmers, production roles, or design roles such as UI designers.

Seniority Levels

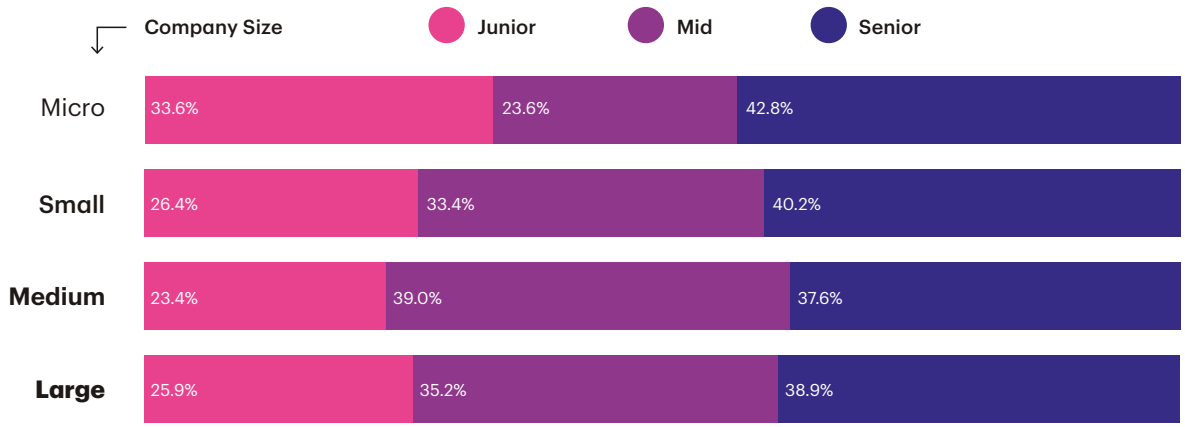
The creative technology sector is unique in its talent composition in BC. While many companies in the overall tech sector rely on a strong portion of junior and mid-level hires,[95] BC's creative technology sector is heavily weighted to the mid and senior levels. This was especially the case for companies located in Vancouver or the Greater Vancouver Area—senior level talent was more likely to be found in this region, vs. in other regions like Vancouver Island or Thompson-Okanagan, where a more acute shortage of senior talent was expressed. However, with an overall high saturation of senior talent, interviewees participating in this study expressed this is a unique characteristic of the sector in BC—some expressed the belief that employment opportunities for junior talent (and thereby the volume of junior talent in the sector) was greater in Quebec.

To better understand seniority levels in the creative technology sector, interviewees were asked to describe the distribution of employees according to the following characteristics: junior-level employees (less than three years of experience), mid-level employees (three to five years of experience), and senior-level employees (more than five years of experience). Although some interviewees noted a slight discrepancy in the way they assigned levels of seniority (i.e., one interviewee mentioned that for them, a junior employee would include someone with up to three to four years of experience, and a mid-level employee may have closer to five years of experience) all studios had a high representation of mid and senior-level employees. With the exception of micro-sized companies—who are more likely to have smaller budgets for hiring, and therefore may be limited in their ability to bring in senior-level talent—studios said that roughly three-quarters of their employees were at the mid or senior-level.

Although data on the representation of underrepresented groups according to seniority level was not known by industry interviewees in this study, ICTC partnered with Women in Animation, the Animation & VFX Alliance, and DigiBC to conduct a survey on women in the creative technology sector during late fall 2020. While not included in this study, this survey breaks down the representation of women according to job type, and levels of seniority across the creative technology sector.

95 *Viet Vu, Creig Lamb, Asher Zafar, "Who Are Canada's Tech Workers?" Brookfield Institute, January 2019, https://brookfieldinstitute.ca/wp-content/uploads/FINAL-Tech-Workers-ONLINE.pdf*

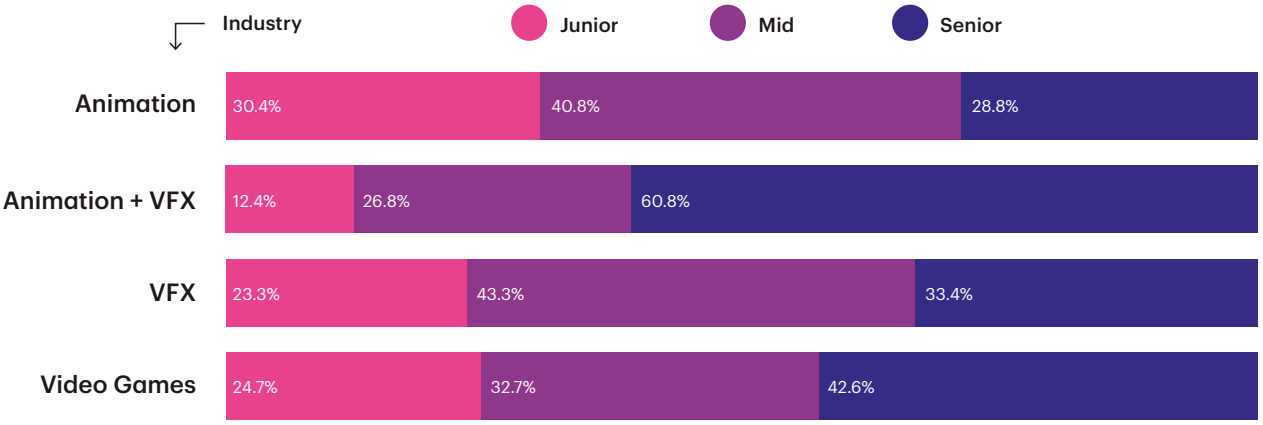
Figure 18: Seniority levels at companies interviewed, by company size (digital/technical roles)



However, seniority levels varied according to sub-sector. Studios that do both animation and VFX work had the highest representation of workers at the mid and senior level, followed by VFX companies. VFX often requires very specific talent and skill sets (for example, a VFX project may require hiring someone with specific expertise in making water look realistic), and it is coupled with tight and unwavering timelines, both factors that cause them to look for the most efficient means to fulfill contract obligations. At the same time, because BC has a high representation of work-for-hire studios, it is critical that these studios shape bids and proposals that are as attractive as possible. Often, efficiency coupled with competence is an outcome of both training and experience. As one interviewee from the animation sub-sector put it:

> *There are two ways to be affordable: you can be fast and spend more money on senior staff, or you can go slower with more juniors and spend more time... We live by quota, and we move fast—because we have senior people, we're able to bid quite tightly.*

Figure 19: Seniority levels at companies interviewed, by sub-sector (digital/technical roles)

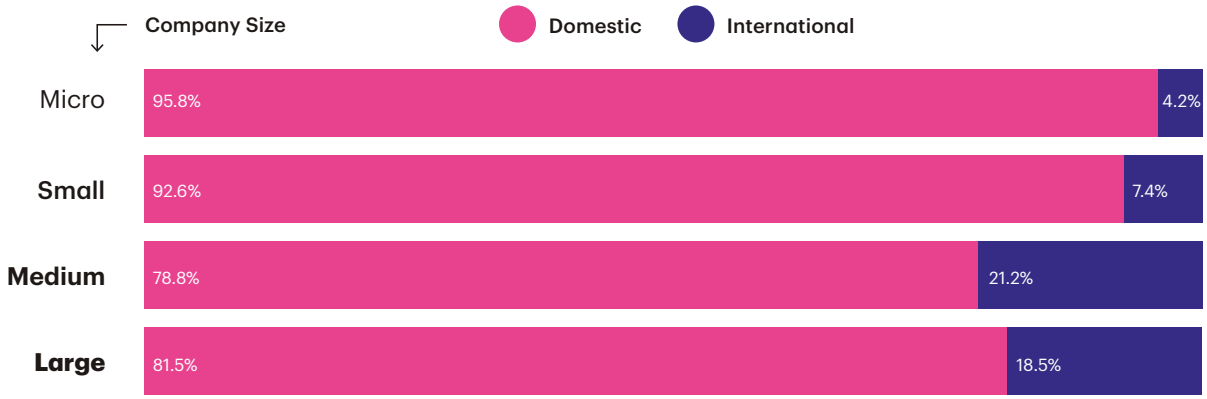


Domestic and International Talent

International talent is critical to filling supply gaps in the creative technology sector. During periods of peak activity, BC's creative technology studios may seek to onboard thousands of employees. International talent is undoubtedly required to fill the volume of roles required by these companies. However, while some international talent is needed to meet headcount needs, BC's creative technology companies are staffed primarily with domestic talent.[96] According to industry interviewees in this study, about 90% of BC's creative technology sector talent is found locally or within Canada, and 10% of talent is hired internationally, often filling very specific roles in short supply at local levels. Companies based in Vancouver or the GVA were also more likely to hire (and be able to attract) international talent, than companies in other regions of the province.

Larger studios have a higher proportion of international talent, likely due to access to greater resources and previous experience navigating the immigration system. Although many smaller studios seemed confident with their ability to source the talent they need locally, seemingly complex legislation, unclear immigration protocols, and added costs were cited as barriers to entry.

Figure 20: Ratio of domestic to international talent at companies interviewed, by size

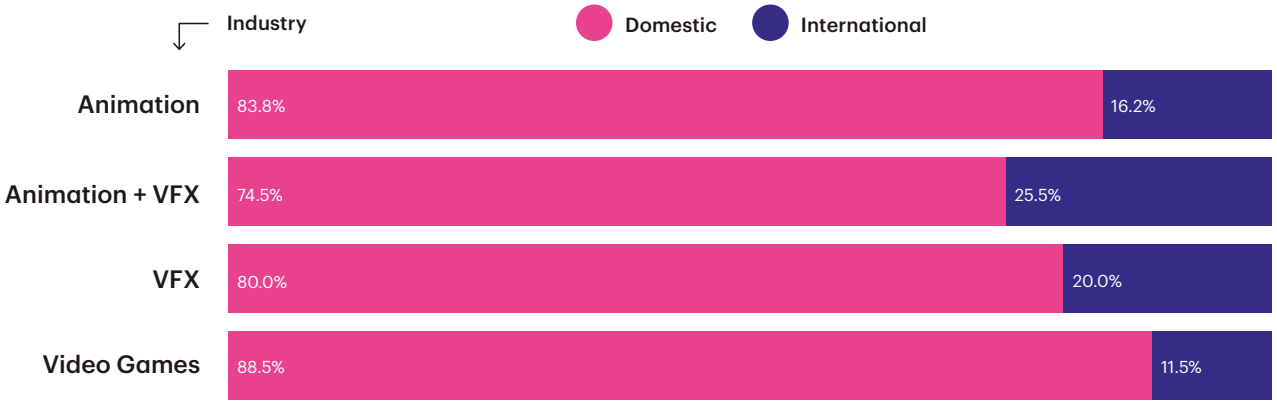


As for industry type, unsurprisingly the VFX and animation sub-sectors housed a higher proportion of international talent, compared to video game companies. Because larger studios in these sub-sectors require access to large pools of talent (one interviewee noted plans to hire over 500 employees in 2020, alone), it is inevitable that they will need to look beyond the BC talent pool to meet their needs. Described in more detail later in the study, the most commonly used immigration streams of large companies were the Global Talent Stream, and BC PNP.

Certain roles in particular, such as Riggers, Pipeline Technical Director, or CFX Artists, were considered to be in high demand during peak periods, with associated domestic talent insufficient to meet demand.

96 *Domestic talent includes citizens and Permanent Residents*

Figure 21: Ratio of domestic to international talent at companies interview



Diversity and Inclusion

Issues of diversity and inclusion continue to be a significant area of concern in the creative technology sector (mirroring challenges of the larger tech sector). According to census data as cited in the 2016 Tech Talent BC Report, women represent "45% of the Canadian labour force and yet represented only 15-20% of BC's technology labour market"[97] (this figure lags the Canadian average of 25%). Similarly, First Nations groups aged 18-65 represent 2.5% of the population of BC yet comprise less than 1% of the tech workforce.[98] Data on the representation of peoples with disabilities in the creative technology sector is not available, however according to Statistics Canada's 2017 Canadian Disabilities Survey, only 25% of STEM graduates with disabilities were found to be employed in the tech sector. Similarly, according to Statistics Canada's Labour Force Survey, in 2019, two in five workers in the tech sector were foreign-born. Unfortunately, no reliable data is available on the representation of visible minorities in the creative technology sector or the tech sector.

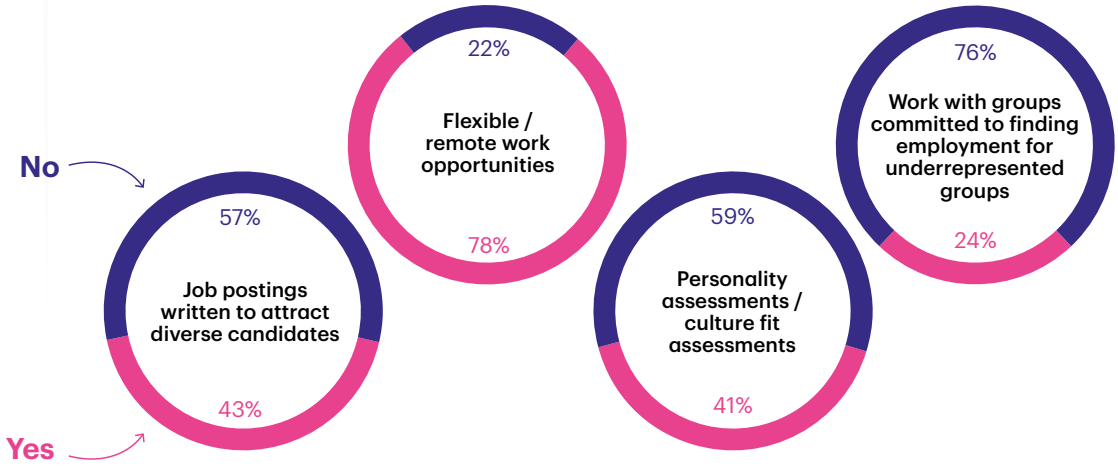
Recent years have seen a growing employer commitment to diversity and inclusion in the tech sector, but interviewees in this study also see the challenges they face in this area. While some companies were happy to highlight their longstanding efforts in this area, many appeared unsure of how to further these efforts; interviewees frequently cited variations of "We don't currently have any formal diversity and inclusion policies, but we would like to do more. We just don't know where to start or who to contact."

For these companies, the uncertainty started as early as the recruitment process, although most interviewees had some practices in place, whether formal or informal. Nearly half of interviewees were able to confirm that job postings were written in a way to attract diverse candidates (some believed this to be the case but were not able to confirm). Another three-quarters of interviewees offered remote or flexible working opportunities (which are common accommodations made for people with disabilities, and increasingly other segments of the population, including parents, those that care for others, etc.),[99] but several (nearly half) stressed that this was a new development, resulting from COVID-19. Previous to the large-scale move to remote work inspired by COVID-19, interviewees noted that strict IP and data confidentiality clauses of contracts made remote work a challenging space to navigate.

97 *"2016 TechTalentBC Report," BC Tech Association, 2016, https://www.workbc.ca/getmedia/8d38ac6f-82d4-4db1-b0bf-ac0f77d78af5/2016_techtalentbc_report.pdf.aspx*
98 *Ibid*
99 *Stuart Morris, "Workplace accommodations for employees with disabilities in Canada, 2017", Canadian Survey on Disability Reports, Statistics Canada, September 25, 2019, https://www150.statcan.gc.ca/n1/pub/89-654-x/89-654-x2019001-eng.htm*

Inclusive Recruitment Practices

Figure 22: Inclusive recruitment practices at companies interviewed



The area where interviewees expressed the least success was in working directly with organizations helping underrepresented groups. Fewer than one-quarter of interviewees expressed having formal relationships with such organizations, although many were exploring avenues for engagement. The organizations referenced include:

- Women in Animation (referenced by nearly half of animation studios)
- Women in Film and Television Vancouver[100] and Women in Games[101]
- Capilano University's Indigenous support group
- BC's Tech's pilot program for Indigenous employment
- Intersections Media
- Junior Achievement BC
- Doors Open to Technology
- HR Tech Group's Diversity and Inclusion committee
- imagineNATIVE (a film and media arts festival focusing on Indigenous content)[102]

100 *"Women in Film and Television Vancouver," https://www.womeninfilm.ca/*
101 *"Women in Games Vancouver," Meetup, https://www.meetup.com/Women-in-Games-Vancouver/*
102 *"imagine NATIVE," https://imaginenative.org/*

Image courtesy of Lost Boys School

Learning and Development

Training

Unsurprisingly, the highly varied nature of work and positions in the larger creative technology sector resulted in a range of responses on the question of whether companies provide training (beyond a standard orientation upon starting in a job).

The project-based nature of some work (and utilization of freelancers or contractors) along with tight timelines means that in some of these areas, there was very little formal training, and workers were expected to already be familiar with tools and processes—in short, to “be able to hit the ground running.” On the other end of the spectrum, some of the larger organizations had highly structured, formal, and comprehensive training, as well as professional development models for all staff. The vast majority fell somewhere in between; many companies had informal or impromptu training models, or provided some level of training, depending on the nature of the position. Often this included pairing up with a "buddy,” accessing online materials, or providing access to training content, videos, wikis or “lunch and learns” for new staff.

Understandably, larger corporations with dedicated HR departments and talent development roles had more mature structures for providing training, while newer and smaller companies typically had less formalized systems. It is worth noting that many respondents believed they were making positive progress in their training offerings, and with growing maturity, would be able to better deliver a more robust, formalized experience.

In terms of the nature of training, it ranged across subjects including:

- General company policies, culture, expectations
- HR procedures, anti-harassment, or safety training
- Anti-bias (in hiring)
- Technical skills (such as utilizing software used by the organization)
- Management and leadership training
- Teamwork
- Sales training
- IT/cybersecurity

Upskilling

Upskilling refers to the process of gaining new skills to aid employees in their current job, and reskilling often refers to training employees to transition to new roles.[103] According to this study, the creative technology sector is a strong proponent and supporter of this type of professional development. Overall, there was high degree of support for continued skill development for staff, as well as openness about staff expanding their scope of responsibility, or pivoting to completely new functions within the organization.

Most companies (close to 70%) also noted having had their own experiences with upskilling or reskilling, where existing staff explored new roles. Interviewees felt that allowing employees to follow their passions was ultimately beneficial to the business—it helped employees engage in the work, and, where retention was desired, aided it.

103 *"What is upskilling and how do you help employees achieve it?" Randstad, 2019, https://www.randstad.ca/employers/workplace-insights/talent-management/what-is-upskilling-and-how-do-you-help-employees-achieve-it/*

COVID-19 and the Move to Remote Work

COVID-19 has undoubtedly disrupted the creative technology sector, with remote work being one of the most substantial shifts.

Industry interviewees believed that the move to remote work had long been a difficult, if not impossible, proposition due to concerns over security and control over intellectual property for projects. That is, with many BC-based studios run on a work-for-hire basis, these studios must adapt their processes to the respective clients' privacy and security policies. Until recently, many of these policies required that work be completed in-studio only. Recently, this has changed somewhat. The majority of clients of work-for-hire firms adapted to remote-work environments in the face of COVID-19, at least in the immediate term. Now, companies in the creative technology sector face questions related to navigating the inherent trade-offs of remote work and when or how they should return to shared offices. As one interviewee from the VFX sub-sector relayed, "*The current reality can feel like an impossible situation: no matter what the decision, many staff will be unhappy.*" Many interviewees felt that a significant portion of employees yearn for a return to their previous style of work environment and are struggling with the challenges of working from home, while others felt that staff may be reluctant to return to work (especially those relying upon public transportation or with higher health risks) until the pandemic abates.

As the pandemic continues, there may be larger questions for what this means for the "future of work", including whether or not the move to remote work is one that will remain once is safe to be back in the office fulltime. As several industry interviewees relayed, the creative technology sector is characterized by intense production periods, tight timelines, and the need to work efficiently with colleagues. While the sector is navigating this reality well for now, it remains to be seen which work models remain in place as the pandemic continues.

In terms of overall economic impact, there are differences by sub-sectors. Visual effects (VFX) projects have slowed down and are likely to continue to falter after the current queue of film and television production is cleared (unless it becomes safe to resume live-action film in the meantime). This may lead to a further drop in business. Conversely, while live film production is largely halted, this has not impacted animation, which has faced an increased demand for new content that can still be produced in isolation.[104]

The videogame sub-sector (and particularly the well-established video game companies) has largely benefited from pandemic lockdowns, with reports of higher usage[105] and increased sales, resulting in rising stock prices (as the videogame industry is better positioned to weather market volatility).[106] However, the pandemic has still been disruptive in the transition to work-from-home as well as the cancellation of industry events to promote new projects. Smaller studios in particular voiced concern about long-term financing related to the duration of the pandemic.

104 *Stuart Derdeyn, "Hollywood North: Animation sector working hard during COVID-19 pandemic," Vancouver Sun, June 10, 2020, https://vancouversun.com/entertainment/movies/hollywood-north-animation-sector-working-hard-during-covid-19-pandemic*

105 *Nick Romano, "Game (still) on: How coronavirus is impacting the gaming industry," Entertainment Weekly, March 19, 2020, https://ew.com/gaming/coronavirus-videogames-industry-impact/*

106 *Daniel Howley, "The world is turning to video games amid coronavirus outbreak," Yahoo! Finance, March 18, 2020, https://finance.yahoo.com/news/coronavirus-world-turning-to-video-games-150704969.html*

SECTION III

The Demand for Creative Technology Talent in BC

Image courtesy of Smoking Gun Interactive

Talent Demand Over the Years

Seeing substantial growth in economic impact and employment over the years, most interviewees in this study were optimistic about the prospects of the sector going forward. A small portion of industry representatives (8%) believed that demand for talent decreased over the last three years due to growing competition from jurisdictions in Canada (Montreal, specifically) and abroad (the US and Australia, in particular). Over half of interviewees (55%) responded that, despite this competition, BC remained a central hub for creative technology, with continued demand for talent. The demand for talent was echoed especially by small and medium-sized companies, which in some cases reported doubling their employee base during the last two to three years. Among large studios, many believed that demand remained consistently high over the last few years.

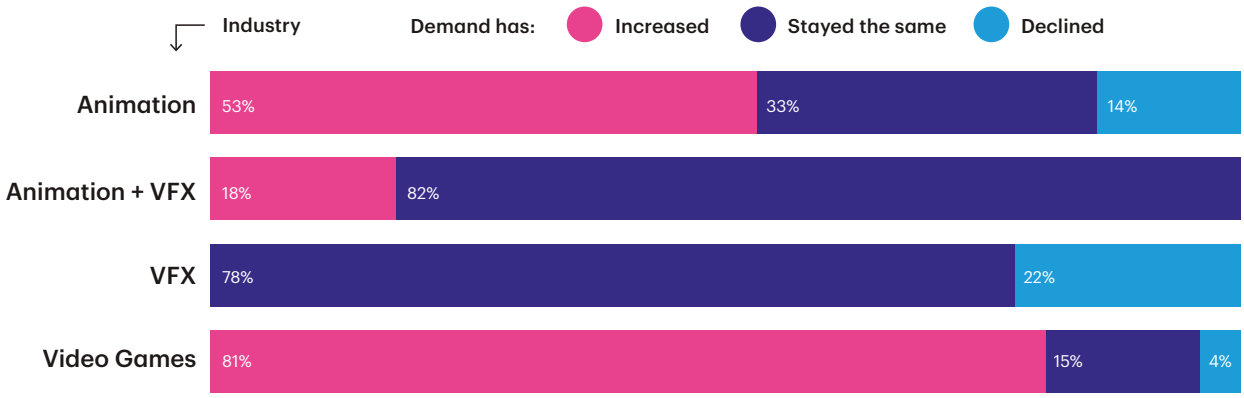
Figure 23: Demand for talent over time, according to companies interviewed

Although many interviewees reported growth in demand for talent over the years, sub-sectors like animation and VFX can see varying levels of demand during a single calendar year, depending on project cycles. Over the last three years, many studios, regardless of size, saw some fluctuation in staffing. Larger studios held a general sentiment that headcounts stayed roughly the same after factoring in fluctuations during a given year; whereas smaller studios tended to report an increase in overall headcount.

When assessing perceptions on demand for talent across company type, video game studios note the strongest growth in demand over the last three years—over 80% of video game companies suggest that demand has increased. This was followed by animation companies, where over 50% report an increase in talent demand. Studios that work on VFX projects had a different opinion on demand over the years.

The majority felt that demand had stayed the same. Some noted that the industry in BC has stagnated, while Ontario and Quebec are picking up steam. Notably, VFX businesses appear to be the most negatively impacted by COVID-19 of all creative technology sector sub-sectors. With the shutdown of live-action film in mid-March, many VFX interviewees expressed uncertainty about how lockdowns and slowdowns would affect work opportunities going forward. Several expressed a level of apprehension about the future of the industry, should live-action film be stalled for a significant amount of time.

Figure 24: Demand for talent over time according to companies interviewed, by sub-sector



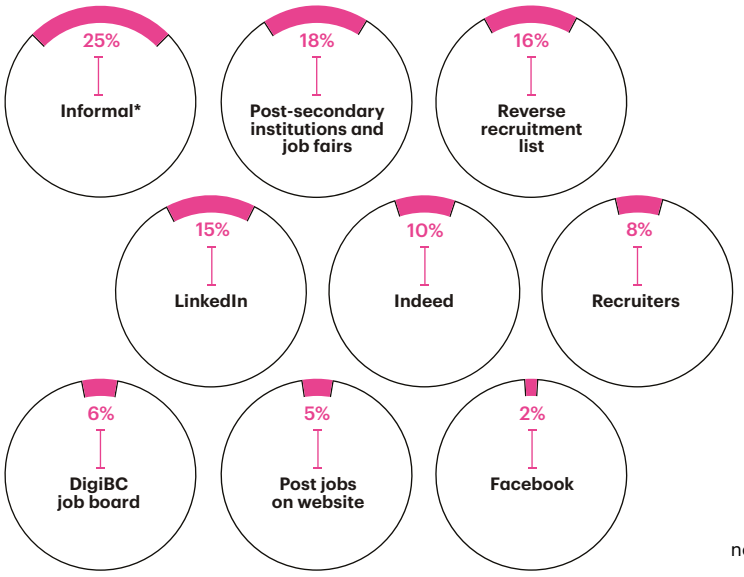
Sourcing Talent

The creative technology sector uses numerous methods to source talent for in-demand roles. For junior-level talent, many studios engage directly with post-secondary institutions, often building relationships with instructors from programs of interest. This allowed studios to not only gain quick access to skilled talent before they graduate and formally enter the job market but also to work with educational institutions and provide input on industry needs, which can help inform future curriculum. Although a fruitful practice, this type of interaction tended to occur on a case-by-case or studio-by-studio basis—it is not a practice common to all studios and educational institutions.

For mid and senior-level roles, other methods were utilized. While some employers used external recruiters, there was a very strong reliance on informal recruitment methods: world of mouth, referrals, attending networking events, and meetups. These methods were used by a quarter of all interviewees, whereas more traditional recruitment methods, like posting jobs on job boards, were relatively uncommon. Although 10% of industry interviewees said they posted jobs on Indeed, this was not necessarily a standard process. For some, posting a job on Indeed was considered "Plan B" if talent was not available via other informal methods. The other job boards that were used on occasion were the DigiBC job board, Facebook, and LinkedIn. Employers noted using LinkedIn more for their internal recruitment and/or when HR teams *searched* for talent, rather than for posting jobs.

One method of informal recruitment noted by 16% of companies (and nearly three-quarters of all animation companies) was the "reverse recruitment list." A unique feature of the industry, this list can be likened to a talent rolodex. It identifies talent available in the local ecosystem, their roles and skillsets, as well as the end dates of their current contracts. Because animation and VFX rely heavily on contract workers, this list is circulated (privately) among studios in the province, with the goal of finding ways to always re-absorb talent in the ecosystem once their contracts end. This unique development is a boon to the local workforce, helping to ensure that skilled talent can be kept in BC.

Figure 25: Methods of sourcing talent, according to companies interviewed



*Word of mouth, referrals, networking/meetup events, etc

Image courtesy of Hyper Hippo

A Year in Review:

Talent Volume in 2020

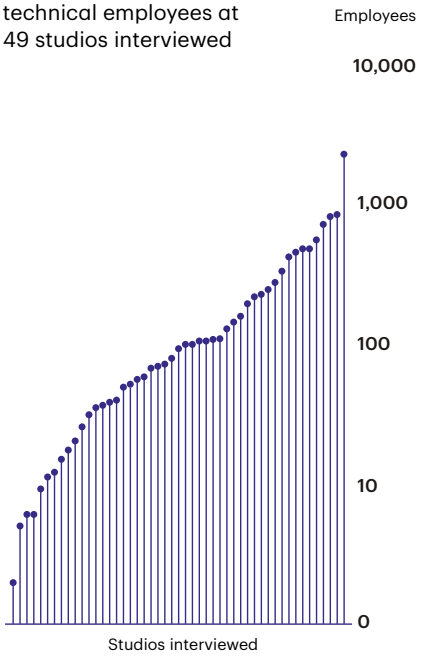
Current Headcount

2020 was a year that started off with a sense of optimism for many, but immediately dove into uncertainty, and was followed by economic slowdowns previously unthinkable. At the height of the pandemic lockdowns, unemployment in Canada climbed to over 13%, rates not seen since the Great Depression.[107]

Although this uncertainty impacted nearly all sectors of the economy, employment in the creative technology sector remained strong. At the time of these interviews (between May to July 2020), employee headcounts among 49 studios in animation, VFX, and video games in BC ranged from two to nearly 2,000. In aggregate, during this period, these studios alone were responsible for nearly 10,000 jobs in the province. Naturally, the largest bulk of employment was found in the most populous cities in the province, with the highest proportion of studios located in Vancouver, followed by the general GVA, with Victoria coming in third.

107 *Maryna Ivus, Akshay Kotak, Ryan McLaughlin, "The Digital-Led New Normal: Revised Labour Market Outlook for 2022," ICTC, August 2020, https://www.ictc-ctic.ca/wp-content/uploads/2020/08/Outlook-ENG-FINAL-8.24.20.pdf*

Figure 26:
Number of digital/ technical employees at 49 studios interviewed

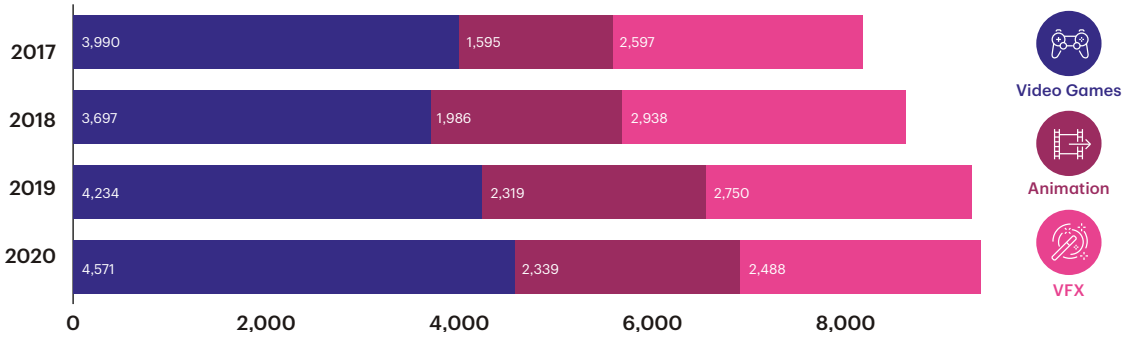


Note: Data collected from mid-May 2020 to late July 2020. Employee headcounts are time stamped to the date of interview. Projections of employment for the remainder of the year are available below.

Moreover, the creative technology sector's employment footprint has shown notable signs of growth over the years. While 2020 headcounts are only based on the first half of the year (and therefore may change), employment among the studios interviewed grew by more than 1,200 between 2017 and 2019. The largest increases in headcount were seen among animation companies (growth of 724), followed by video games.

Although it is too early to predict the long-term impacts of COVID-19, in 2020 VFX has seen the largest contraction in employment. Should live-action film—the essential component required for VFX companies to begin work—return to near-previous levels of activity, it is possible that the VFX sub-sector will recover to previous levels of activity, but not necessarily increase. While many interviewees were positive about the sub-sector's ability to rebound from the COVID-19 crisis, VFX was also the only sub-sector to report that demand had not increased in recent years. Specifically, despite some optimism for a post-COVID rejuvenation to some degree, nearly one quarter of interviewees felt that demand had steadily decreased in recent times.

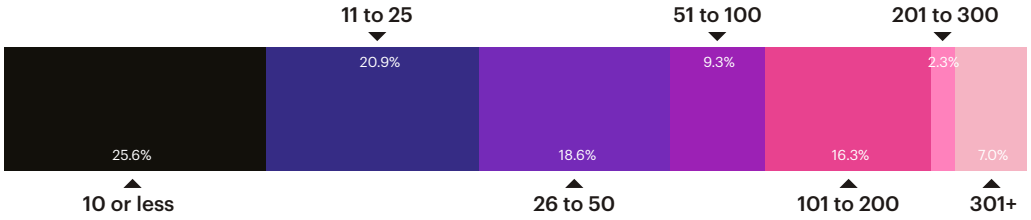
Figure 27: Employment count over the years, according to 49 studios interviewed, by sub-sector



2020 Anticipated Hiring

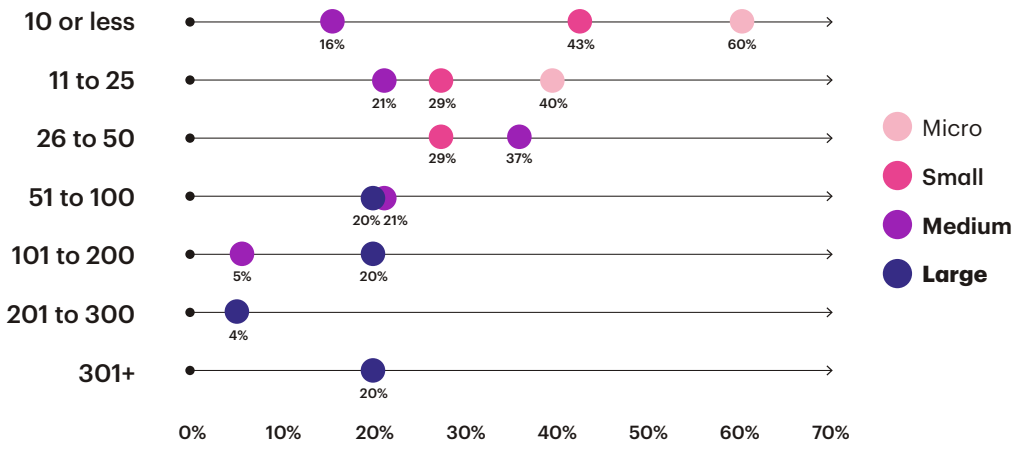
Despite COVID-19 and the associated economic slowdowns across the economy, nearly every studio interviewed[108] had plans to onboard new digital, artistic, production, and design talent in 2020. Once again, the sub-sector facing the most significant adverse impacts associated with COVID-19 is VFX. While no VFX interviewees believed they would stop hiring altogether in 2020, the majority believed that the volume of talent to be onboarded will be considerably less than anticipated at the start of the year (before COVID). It is possible that hiring plans for VFX have been further impacted following the completion of interviews. Second waves of COVID-19 occurring across Canada and the world continue to pause the full re-opening of live-action film.

Figure 28: 2020 Hiring in BC, according to companies interviewed



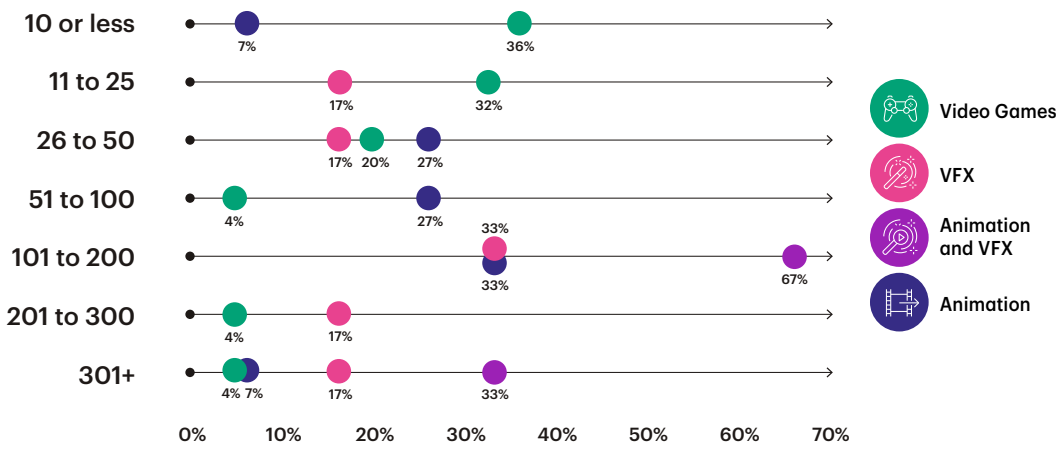
Examining anticipated hiring by company size, it becomes clear that large studios still expect to hire anywhere from 50 to over 300 new people throughout 2020. Of course, the need for talent also differs according to sub-sector. For animation and VFX companies, with significant periods of ramp up and ramp down, accelerated hiring may simply be a result of the cyclical nature of the sub-sector (i.e., hiring in ramp-up periods), vs. an indicator of significant growth. For video game companies—who are often able to avoid significant periods of ramp up and ramp down during a calendar year—accelerated hiring is more likely to suggest overall growth. The median range of planned new hires throughout the remainder of 2020 was 11 to 25. For animation, and for many VFX studios, the median range was 101 to 200.

Figure 29: 2020 hiring plans according to companies interviewed, by size



108 One studio was showcased some uncertainty, suggesting that they were unlikely to hire new talent, due to the impacts of COVID-19 on their business

Figure 30: 2020 hiring plans according to companies interviewed, by sub-sector



In spite of the significant uncertainty and global economic downturn as a result of COVID-19,[109] BC's creative technology sector businesses remain resilient, with plans to create hundreds of high-quality employment opportunities for British Columbians for many years to come.

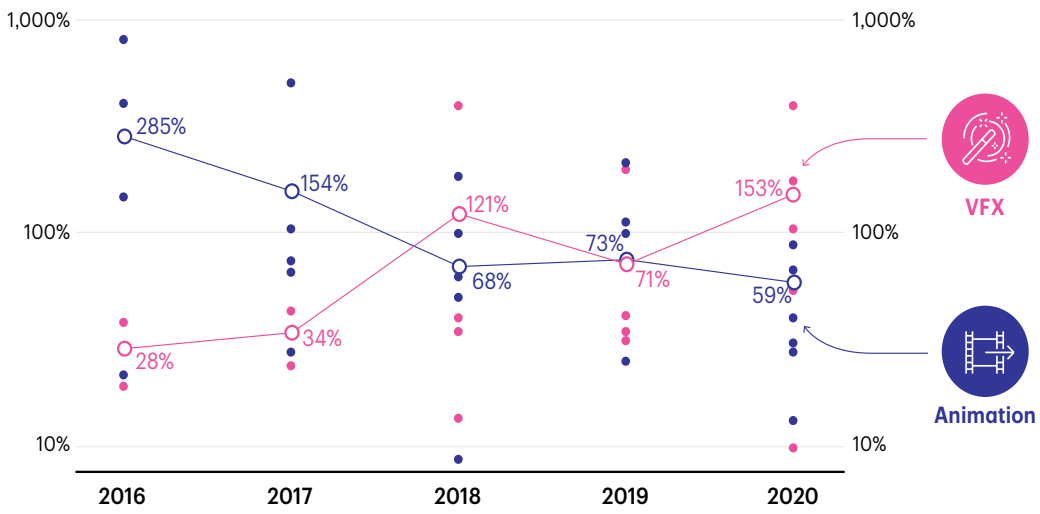
An Overview by Industry:
In-year Headcount Fluctuations

As discussed, certain sub-sectors in the creative technology sector are more prone to headcount fluctuations because of production cycles. Video game studios can maintain relatively low headcount fluctuations (under 10%), whereas animation and VFX studios can expand or contract significantly, depending on whether they are in a ramp-up or ramp-down period. To shed light on these nuances, ICTC conducted an online survey ("headcount survey") to extract information on production cycles across the sector. This survey was completed by 67% (33 of 49) of video game, animation, and VFX studios that participated in interviews. The survey was also sent to other companies that fall into these categories, but were not available for interviews (no additional uptake took place via this stream). The survey, based on 33 responses evenly spread across sub-sector, concluded that headcounts among VFX and animation studios can fluctuate substantially throughout each year.

The below figure highlights these fluctuations (% increase between lowest to highest headcount) within years, according to data provided in the survey. The dots in the figure represent values according to data provided for highest headcounts in a year (the baseline being lowest headcounts), while the connected lines indicate the average for animation and VFX firms across time. While some companies had relatively low levels of headcount fluctuation (i.e., a lowest headcount of 140, and highest of 160 in a given year), others noted experiencing significant changes throughout the year (i.e., a lowest headcount of 550, and a highest headcount of 850). The figure reveals an interesting trend: animation companies have seen declining within-year headcount volatility from 2016 to 2020, whereas VFX studios have been rising in volatility over the same period. While it is not possible to confirm why this is the case without further research, it may be that the growing demand for animated content over the years is creating a greater source of stability for the sub-sector.

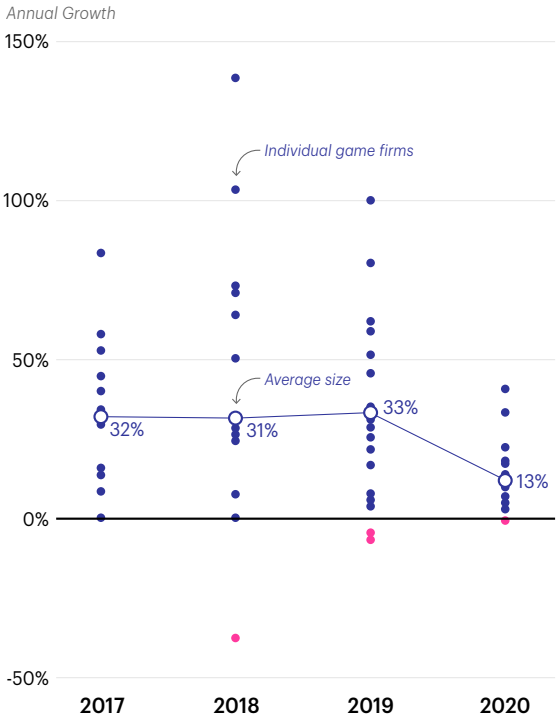
109 *Maryna Ivus, Akshay Kotak, Ryan McLaughlin, "The Digital-Led New Normal: Revised Labour Market Outlook for 2022," ICTC, August 2020, https://www.ictc-ctic.ca/wp-content/uploads/2020/08/Outlook-ENG-FINAL-8.24.20.pdf*

Figure 31: Headcount fluctuations in a calendar year, , according to animation and VFX companies - 16 of 33 companies surveyed (headcount survey)



Note: Although 33 companies responded to the headcount survey, only animation and VFX companies stated experiencing notable (i.e., more than 15%) headcount fluctuations in a given year. Aa a result, the graph above excludes video games. It represents headcount fluctuations at animation and video game companies only (16 of the 33 respondents).

Figure 32:
Y-O-Y growth rate of video game companies, according to companies surveyed

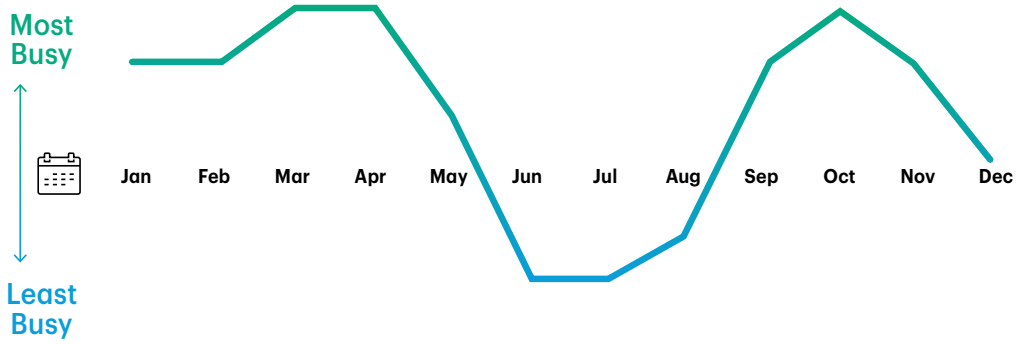


Although the majority of video game companies surveyed did not experience any relevant fluctuations in headcounts,[110] figure 32 reveals the year-over-year headcount growth rate for video game studios from 2017 to the present. The video game studios surveyed for this study are growing in staff at a rapid rate. The average growth rate was above 25% per year from 2017 to 2019. The growth rate for 2020 appears lower, however, this is because survey respondents were only able to provide headcounts for the first half of the year.

110 Some described minor headcount fluctuations (i.e., less than 15%). As 15% was the cut-off for annual headcount fluctuation, video game companies are not included in Figure 31.

Finally, the figure below shows the months rated as “most busy” by survey respondents which have significant within-year variations in employment due to project cycles. According to the survey data, the summer months of June, July, and August are the least busy months of the year. December also involves a significant drop-off due to holidays.

Figure 33: Busiest months according to companies surveyed who reported 15% of more in-year headcount fluctuations



Note: 17 studios reported in-year fluctuation. 16 animation & VFX studios, where fluctuation was believed to be above 15% per year, plus one video game studio who reported fluctuation, although below the 15% threshold. Figure 33 showcases perceptions of relative “business” according to those 17 companies.

Image courtesy of Kano

Jobs Relevant to the Creative Technology Sector

BC's creative technology sector is characterized as a unique blend of primarily artistic/creative and digital/technical roles. It creates employment opportunities for British Columbians from various educational and experiential backgrounds. Creative technology jobs spread far beyond the traditional gamut of software or data-based roles often characterized as a crux of the technology sector.

Based on input gathered from interviewees and the industry advisory committee in this study, there are nearly 60 unique occupations that are common to the creative technology sector, across the following areas: Artistic/Creative, Digital/Technical, Production, and Design.

Although the sector relies heavily on informal or internal recruitment methods and practices (as opposed to simply "posting jobs online and waiting for applicants"), an analysis of job postings highlights a strong demand for talent across a variety of these occupations in BC. Gathering data on job postings over a seven-month period, from May to November 2020 (full job lists were used following the immediate economic slump caused by the pandemic in April)[111] thousands of unique job postings were identified. When considering that fewer than half of interviewees noted posting jobs online in some fashion (on Indeed, their website, the DigiBC website, or Facebook, and on occasion LinkedIn), it is clear that this sector can be a significant source of high-quality employment for British Columbians.

Title combinations arose as an interesting nuance discovered in the collection of job data, when cross-referenced with supply data gathered from workers in the identified roles (individuals currently working in BC's creative technology sector under job titles deemed relevant for this study).[112] These combinations were particularly present among artistic/creative roles. For example: "Matchmove/Rotoscope Artist," "VFX Supervisor/Compositor," "Texture Painter/Matte Painter," "Animator/Motion Capture Specialist," "Rigger/Designer," "Lighter/Look Development Artist." These combinations suggest that workers in creative/artistic roles may end up wearing many different hats or take on numerous responsibilities that go beyond their original job title.

Tables 2-5 below showcase the number of job postings found across job boards from May to November 2020, according to in-demand roles identified by industry interviewees and the advisory committee. For further granularity, these roles are separated according to four key occupational categories: artistic/creative, production, digital/technical, design.

111 *Webscraping was completed for a "draft" list of jobs that was developed by ICTC, sourced from a literature review and some initial feedback from the advisory committee in February and March. Therefore, some job values are available for March and April, but are under categories and job titles that are not comparable to the final job list. As a result, they are not included in this study. The finalization of the job list for webscraping coincided with a rebound of job postings following a slight downturn seen in March and April.*

112 *Information on worker profiles collected from online platforms that specialize in networking and employment.*

Table 2: Job postings May-November 2020: Artistic/Creative roles

Artistic/Creative

Occupation	May	June	July	Aug	Sept	Oct	Nov
Total Artistic Roles	**105**	**71**	**248**	**230**	**178**	**159**	**115**
2D Artist	42	11	55	74	47	46	16
3D Artist	13	7	52	60	29	28	9
Storyboard Artist	3	5	11	4	2	5	6
FX Artist	7	9	17	16	17	11	12
CFX Artist	1	1	2	0	2	0	1
Concept Artist	3	6	26	16	10	6	6
Environment Artist	2	2	39	44	29	11	15
Match move Artist	1	1	1	0	0	0	0
Layout Artist	6	5	4	3	6	15	16
Technical Artist	15	13	24	17	14	20	14
Matte Painter	1	3	3	5	13	8	11
Texture Painter	0	0	1	0	0	1	1
Modeller	11	8	13	7	9	8	8
Total Animation Roles	**2**	**1**	**8**	**22**	**8**	**24**	**33**
Animator	0	1	4	10	4	16	20
Gameplay Animator	1	0	0	8	2	2	1
Motion Capture Animator	1	0	4	4	2	6	12
Total Lighting Roles	**6**	**2**	**6**	**5**	**8**	**4**	**7**
Lighter	2	1	2	4	2	1	2
Lighting Engineer	1	0	0	0	0	0	0
Lighting Technical Director	3	1	4	1	6	3	5
Total Technical Management Roles	**17**	**18**	**22**	**30**	**52**	**30**	**58**
Technical Art Director	2	1	5	1	1	0	2
Pipeline Technical Director	1	1	4	8	12	10	14
Render Technical Director	2	0	0	0	0	2	2
Pipeline Supervisor	3	3	0	3	4	1	10
CG Supervisor	4	6	11	15	18	14	12
Art Director	5	7	2	3	12	3	18
Total "Other Technical" Roles	**5**	**2**	**7**	**10**	**5**	**3**	**2**
Compositor	2	1	2	5	2	2	1
Rigger	1	1	5	5	3	1	1
Shader Writer	2	0	0	0	0	0	0

Table 3: : Job postings May-November 2020: Production roles

Production

Occupation	May	June	July	Aug	Sept	Oct	Nov
Total Producer Roles	**28**	**12**	**25**	**22**	**20**	**11**	**15**
Producer	14	12	25	22	20	10	15
Digital Producer	14	0	0	0	0	1	0
Total Technical Management Roles	**26**	**30**	**31**	**35**	**35**	**17**	**27**
Director	16	20	3	2	1	3	3
Development Director	1	2	23	20	18	7	3
Motion Capture Director/Manager	1	0	1	1	0	1	1
Art Director	5	7	2	6	12	3	18
Production Manager	1	0	0	0	0	1	0
Development Manager	1	1	0	0	0	0	0
Layout Supervisor	1	0	2	6	4	2	2

Table 4: Job postings May-November 2020: Digital/Technical roles

Digital/Technical

Occupation	May	June	July	Aug	Sept	Oct	Nov
Total Programming Roles	**35**	**33**	**41**	**34**	**17**	**20**	**18**
Programmer	12	10	17	14	7	8	6
UI Programmer	3	1	1	1	0	1	1
Render Programmer	2	0	0	0	0	2	1
Gameplay programmer	6	6	9	8	4	4	3
Online programmer	2	5	2	2	0	1	2
Graphics programmer	1	3	1	0	0	0	1
Systems programmer	0	0	1	1	1	0	2
Audio programmer	1	1	0	2	0	1	0
Pipeline programmer	1	2	1	1	1	1	0
Animation systems programmer	0	0	1	0	0	0	1
Unreal Engine programmer	2	1	0	0	1	0	0
Mobile Developer	5	4	8	5	3	2	1

Table 5: : Job postings May-November 2020: Design Roles

Design

Occupation	May	June	July	Aug	Sept	Oct	Nov
Total Front-End Design Roles	**16**	**10**	**13**	**12**	**4**	**4**	**6**
Level Designer	3	1	4	4	2	3	1
UI Designer	5	6	6	4	1	1	3
UX Designer	4	2	1	1	1	0	2
Narrative Designer	1	0	0	2	0	0	0
Digital Content Designer	0	0	2	0	0	0	0
Online Designer	3	3	0	1	0	0	0
Total Back-End Design Roles	**8**	**7**	**18**	**16**	**8**	**4**	**6**
Gameplay Designer	6	6	10	8	6	2	5
Core Designer	0	0	7	5	2	2	1
Systems Designer	2	1	1	3	0	0	0

Jobs Most in Demand

Overall job growth is a common and relevant metric for assessing the success of a certain sector. However, because the creative technology is so often lumped under the veil of technology writ large, it is important to understand just which occupations are seeing the most demand.

While numerous jobs are relevant to the creative technology sector, certain jobs are more in demand and harder to fill than others. In all sub-sectors, the most in demand (or hard to fill) roles were found primarily across digital/technical, followed by creative/artistic job categories. Production and design roles were referenced less frequently, potentially suggesting that, while relevant, they are easier to fill.

Among digital/technical occupations, programmers/software engineers (non-specific) were selected as “in demand” by nearly half (43%) of all interviewees (16 from the video game sub-sector, four from the animation sub-sector, one from the VFX subsector). This was followed by gameplay programmers (14%), however the latter was only cited as in demand by video game companies. System-specific digital/technical roles referenced as in demand by all industries were either Unity or Unreal Engine programmers.

Among creative/artistic roles, the most in-demand jobs were animators, referenced as in demand by 33% companies (across all industries), followed by FX artists, referenced by 18% of companies (in animation and VFX).

Table 6: Most ‘in-demand’ digital/technical roles for video game companies, according to interviewees

Video Games

Job	No. of Studios referencing "in-demand"
Programmer/software engineer (general)	16
Gameplay programmer	7
Data scientist/analyst	6
3D artist	4
Technical artist	4
UI programmer	4
Network programmer	3
Unity programmer	3
Game designer	3
Technical designer	2
Rendering programmer	2
UX programmer	2
Backend programmer	2
Producer	1
QA Analyst	1
Unreal Engine programmer	1
Systems programmer	1
2D artist	1
Game economy designer	1
Lighter	1
Animator	1
Environment artist	1
Rigger	1

Table 7: Most 'in demand' digital/technical roles for animation companies, according to interviewees

Animation

Job	No. of Studios referencing "in-demand"
Animator	12
Rigger	5
Programmer/software engineer (general)	4
Lighter	4
Pipeline TD	4
Technical director	3
FX Artist	3
CG Supervisor	2
Compositor	2
Unreal Engine programmer	2
Storyboard artist	2
CFX artist	2
Layout artist	1
Modeller	1
Render programmer	1
Build programmer	1
Matte painter	1
Digital designer	1
Unity Engine programmer	1
Environment artist	1

Table 8: Most 'in demand' digital/technical roles for VFX companies, according to interviewees

VFX

Job	No. of Studios referencing "in-demand"
FX artist	6
CFX artist	4
Compositor	4
Animator	3
Environment artist	2
Programmer/software engineer (general)	1
Pipeline TD	1
Unreal Engine programmer	1
CG artist	1

Source Time for In-Demand Jobs

Another key distinction between all relevant jobs for the creative technology sector and in-demand jobs is source time. Typically, the jobs with the highest level of demand can also take the longest to source. Although some companies interviewed in this study noted the ability to source for their in-demand jobs in under one month, another significant portion of interviewees described it as a longer process that can take anywhere from one to two months, all the way to more than six months. Animation and VFX studios interviewed had the "easiest" time sourcing in-demand talent, with at least one-quarter of interviewees saying this was possible in under one month. However, important to note is the fact that animation and VFX studios are the ones that utilize the reverse recruitment list, stating details for talent that may be immediately available. For video game companies—which do not use this list—source times were longer, with more than 65% of companies suggesting that finding talent for their in-demand roles takes, on average, three months or more.

Similarly, when broken down by size of studio, the larger studios are able to source in-demand talent in a relatively short period of time (nearly half stating that this is possible in less than one month). For small and medium-sized companies—particularly where wage competition is a challenge—source time tended to be longer for in-demand roles. Over 70% of small companies said that source time would be three-plus months (with half suggesting it would be over six months), and nearly 60% of medium-sized companies suggested this would take three months or longer. Micro-sized companies (employing fewer than 10) appear able to source in-demand roles easily (the majority suggesting a source time of less than one month), however the volume of hiring done by companies in this category is significantly lower than the others. Where a medium-sized company may be hiring upwards of 50 roles at one time, a micro-sized company may be seeking one or two.

Figure 34: Job source time according to companies interviewed, by sub-sector

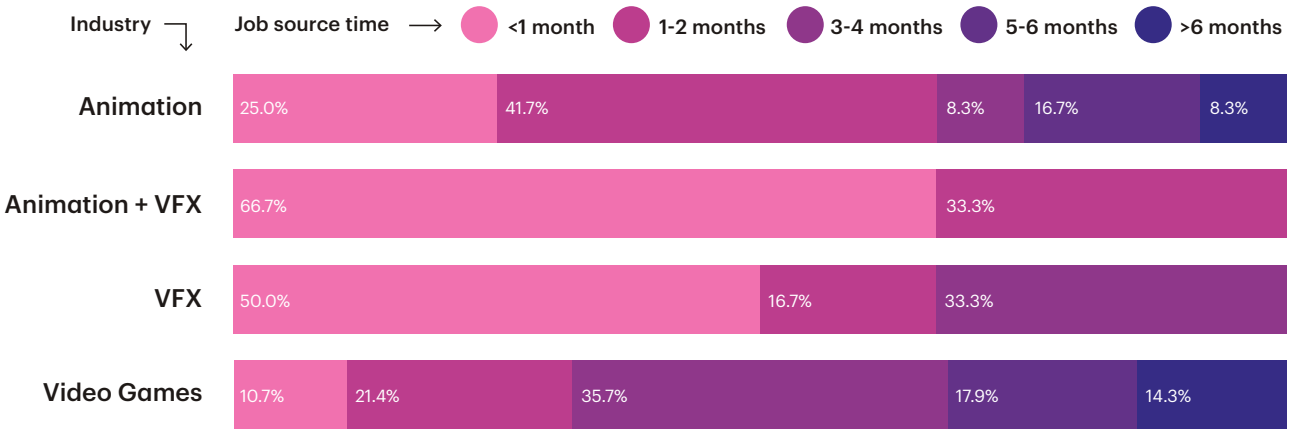
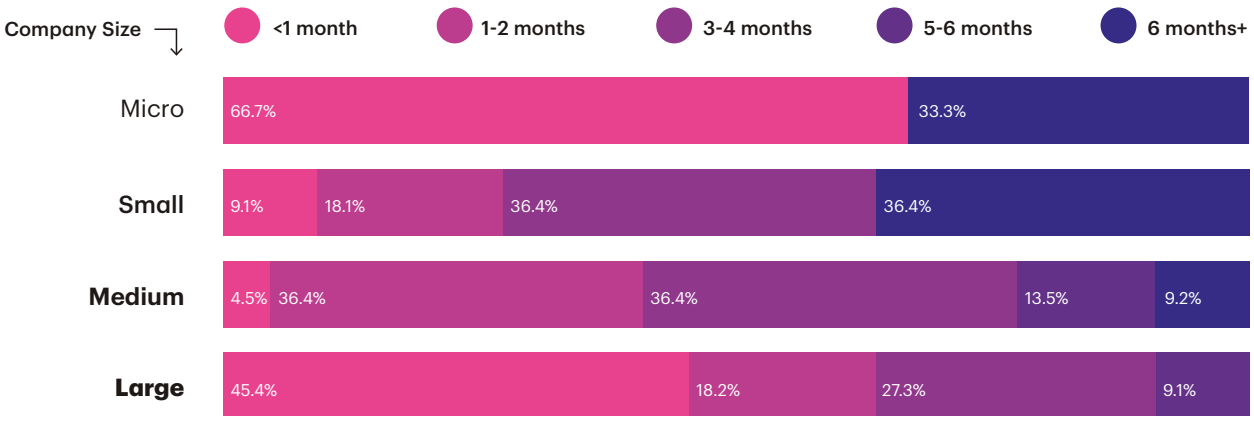


Figure 35: Job source time according to companies interviewed, by size



Note: Micro companies = 9 or fewer, small = 10-49, medium = 50-249, large = 250+.

Key Skills for Top In-Demand Jobs

Talent in the creative technology sector comes equipped with a variety of competencies and skills, some learned in school and others gained through real-life work experience. The types of competencies and skills needed for each role depends heavily on the type of role, and in some cases, even the specific studio. For example, although upskilling and cross-training is common and accepted in this sector, talent within creative/artistic roles will not necessarily come equipped with skills needed for digital/technical roles.

At the same time, although systems such as Unity or Unreal Engine may be learned by students in school, many studios in the animation and VFX space will only use this "off the shelf" software as a foundation to create their own bespoke systems and tools. Couple this with the reality that every studio has its own pipeline, and it is clear that experienced talent becomes high in demand.

Tables A3-A6 (see Appendix IV) provide information on the of skill backgrounds for occupations in the creative/artistic, digital/technical, production, and design spaces that were deemed relevant in job posting, and validated by the project advisory committee. A differentiation is made between general competencies for each role, as well as specific skills and/or applications (for example, competency with texturing versus experience with Zbrush). Please see Appendix IV for a detailed overview.

The Jobs of the Future

Identifying nearly 60 unique roles for the sector (of which approximately 30 were identified by interviews to be in highest demand), interviewees provided valuable insight on the current roles relevant to the sector and its industries. Looking into the future, interviewees also provided insight on roles that are not common or in demand today but may become highly sought after as the sector and consumer demand evolve.

A wide variety of suggestions were offered for which roles may become relevant in the short term (in the next two to three years). Some were roles that exist today which would either become prominent or continue to grow in demand, and others were conceptual (currently non-existent) roles that may emerge depending on the evolution of the sector. Interestingly, many of the conceptual roles were often tied to the evolution of XR, an industry that is still relatively nascent in Canada and BC. As one interviewee put it:

> *We will need a creative technology role that has a user experience focus or a human-computer-interaction focus. The best example is someone who has the technical skills to take hand-tracking cameras and turn that into a very satisfying tactile experience. If a user wants to make pottery through VR, you need someone who understands not just the technical process for working with hand tracking but also what it should feel like to make pottery in VR.*
>
> *– Video game interviewee*

Image courtesy of DNEG © 2020 Home Box Office, Inc.

Animation and VFX studios largely suggested a continued boost in roles that exist, which were believed to increase in demand with the evolution of the industry; video game companies included a number of currently non-existent jobs that may emerge in the coming years.

The following exemplifies the types and frequency of roles that interviewees felt could potentially become relevant in the coming years.

Table 9: Future Jobs as suggested by interviewees

Job	Status	Industry	No. of mentions
Data scientist/Analysts	Existing	Video Games	6
Unreal Engine programmers	Existing	Animation	4
Unity programmers	Existing	Animation	4
Real-time Engine programming	Conceptual	VFX	4
AR/VR/MR developers	Existing*	Video games, Animation, VFX	4
UX programmers	Existing	Video games, Animation	3
UI programmers	Existing	Video games, Animation	3
Technical directors	Existing	Video games, Animation	3
Diversity/Inclusion/Equity managers	Existing*	Animation, VFX	2
Riggers	Existing	Animation	1
Pre-visualization artists	Existing	VFX	1
Online streaming specialists	Conceptual	Video Games	1
Live game operations specialists	Conceptual	Video Games	1
Human-Computer virtual interaction specialist	Conceptual	Video Games	1
Game interactivity specialist	Conceptual	Video Games	1
Project coordinators	Existing	Animation	1
Business analysts	Existing	Video Games	1
Blockchain programmers	Existing*	Video Games	1

*Technically already in existence, but uncommon

SECTION IV

What Does BC Talent Look Like?

Image courtesy of Phoenix Labs

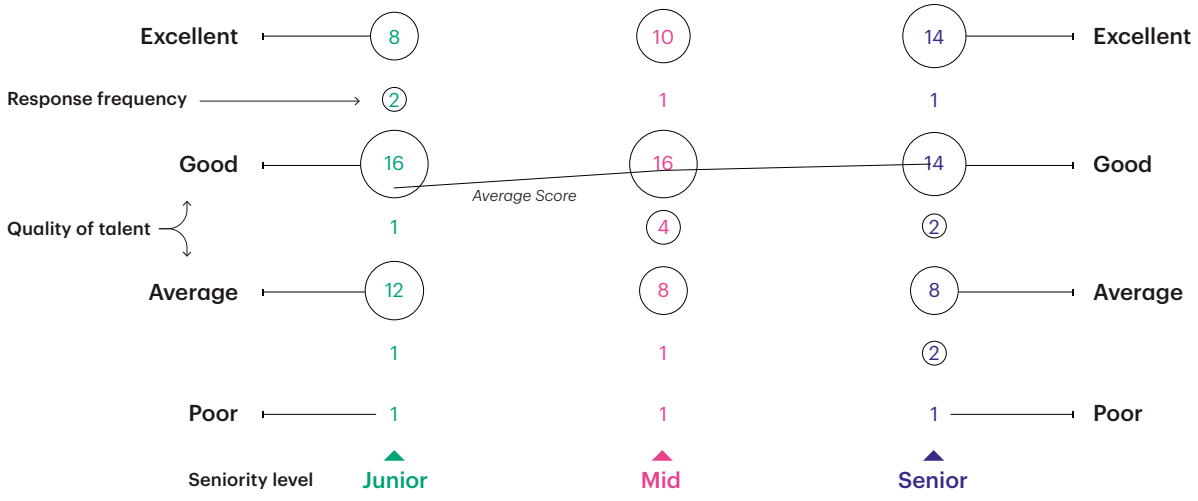
Image courtesy of Metanaut

Quantity and Quality of BC Talent

Understanding that the creative technology sector relies on skilled domestic and international talent, the overall quality of both talent streams was assessed. Throughout the study, interviewees frequently noted the existence of a talent shortage, particularly for artistic/creative and digital/technical roles—in some cases overall (i.e., for all roles), and in others, for specific difficult to source roles within those categories. Assessing the quality of talent in BC was completed in order to understand whether the identified talent shortage in BC is linked primarily to quantity (i.e., insufficient volume), quality (i.e., insufficient skills) or both.

According to interviewees, the quality of BC talent is strong when it comes to fit for top roles (artistic, digital, production, and design). The following graph indicates the frequency of responses for poor, average, good, and excellent ratings (circle size) for junior, mid, and senior-level talent in BC, along with the average score (red line). All three seniority levels scored close to "good" overall, showing more positive responses as years of experience increase.

Figure 36: Average domestic talent scores for artistic/creative,[113] digital/technical roles, as expressed by interviewees



113 Interview questions were initially designed to rate the quality of talent for digital/technical roles, only. However, the literature review identified that key jobs in the sector were split largely by digital/technical and artistic/creative. As a result, interviewees were asked to rate the quality of both.

An important nuance is that when junior talent was rated below good (most frequently "average"), the reasons were, in fact, related to quality. Interviewees suggested that junior talent either lacked a certain desired level of specialization needed for the roles or lacked the necessary soft skills or "life skills" to be as successful as possible. This includes things like the ability to communicate timely and effectively (especially when help is needed), professionalism, and preparedness for the realities of the industry (i.e., long hours, temporary contracts, tight deadlines). Conversely, when mid and senior talent received ratings below "good" the elaboration was almost always tied to two factors: insufficient quantity of talent available, or high competition for the same talent by numerous companies—both factors relating to quantity, not quality.

Animation

For animation companies, mid-level and senior talent was viewed very positively, with the majority of employers rating them "good" or "excellent." Junior-level talent fell more in the range of average to good, with some employers noting that certain schools "churn out a higher quality of talent than others." Specifically, some companies mentioned that it was difficult to find skilled juniors for roles that required specialized skillsets (i.e., Riggers), which are in demand for animation companies. Here, the notion was that many juniors were coming out of school as "generalists" that would require some extensive training when joining a company. In order to remain competitive (in bids), animation companies often require talent with more specialized skillsets that can ramp up quickly. This was a key factor (i.e., the lack of specialization, and time needed by existing supervisors to dedicate to training juniors) that was raised as a roadblock to both hiring higher volumes of juniors, and for career advancement of juniors to mid-level talent.

While senior talent was described as "good" or "excellent," the majority of animation companies also highlighted that although the quality of senior talent for in-demand roles in BC was good, quantity suffered. Several companies stressed that there was simply not enough volume of skilled senior talent in BC, making the market for this talent extremely competitive.

VFX

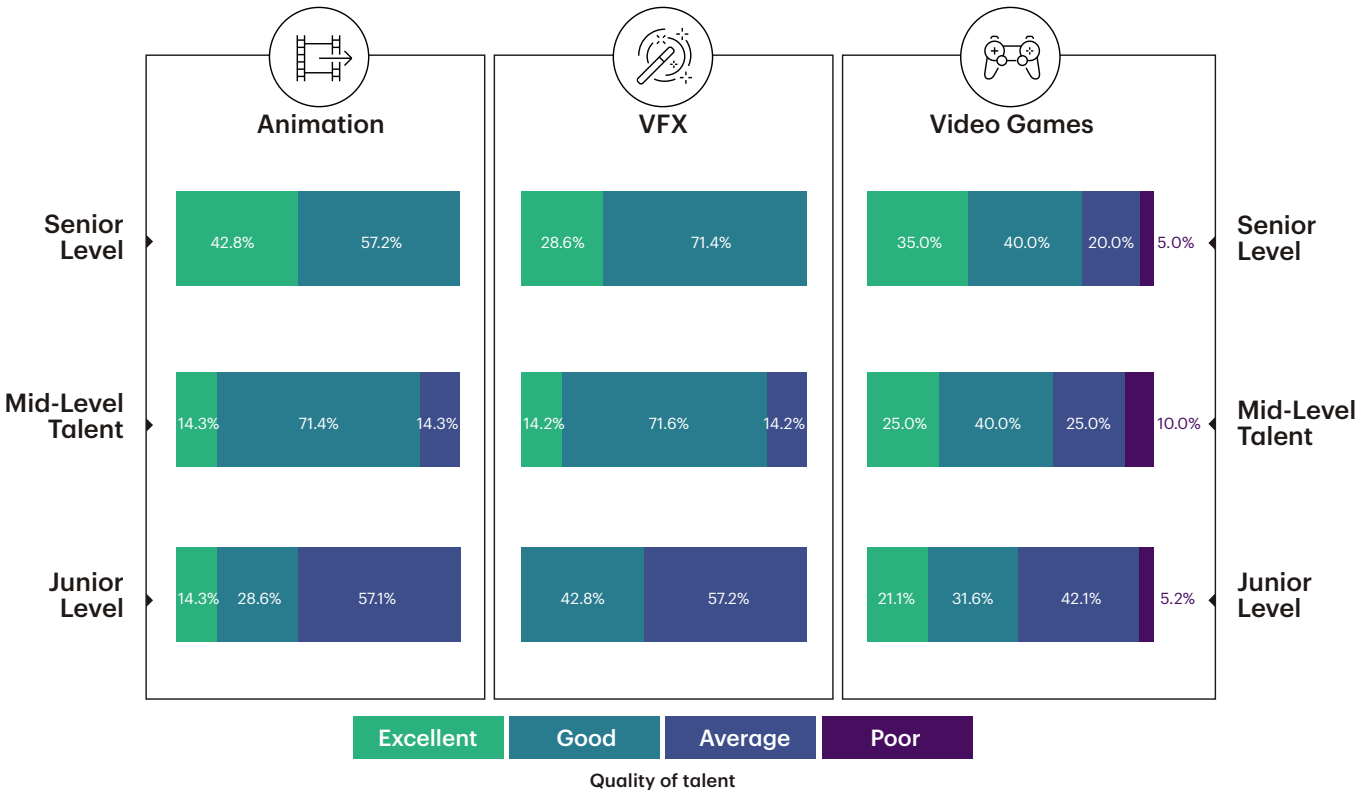
VFX companies provided positive feedback on all levels of talent from BC, with all employers providing a good to excellent rating.

However, a key challenge or concern that was highlighted by animation and VFX companies was the predominance of international students at private schools teaching some of these specialized skills. Many graduates of these schools—often private, not public—do not qualify for the post-graduation work permits, and because of salary caps ($80,000 minimum) for visas like the Global Talent Stream, many grads would not qualify for work permits. In short, both VFX and animation companies noted "risks" in hiring internationally trained junior talent because the current system is designed to attract junior talent to acquire an education but offers the product of that investment (graduates with in-demand skillsets) to other jurisdictions.

Video Games

Lastly, for video game companies, the overall quality of talent was seen as positive. Here, once again, senior and mid-level talent was viewed the most positively overall (75% of interviewees ranked senior talent as excellent or good; 65% for mid-level talent), but junior-level talent was ranked slightly less favourably, with more than 40% of interviewees ranking them as "average." An interesting nuance is that video game companies were the only ones to rank any—and actually all—levels of talent as "poor." However, the interviewees that did provide this rating elaborated to state that their assessment was based on a skillset-per-cost analysis. That is, while BC talent had comparable skills and competencies to talent from other jurisdictions, the cost for this skillset in BC was perceived to be far above that of other jurisdictions.

Figure 37: Quality of BC talent according to companies interviewed, by sub-sector



Comparing the overall quality of talent from one jurisdiction to another can be challenging, as it requires a significant amount of qualitative analysis with industry experts that have worked with employees in various jurisdictions. In this study, the three major hubs for the creative technology sector were identified to be Vancouver (and the Greater Vancouver Area), followed by Victoria, and Kelowna (see Appendix III for a city breakdown of studio location). While regional focus groups were conducted to capture insights from Northern BC, Vancouver Island, and the Interior, all representatives appeared to share the notion that both the quantity and quality of talent outside of the mentioned city centres made it very difficult for creative technology companies to—currently—operate outside of them. One focus group participant, originally from the Interior, stated that he had to establish his company in Vancouver in order to gain access to skilled talent at the volume needed to sustain the business, despite his desire to grow the sector in the Interior. The participant went further to highlight that the unavailability of talent in the region meant that it was easier to source talent outside of BC or Canada altogether, than from the Interior.

Looking both within and outside of BC, an assessment of candidate pools using self-reported skills paints an interesting picture. Below, the top 10 competencies and skills are explored using hundreds of profiles from BC in top in-demand roles. This is compared against a similar sample of profiles from the Los Angeles and Bay Area in California, the two epicentres of the creative technology sector in the United States.

The tables below reveal little difference in skills and competencies possessed between the two talent pools for top in-demand jobs. In each job, similar skills and competencies are evident (i.e., talent in both jurisdictions appear to have similar skills and competencies). In many instances, a greater proportion of BC talent—despite the LA and Bay Area having larger volumes of talent—have identified as skilled in critical areas. Using this comparison, it becomes clearer that BC's talent shortage is likely just a challenge of quantity, not quality.

Table 10: BC and LA/Bay Area Skill Comparison for Top In-Demand Jobs - **Lighting TD**

BC Talent		**LA and Bay Area Talent**	
Maya	23%	Visual effects	16%
Houdini	18%	Maya	15%
Visual effects	16%	Compositing	13%
Nuke	15%	Nuke	12%
Compositing	14%	Houdini	12%
Photoshop	13%	After Effects	12%
After Effects	12%	3D Modelling	11%
Character animation	11%	Animation	10%
3D modelling	10%	Photoshop	10%
Texturing	10%	Texturing	10%

Table 11: BC and LA/Bay Area Skill Comparison for Top In-Demand Jobs - **FX Artist**

BC Talent		LA and Bay Area Talent	
Maya	23%	Visual effects	16%
Houdini	18%	Maya	15%
Visual effects	16%	Compositing	13%
Nuke	15%	Nuke	12%
Compositing	14%	Houdini	12%
Photoshop	13%	After Effects	12%
After Effects	12%	3D Modelling	11%
Character animation	11%	Animation	10%
3D modelling	10%	Photoshop	10%
Texturing	10%	Texturing	10%

Table 12: BC and LA/Bay Area Skill Comparison for Top In-Demand Jobs - **Compositor**

BC Talent		LA and Bay Area Talent	
Nuke	21%	Nuke	20%
Compositing	18%	Compositing	18%
Maya	16%	After Effects	17%
Visual effects	14%	Maya	16%
Photoshop	13%	Visual effects	15%
Rotoscope	13%	Photoshop	12%
After Effects	12%	Digital compositing	11%
Digital compositing	11%	Rotoscope	10%
Post-production	10%	Matte painting	10%
Animation	10%	Post-production	10%

Table 13: BC and LA/Bay Area Skill Comparison for Top In-Demand Jobs - **Rigger**

BC Talent		LA and Bay Area Talent	
Maya	38%	Maya	15%
Animation	33%	Character rigging	13%
Character animation	29%	Character animation	12%
Rigging	28%	Rigging	12%
Character Rigging	28%	Animation	12%
3D modelling	23%	MEL	11%
Visual effects	21%	3D Modelling	10%
Python	20%	Photoshop	10%
MEL	19%	Visual effects	10%
After Effects	16%	Texturing	10%

Table 14: BC and LA/Bay Area Skill Comparison for Top In-Demand Jobs - **CFX Artist**

BC Talent		LA and Bay Area Talent	
Maya	30%	Maya	8%
Animation	14%	Houdini	6%
Photoshop	13%	Animation	5%
Visual effects	12%	Photoshop	5%
After Effects	10%	Character animation	5%
Nuke	10%	After Effects	4%
3D Modelling	9%	Premiere	4%
Rigging	9%	Storyboarding	3%
Houdini	8%	Illustrator	3%
MEL	7%	Rigging	3%

Table 15: BC and LA/Bay Area Skill Comparison for Top In-Demand Jobs - **Pipeline TD**

BC Talent		LA and Bay Area Talent	
Maya	35%	Maya	31%
Python	31%	Python	23%
3D Modelling	23%	Animation	19%
Animation	23%	Visual Effects	19%
C++	19%	Texturing	17%
Rigging	17%	Nuke	17%
Compositing	16%	Character Animation	13%
Lighting	15%	Compositing	12%
Texturing	15%	MEL	12%
MEL	14%	After Effects	11%

SECTION V

INTERNATIONAL TALENT

Image courtesy of Industrial Light & Magic

Why Is International Talent Important for the Creative Technology Sector?

The ability to source international talent quickly and effectively is key for the creative technology sector, especially for industries like animation and VFX, which work on large projects with tight timelines. For these industries, one new project may require onboarding thousands of workers, across specific roles. While the quality of BC talent is strong, the sheer volume required by these businesses to fulfill project needs and continue to expand BC's creative technology footprint necessitates sourcing talent from other supply pools. This is especially true for specific roles in which the volume of talent is in short supply in BC.

> *We need to look internationally as well because there is so much competition for the limited volume of senior talent that is here. We have some really great senior talent here, but there is just not enough of it... Vancouver has a good pool of artistic talent, but roles like rigging, pipeline, character FX... all of that is much harder to find [in the volumes that we need] without international support.*
>
> *– VFX studio interviewee*

Jobs Hard to Source in BC:

Why It is Sometimes Necessary to Open Up Recruitment Channels Beyond BC's Borders

With the volume of talent being insufficient in BC to fill the needs of the creative technology sector, especially during peak production periods, interviewees provided an understanding of which jobs required them to utilize international talent most frequently. There is some similarity between these roles and the overall "most in-demand" roles, suggesting that, once again, the issue of talent gaps in BC is largely about quantity and not quality.

As a result, many interviewees noted that international avenues were almost exclusively used to source senior talent. When it comes to specific jobs, software engineers/programmers were required by all studios. While video game companies stressed the importance of senior-level skilled programmers, animation and VFX studios suggested that this skillset was required at all levels. Notably, interviewees mentioned that there is a high level of competition for this talent in BC across the board—meaning that a good programmer will be in demand within the creative technology sector, the tech sector overall, and increasingly, across the overall economy. The relatively small pool of talent in this field, coupled with a plethora of competitors (including large "bread and butter" tech firms like Microsoft or Amazon) make it difficult for creative technology studios to obtain the volume of talent they need for their businesses.

Image courtesy of Hyper Hippo

Other roles were fairly industry specific, but with significant overlap between animation and VFX studios. For both of these sub-sectors, Pipeline technical directors stood out as the most difficult roles to fill without using international talent. Pipeline development roles are coding-heavy and are viewed as a foundational pillar, among others, of many studios. As one interviewee put it:

> *Pipeline development is specific to developing software for our studios—so our production pipeline. Because all software out of the box doesn't work together, the pipeline team writes code—either custom code to solve internal problems that we have, or to connect all these pieces of software that we use from design and development, all the way to lighting, rendering, and compositing.*
>
> *– Animation studio interviewee*

Because this role is so in demand across all animation and VFX studios, the volume of local talent with skills and experience in this area becomes insufficient to meet industry needs. One interviewee articulated this reality in relation to the Pipeline TD role, noting:

> *The reason we go internationally is because of the demand for numbers (volume), not because the skill set is necessarily readily available elsewhere.*
>
> *– VFX studio interviewee*

Tables 16-18 below represent the roles that studios referenced to be both high in demand and relatively reliant on international talent to fill.

Table 16:
Jobs that BC Firms Must Hire Internationally

Video Games

Occupation	Mentions
Software engineers / programmers (general – at senior level)	10
Technical artists	6
Backend programmers	4
Gameplay programmer	4
Game designer	4
Network Engineer	3
UI programmer	3
Rendering programmers	2
Online programmers	2
Unity programmer	2
Data analyst	2
Environment artist	2
UX programmer	1
VFX Artist	1

Table 17:
Jobs that BC Firms Must Hire Internationally

Animation

Occupation	Mentions
Pipeline TD	8
CG Supervisor	4
Digital animator	4
Digital artist	3
Rigger	3
Producers (senior-level)	2
Software engineers / programmers (general)	2
Compositor	2
Unreal Engine programmer	2
FX artist	1
Animation supervisor	1
Lighter	1

Table 18:
Jobs that BC Firms Must Hire Internationally

VFX

Occupation	Mentions
Pipeline TD	4
Software engineers / programmers (general)	3
FX Artist	3
Creature TD	2
CFX Artist	1
Environment artist	1
Matte painter	1
Producer	1
Compositor	1
VFX supervisor	1

Top Source Countries for Skilled Creative Technology Talent

Although several source countries were mentioned as potential resources for skilled talent, the US was a clear leader, mentioned by more than 60% of interviewees as a top source of talent across the board, and particularly for artistic/creative and digital/technical roles. Others at the top of the list were the United Kingdom, France, India, and Mexico, which were deemed as top locations primarily for creative/artistic talent. This was followed by Brazil, which was regarded as a top destination for artists, and Australia, another jurisdiction with a strong and growing creative technology sector.

A few "up and coming" source countries were mentioned by a handful of interviewees, although for the most part, there was no significant change anticipated in regard to source countries for international talent. The US was expected to expand its talent footprint in Canada, owing largely to Canada's liberal immigration policies, in comparison to increasing protectionism in the US. Brazil and Mexico were also considered as potential growth areas for talent, followed by Germany. In fact, a few interviewees mentioned that Germany was developing some interesting educational programming, which could produce skilled talent in the near future.

Figure 38: Top source countries for international talent (for artistic/creative and digital/technical roles), as identified by interviewees

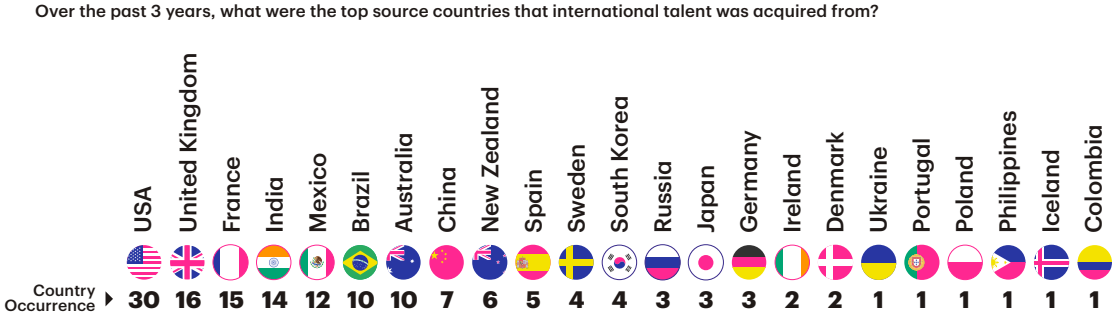
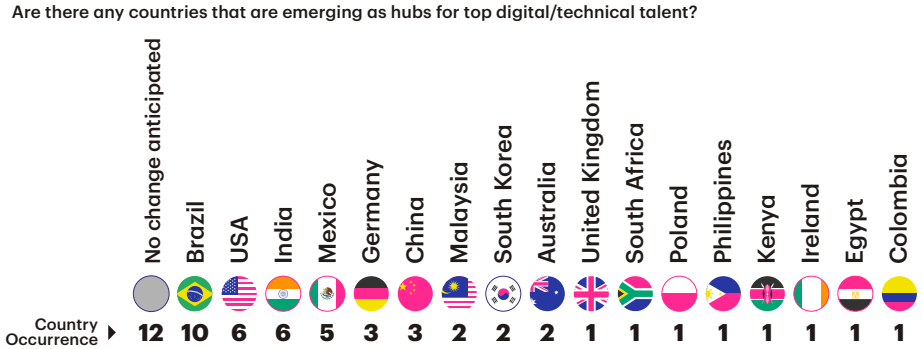


Figure 39: Emerging international hubs for artistic/creative or digital/technical roles, as identified by interviewees



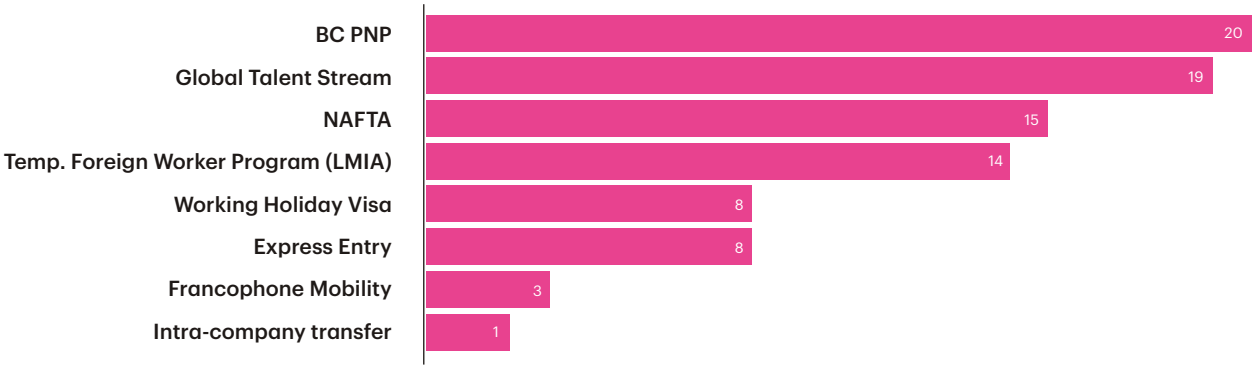
Most Used Immigration Channels

The immigration channels most frequently used by studios to source talent were also the channels that were the most praised. BC Provincial Nominee Program (PNP) was used by nearly half of interviewees who source international talent. This was followed closely by the Global Talent Stream (GTS), which allows studios to source qualified talent for in-demand roles in a matter of weeks. GTS boasts a processing time of two weeks, and interviewees who used the program validated the accuracy of this timeline. On several occasions, interviewees regarded GTS to be effective and efficient, while also containing important caveats that ensures the local BC ecosystem benefits from the international talent as much as possible. For example, GTS requires that plans are developed to ensure that domestic talent can learn from the international talent being sourced—as a result, in many cases, the international talent sourced by GTS was also utilized to train domestic talent (often the more junior levels).

Owing to the importance of the US and Mexico as top source countries, NAFTA was also a popular channel choice, followed by the traditional TFW program. Other streams like the Working Holiday Visa tended to be used on an ad-hoc basis and primarily "only when the opportunity presented itself" (these were not go-to immigration streams for many studios in the creative technology sector).

Image courtesy of Eastside Games

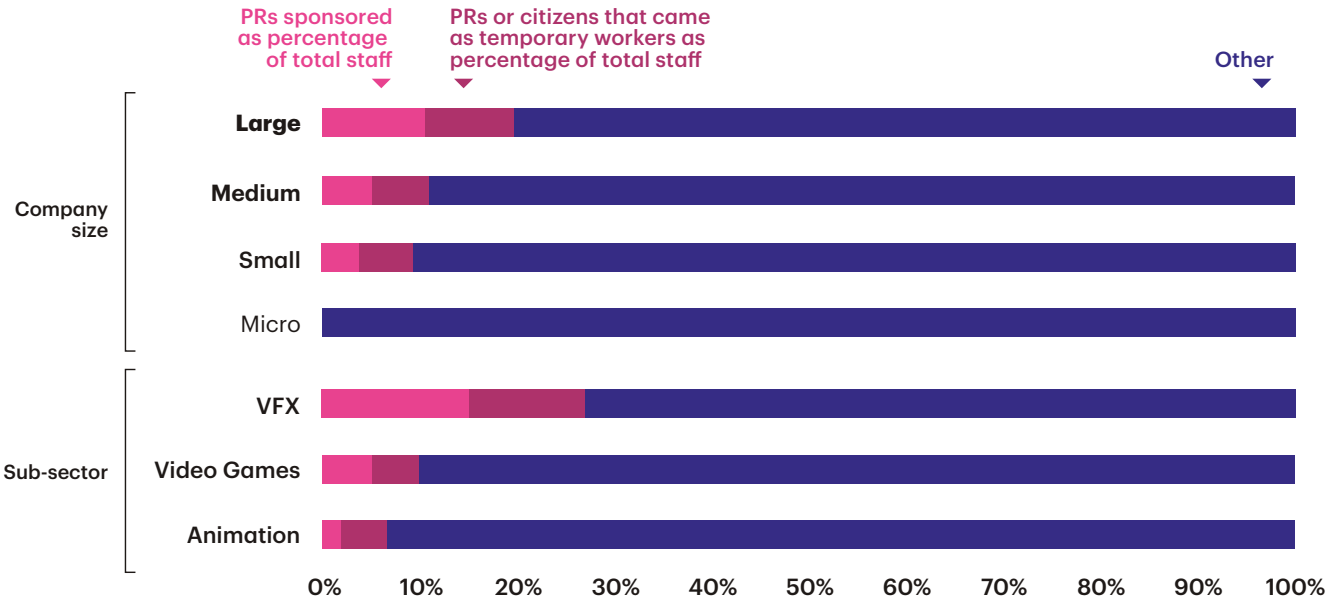
Figure 40: Top immigration channels for sourcing talent, as identified by interviewees



A Strategic Approach to International Hiring

Important to note is that while the creative technology sector relies to some extent on international talent to meet demand, it approaches immigration from a strategic perspective. That is, it does so with the intent of keeping that talent in BC. Although larger studios tended to provide direct sponsorship, most studios that sourced international talent provided some type of support to help their international hires transition from temporary work permits to Permanent Residents.

Figure 41: Permanent residency applications sponsored by industry interviewees in the last 3 years as percent of total current employment, by size and subsector



Quality of International Talent

International talent was assessed in the same way as domestic talent was assessed so as to provide a holistic perspective on the BC talent shortage in the context of quantity versus quality and to understand any important nuances.

The findings affirm that the talent shortage in BC is one related to the quantity, not quality. Little difference was found between the overall quality of talent for in-demand roles in BC versus internationally. Perceptions of junior and mid-level talent were nearly identical (however, very few studios sourced junior talent internationally), with only senior international talent ranking slightly higher than senior talent from BC. However, once again, the reasons for ranking senior international talent closer to "excellent" than BC talent was almost exclusively related to the bigger talent pool. As one interviewee from the video game sub-sector put it:

> *We only look outside of the province or country if we cannot find talent locally. This usually leads to strong results, as it is a more targeted search and the talent pool is larger.*

Where the quality of talent was mentioned as a differentiator (less than 10% of the time), the reasoning was often related to the level of maturity of certain jurisdictions that have been experiencing a "boom" in the creative technology sector for longer than BC.

One interviewee from the animation sub-sector highlighted this reality, stating:

> *In America and Europe, there are some very strong (public) schools that produce great talent that is really in line with what we're looking for. France, Germany, and the UK are great sources of talent from Europe. I think that's because the industry has been around so much longer there.... Canada saw its boom sort of recently. So, for now, I would say that the quality of talent is stronger coming from international than local sources... but we [BC] are getting there. Domestic talent has improved in the last five years.*

Moreover, the heightened need to hire senior talent (at higher volumes than junior talent) is worth mentioning as a specific nuance related to BC. Across the board, the demand for senior-level talent was evident, with many interviewees noting that this consistent demand for seasoned talent was simply a reality of the sector in BC. In part due to limited tax credits (compared to other jurisdictions) and in part due to the maturity of the sector (i.e., BC's creative technology sector is more mature than that of Quebec's), many BC studios bid on large or complex projects (such as feature films).

What this means is that on a given project, there will be limited opportunities for junior talent to take on—in some cases due to budget and time constraints, in other cases because of the complexity of the project—a reality that creates some challenges for simply relying on junior talent to eventually fill the quantity of senior roles required. Continued support—ranging from educational programming to incentives for IP development and commercialization (along with investment attraction)—is critical to ensure that BC's creative technology sector can compete internationally, grow its talent base, offer career progression opportunities for junior talent, and become a global leader in the space.

Figure 42: Quality Ratings of International Talent, as provided by interviewees

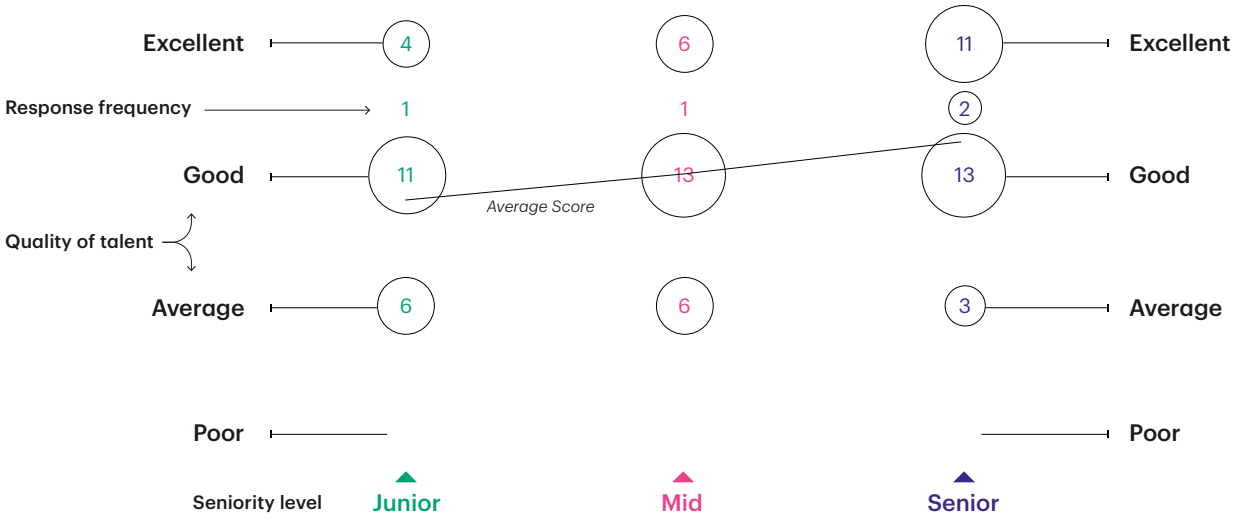
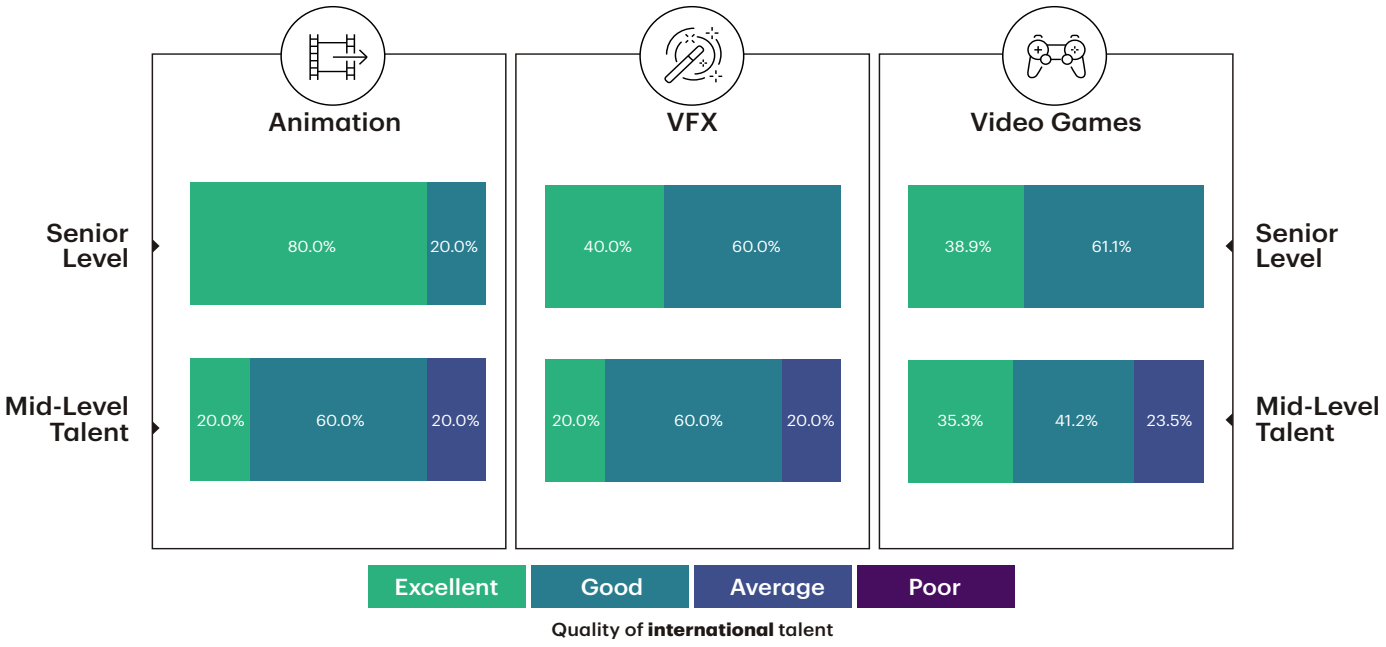
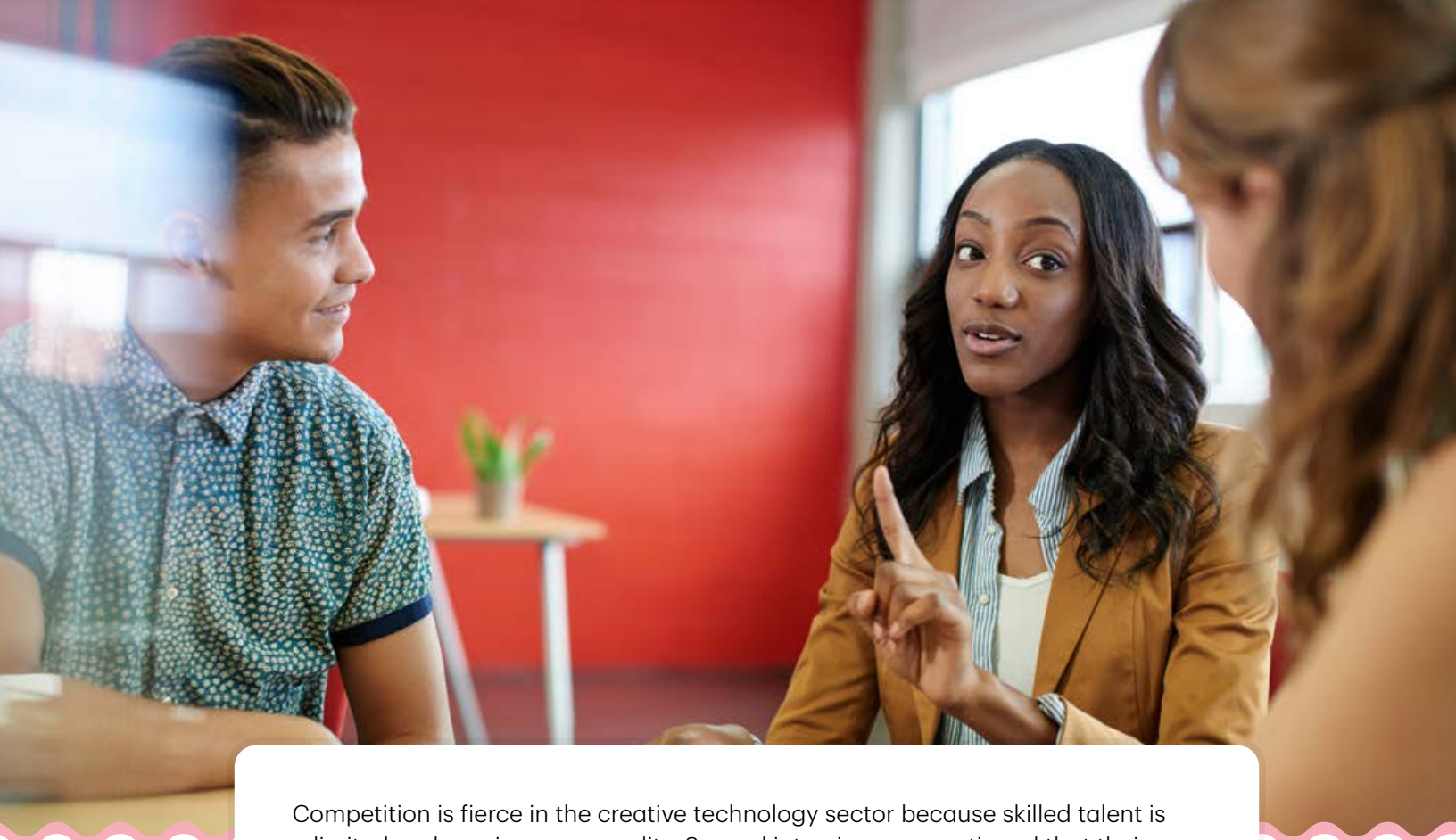


Figure 43: Quality Ratings of International Talent, as provided by interviewees, by sub-sector



SECTION VI

RECRUITMENT AND RETENTION



Competition is fierce in the creative technology sector because skilled talent is a limited and precious commodity. Several interviewees mentioned that their staff are regularly contacted by recruiters through LinkedIn and other means. One interviewee from the video game sub-sector expressed frustration, relaying a perception that *"LinkedIn is designed as a poaching machine."* Another interviewee from the animation sub-sector highlighted this by stating, *"We assume everyone has another offer at all times."*

Once again, this reflects the challenge of talent quantity in BC, where recruitment and retention are key areas of focus for many studios.

Barriers to Recruitment

Beyond simply the insufficient volume of talent, the most significant sector challenge is competition for talent. The majority of interviewees ranked this as either a "barrier" or a "big barrier." Competition for talent was also seen across the board between BC-based companies and wider Canadian-based and international companies. Competition with the growing Canadian creative technology hub in Montreal was highlighted by approximately half of interviewees. Montreal is seen as an increasingly attractive destination for skilled talent due to several factors, including the increased presence of interesting work (Montreal is attracting more studios and projects, partly due to its competitive tax credits), the variety of work that allows the introduction of higher volumes of junior talent into the pipeline, and an attractive cost of living. International jurisdictions that add to the competition-for-talent challenge are primarily in the US (Bay Area, Los Angeles, and Seattle), followed by Australia and the UK.

Other significant barriers included the high cost of living in BC, which can act as a deterrent to talent, particularly when compared to more affordable jurisdictions like Montreal; the shortage of skilled senior-level talent (volume); and challenges in sourcing international talent. On the high cost of living in Vancouver, several focus group participants from regions outside of the main creative technology hubs in BC felt that this is something that may play to their advantage. That is, although the high cost of living may not compel studios to leave Vancouver, many focus group participants felt that this reality—coupled with COVID-19 inspired exodus from city centres—could be key to attracting skilled talent who can work remotely to their areas. On the latter, the challenges associated with international talent were more related to high wages associated with that talent, as well as the scarcity of opportunities for absorbing internationally trained junior talent in BC.

As one interviewee from a VFX studio noted:

> *We have an inability to convert someone from an international student to an employee for a period of time that is reasonable. It seems crazy that we would bring people to attend a local school and facilitate them in the work environment, only to have them disappear in a year's time. What we want is someone to go from school, to work where they can be QC'd in the local environment—maybe they won't be able to survive in the industry, but if someone wants to keep employing them, we should let them. It's crazy that those people are lost to other parts of the world, having gone through paying for tuition here and getting their first job here. This is bonkers. We should retain as much talent as can be retained by the local companies.*

Figure 44: Quality barriers for sourcing talent in BC, as identified by interviewees

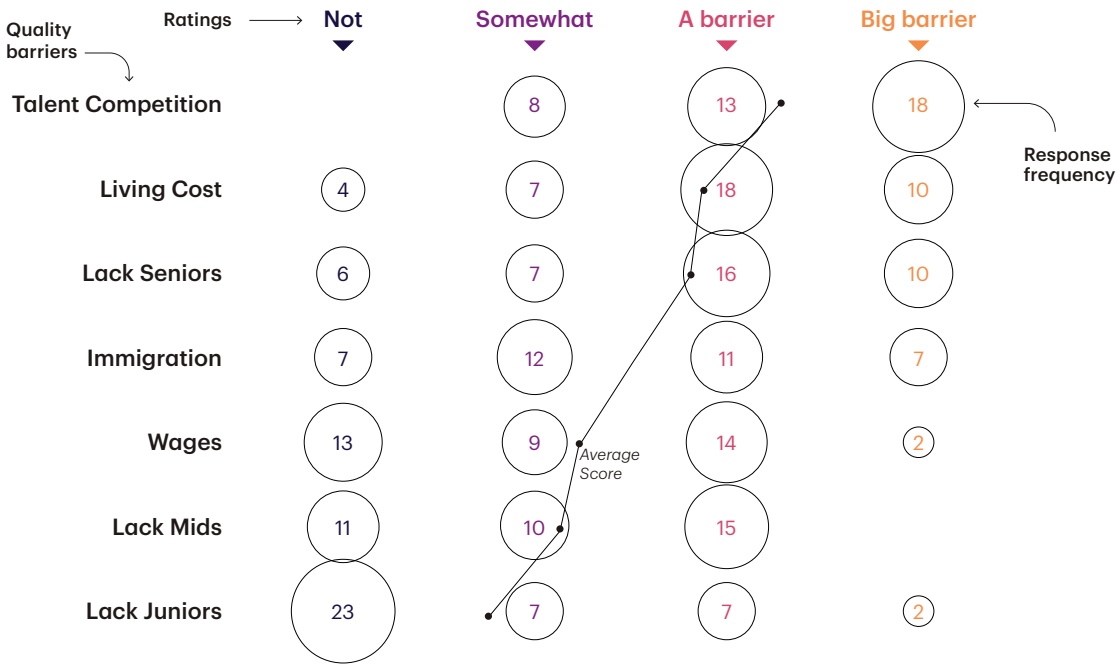


Figure 45: Barriers to recruitment, as identified by interviewees, by sub-sector

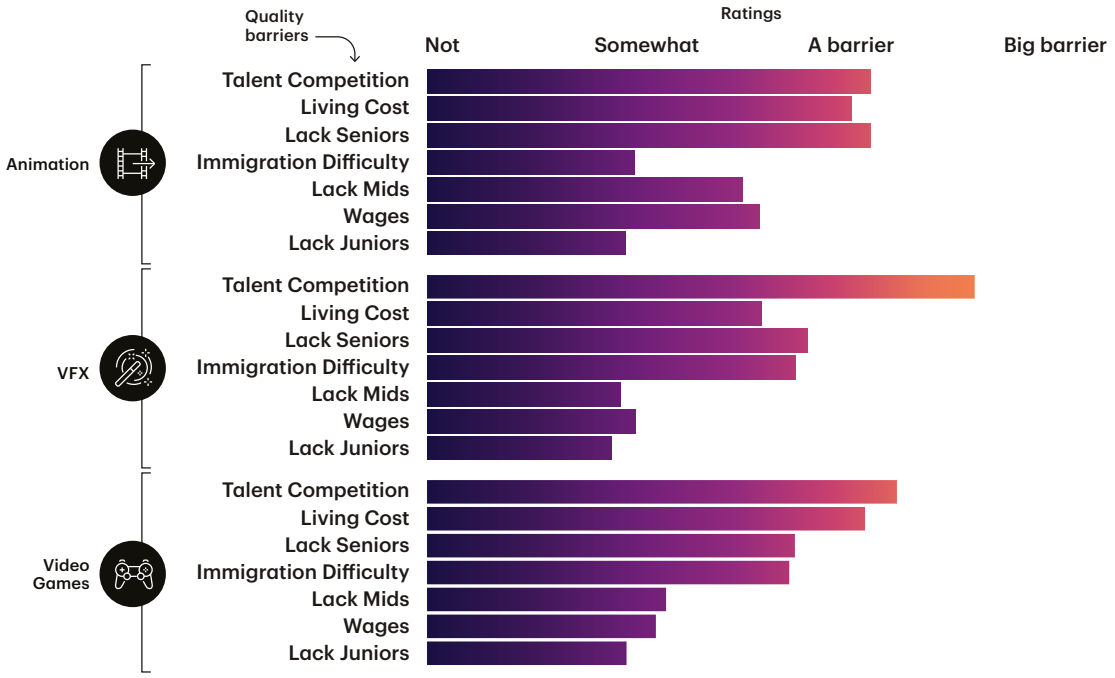
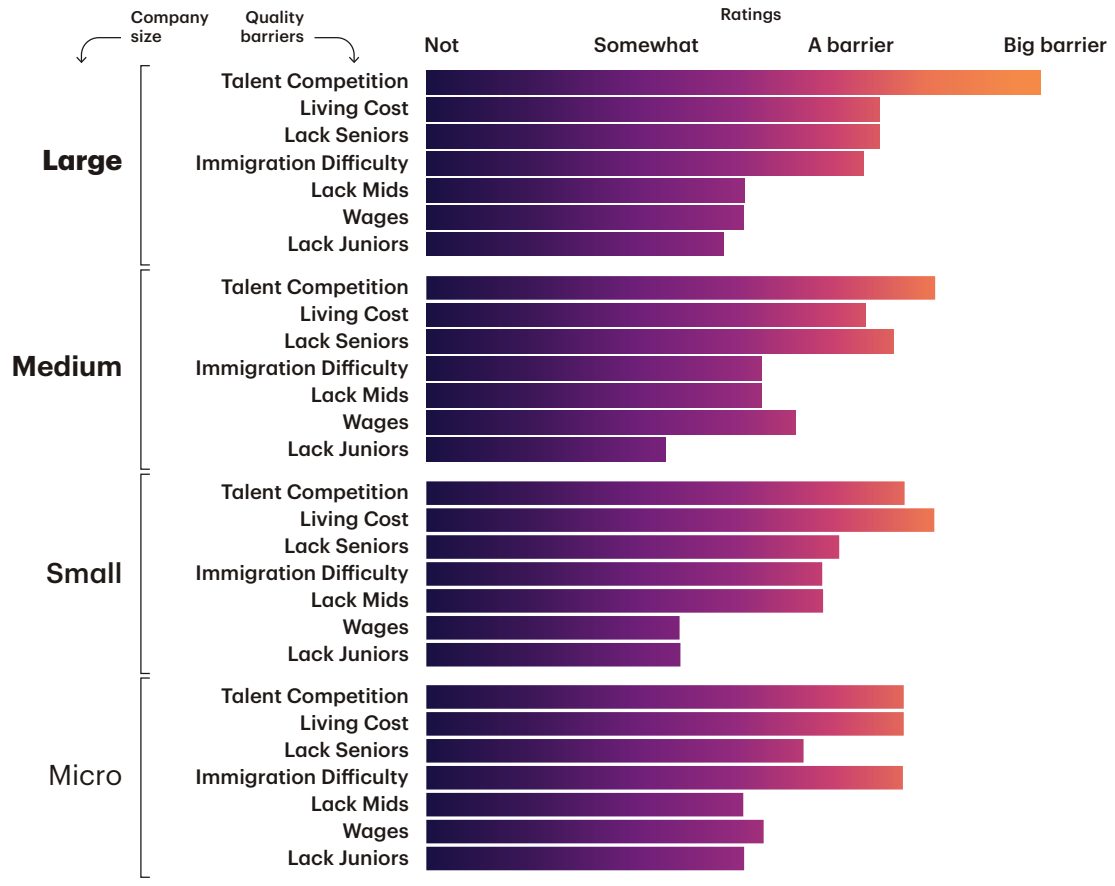


Figure 46: Barriers to recruitment, average by size



Biggest Retention Challenges

On the other end of the spectrum is retention, where a different mix of barriers were noted. Interestingly, while high wages did not make the list of top recruitment barriers, wages were distinctively noted as a top barrier to retention—and primarily by video game companies. This goes back to the notion of "everyone having another offer at all times." With experienced talent in high demand, it is likely and understandable that salary offers from competing studios increase over time. As a result, the more in-demand someone is, the more robust the wage competition there is for them. In some cases, this can result in "bidding wars" for top talent. This is further amplified for roles like software engineers/programmers, which are in high demand not only in the creative technology sector, but in the overall tech sector and broader economy, both in Canada and internationally.

Although the cost of living was also identified as a retention barrier, others include sector-specific realities relating to project cycles (and thereby often short-duration contracts), the nature of the work in the sector (i.e., periods of high volume, tight deadlines, overtime), or simply the desire for new projects or a change of scenery.

Figure 47: Biggest retention challenges as identified by interviewees, by sub-sector

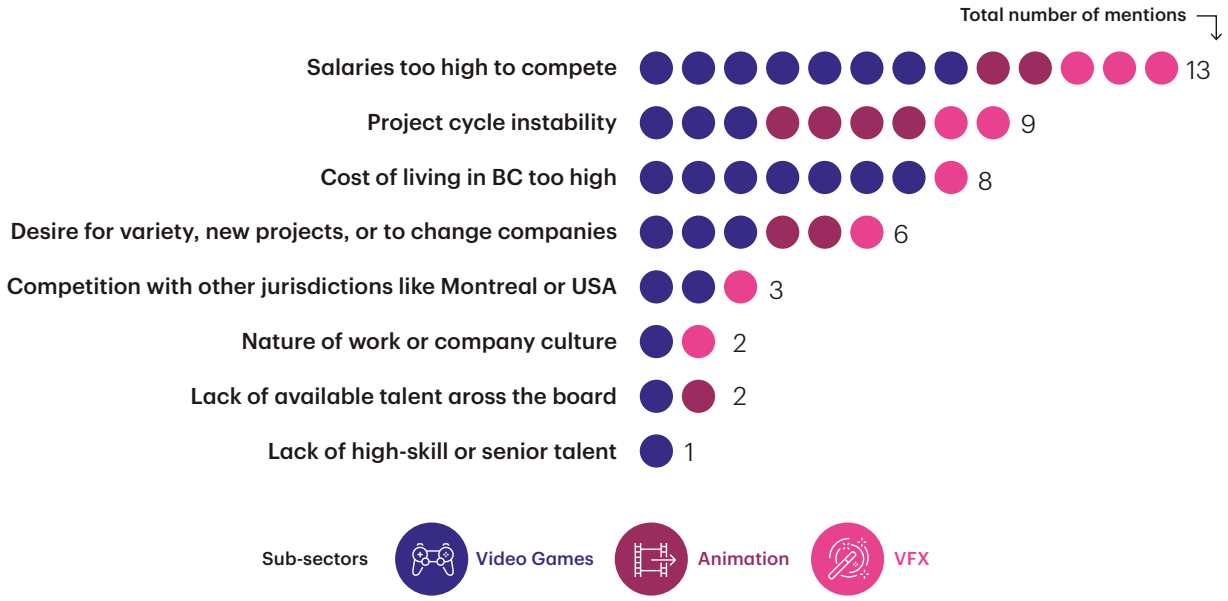


Figure 48: Biggest retention challenges as identified by interviewees, by sub-sector

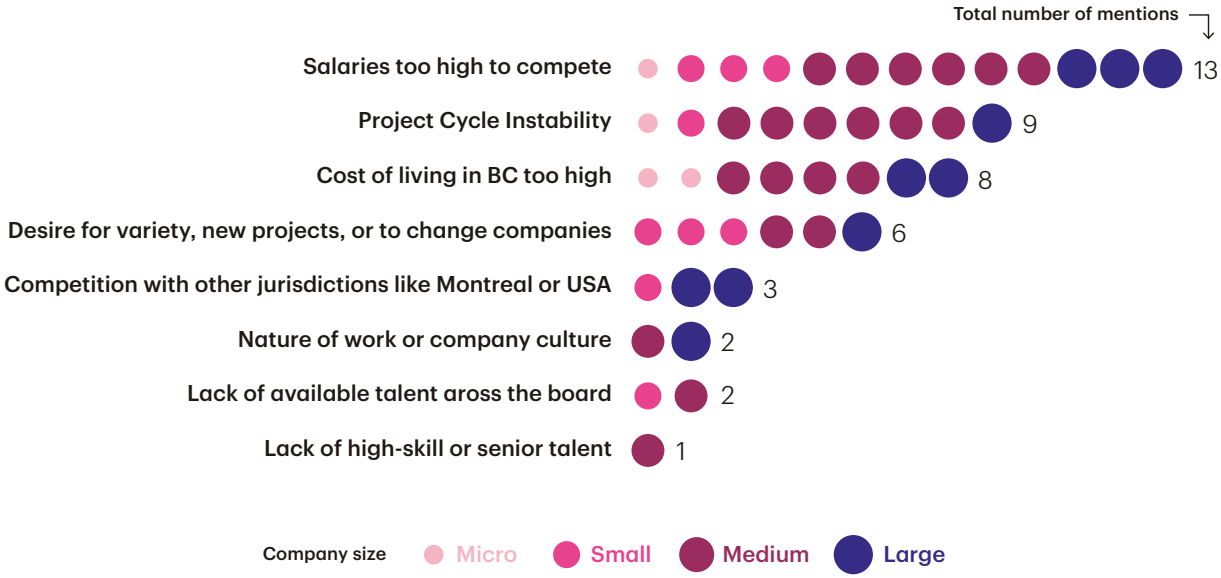


Image courtesy of Okanagan College

A Regenerating Ecosystem:
Talent Absorption in the Creative Technology Sector

The demand for talent coupled with the fast-paced nature of the industry creates a reality where talent reabsorption is not only easy but encouraged. Although industries like animation and VFX tend to operate with a large portion of workers on temporary contracts, all (100%) of interviewees remarked that it was either "very easy" or "relatively easy" for talent whose contracts were ending to find other opportunities in BC's creative technology ecosystem. The only nuance to this was that some jobs have very specific skills for which the volume of domestic talent is lacking (for example, Riggers or Pipeline TD) and may be picked up quicker than occupations like animators, for which the talent pool in BC is larger.

The tight and competitive labour market for creative technology talent in BC ensures that skilled talent will not face challenges finding work, despite the temporary contract-based nature of the industry. Some interviewees noted that COVID-19 has created a longer period of downtime versus previous years, but the broad consensus was still that skilled talent had plenty of opportunities. As one interviewee from an animation company noted, *"They (talent whose contracts are ending) won't be jobless. If they're jobless, their reputation is probably not great."*

SECTION VII

BUILDING TALENT AND SECURING THE PIPELINE:

CREATIVE TECHNOLOGY EDUCATION IN BC

"StarBeam" property of Netflix, created and produced by Kickstart Entertainment

Top Post-secondary Institutions for Creative Technology Talent

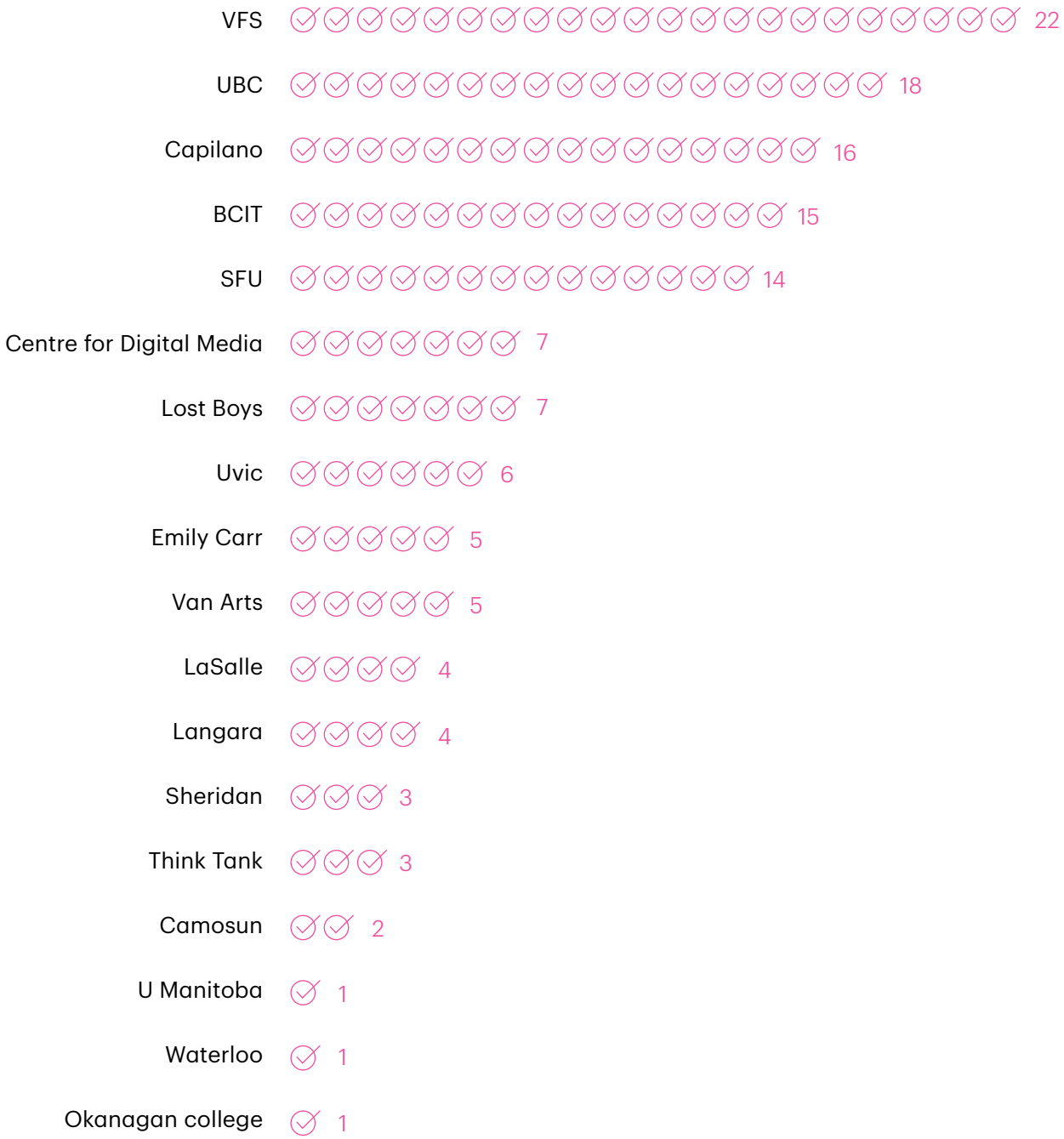
British Columbia's creative technology sector draws graduates from a wide range of post-secondary institutions both inside and outside the province. Interviewees provided insights regarding top educational institutions that they use to source talent for junior-level roles.

The top five schools for hiring junior talent include Vancouver Film School (VFS), the University of British Columbia (UBC), Capilano University, the BC Institute of Technology, and Simon Fraser University. Interviewees also mentioned small private institutions like Lost Boys, Van Arts, and Think Tank, colleges like Langara, LaSalle, and Sheridan, and art institutions like the Centre for Digital Media, Van Arts, and Emily Carr.

One key distinction among post-secondary institutions was in relation to training roles. Private schools like VFS, Lost Boys, and Think Tank were regarded as particularly strong in the development of artistic/creative, as well as production talent that is needed primarily for the animation and VFX sub-sectors. Public schools, such as UBC, BCIT and SFU, were well-regarded for developing skilled talent for software engineering/programming roles needed across all company types. For more information on the volume of post-secondary institutions offering key artistic/creative and digital/technical training, please see Appendix IV.

Image courtesy of Vancouver Film School

Figure 49: Top educational institutions for hiring juniors, as identified by industry interviewees



Educational Programs Most in Demand

The specific post-secondary programs deemed to be most "in demand" were categorized according to the four occupational areas: artistic/creative, digital/technical, production, and design. The top post-secondary programs in BC include the following:

Table 19: Top post-secondary programs in BC for the creative technology sector, as identified by industry interviewees

School	Program
Vancouver Film School	3D Animation and Visual Effects Game Design Programming for Games, Web and Mobile Sound Design for Visual Media VR/AR Design and Development Writing for Games, Film and Television Classical Animation
Lost Boys School of Visual Effects	Advanced Visual Effects Compositing Digital Lighting Artist Effects Technical Director
Centre for Digital Media	Master of Digital Media
Langara	Advanced Game Design 2D Animation and Visual Art 3D Animation for Game, Film, and Visual Effects
LaSalle College	Game Design and VFX
Okanagan College	Diploma in Digital Animation
Capilano University	3D Animation and Visual Development Diploma 3D Animation for Film and Games Diploma Animation Fundamentals Citation Digital Visual Effects Diploma
BCIT	Computer Systems Technology 3D Modelling, Art and Animation
Vancouver Community College	Graphic Design Diploma
Simon Fraser University	Bachelor of Computer Science
University of British Columbia	Bachelor of Computer Science
Emily Carr University	BA of Media Arts

Applications and Enrolment

Representing 10 post-secondary institutions[114] and 24 programs in BC, post-secondary interviewees asserted a noticeable growth in applications for creative technology programs over the previous two to three years. This suggests a growing interest in the field of creative technology among domestic students, a reality that is further supported by the establishment of new programs. In 2019, Boston-based Northeastern University opened a Vancouver campus, offering programs in computer science. Other institutions like BCIT and Capilano University are revisiting their curricula to ensure that their programs meet the needs of industry.

One interviewee stated that application interest recently declined due to COVID-19 (and the subsequent move to online education) but, overall, student interest for these programs still exceeds available seats. Over the past few three years, student applications for creative technology programs were two to 10 times higher than admissions.

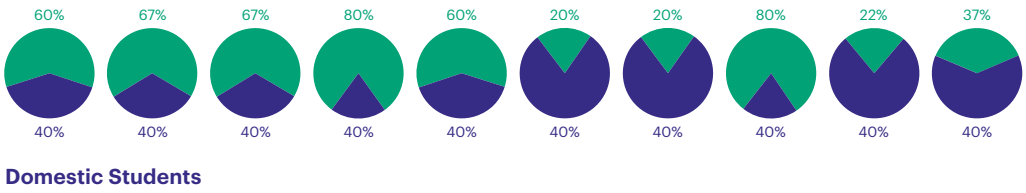
On average, institutions noted a capacity for approximately 65 students per program, with some of the smaller, boutique institutions having as few as 10 students per area of study. Two institutions noted a capacity of near 200 students, and two large programs have capacity of 1,000 students across multiple relevant programs.

114 *Lost Boys School of VFX, Capilano University, Langara College, Vancouver Film School, Northeastern University, Okanagan College, Centre for Digital Media, LaSalle College, British Columbia Institute of Technology (BCIT), Vancouver Island University*

Student Demographics

Most post-secondary institutions had a mixture of domestic and international students, but this was rarely an even split. Private institutions all had more international students (sometimes totalling nearly 80% of all students), while public institutions tended to have more domestic students. According to interviewees, this split has remained largely unchanged over the years.

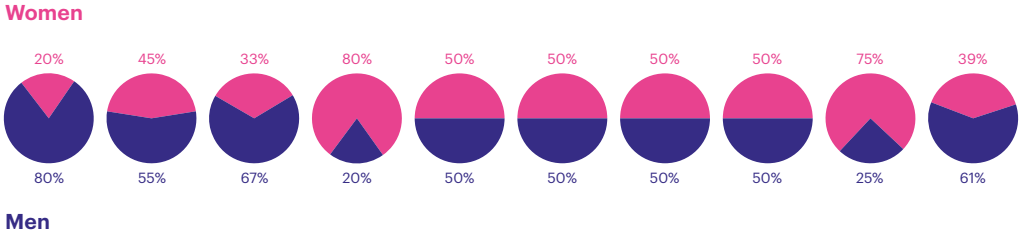
Figure 50: Enrolment in top programs: domestic vs. international students at post-secondary interviewees' institutions (10 total)



Gender Breakdown

There are positive signs that women are increasingly looking to enter creative technology roles. Most programs have seen increased numbers of female participation, with just over a third of institutions having a roughly balanced program. Approximately 21% of institutions indicated that they were predominantly male, and surprisingly, 14% noted that they were predominantly female.

Figure 51: Enrolment in top programs: gender representation at post-secondary interviewees' institutions (10 total)



Indigenous Students

Similar to the responses gained from consultations with industry representatives, most (three-quarters) of post-secondary institutions were largely unaware of self-identified Indigenous students in creative technology (or any) programs. Approximately a third of institutions reported that there were none (or "roughly one to two Indigenous students") in these programs. As a result, the representation of Indigenous students among these post-secondary institutions and programs is largely unknown.

Students with Disabilities

The participation of students with disabilities is another area that was not closely monitored by post-secondary institutions. However here, institutions were able to approximate the overall levels of representation by considering self-declarations or students who have requested specific learning accommodations (including assistive technology).

Some interviewees noted that there appears to be increasing numbers of declarations and requests for learning accommodations for a range of issues such as anxiety or autism spectrum disorder. Still, the majority of interviewees (60%) believed that their programs had no students with disabilities while another 20% believed that the representation of students with disabilities was around 5-6%. Some 20% of interviewees suggested that, according to their records, approximately 10% of students had self-reported a disability.

Diversity and Inclusion at Educational Institutions

BC's post-secondary institutions are committed to incorporating diversity and inclusion at all levels, from admissions all the way to curriculum development and programming. In this study, 70% of BC's creative technology training institutions cited some level of engagement (whether formal or informal) to encourage increased participation from underrepresented groups. These efforts included the following:

- Formal relationships with organizations dedicated to diversity, such as Women in Animation[115]
- Scholarships for Women in Tech[116] and Indigenous groups[117]
- Projects and collaborations with First Nations organizations, recruiters, and job fairs
- Outreach with high schools that have significant numbers of visible minorities, newcomers, or students with socioeconomic challenges
- Recruitment at alternative high schools

While some institutions and individual programs are predominantly male, others are gender balanced, and some are predominantly female. In the future, it may be easier to determine which way this is trending as these programs grow and there is a larger baseline of student demographics to learn from. Nonetheless, it appears promising that the difference in gender participation for students is smaller than the current creative technology workplace. Coupled with concerted efforts to directly engage with students from other underrepresented groups, this points to a future creative technology sector that reflects higher levels of diversity and inclusivity.

115 *Craig Takeuchi, "Women in Animation to launch Vancouver chapter in 2018 to achieve gender parity by 2025," Georgia Straight, November 3, 2017, https://www.straight.com/movies/990661/women-animation-launch-vancouver-chapter-2018-achieve-gender-parity-2025*

116 *"Vancouver Women in Tech," https://vanwit.ca/*

117 *"Vancouver Film School recruiting more Indigenous actors," Global News, March 4, 2018, https://globalnews.ca/video/4061962/vancouver-film-school-recruiting-more-indigenous-actors*

SECTION VIII

THE FUTURE TALENT PIPELINE:

DEVELOPING SKILLED JUNIORS

Program Outcomes

Completion (or student graduation) rates for programs related to the creative technology sector are typically high. According to post-secondary interviewees, completion rates are 80% and above.

- 2 schools stated almost 99% of students complete their studies
- 3 schools stated 90-95% of students complete their studies
- 2 schools stated 85-90% of students complete their studies
- 1 school stated approximately 80% of students complete their studies
- 2 schools did not have graduation data available at the time of interview

While some institutions believed that the challenging nature of the programs themselves means that some attrition should be expected, others indicated that students should receive support to ensure that they are able to complete their studies (given they passed the pre-requisite screening in the first place).

Student Outcomes

Popular culture has popularized the notion that tech labour markets are so tight that students are recruited while still in high school.[118] However, according to interviewees in BC's post-secondary institutions, this is not a frequent reality. The practice of recruiting students prior to completing their studies was typically considered very rare or insignificant, given how infrequently it occurs.

Determining an accurate account of student employment outcomes after graduation is challenging. Some interviewees noted that their programs were too new to have sufficient historical data, while others emphasized the fact that it is very difficult to track students after they graduate. This means that only intermittent snapshots of future employment statistics are available, and only if institutions happen to hear when a student is hired, or if students respond to employment surveys after they graduate. The contract-based nature of some sub-sectors in the creative technology sector (notably, animation, and VFX) further complicates tracking student employment as does the fact that many international students return to their home countries after graduation.

For the institutions that did have relevant in-house data (i.e., data gathered from their programs) on student outcomes, the results were highly varied, ranging from near total employment within a few months to approximately 50% of the class being employed several months later.

> One institution proudly noted that 97-98% of their graduates found employment in relevant fields (often within three months of graduation)

> Two institutions stated that roughly 50% of students were employed six to seven months after graduating

> Another program head stated that nine months after graduation, approximately 50% of graduates from video game-related programs found employment

> One institution said that roughly 60% of their students eventually found relevant employment in the industry, approximately four months after graduating

Overall, student outcomes tended to be higher for students graduating from software engineering programs, although this was primarily because their skillsets are deemed in demand across a variety of sector verticals. The high reliance of the creative technology sector on mid and senior-level talent can create notable challenges for junior talent looking to break into the industry and gain the experience they need to progress in their careers. Therefore, incentives that help studios dedicate time and resources for hiring and training junior-level talent could ensure that new graduates are absorbed, which would aid sector growth.

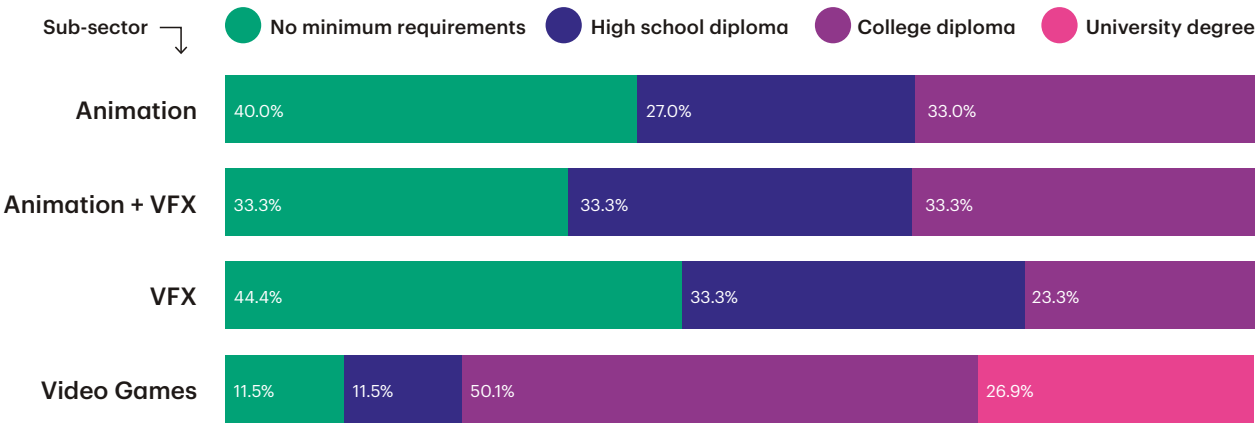
118 *Tess Taylor, "Building strong pipelines may start with high school recruiting," HR Drive, February 16, 2017, https://www.hrdive.com/news/building-strong-pipelines-may-start-with-high-school-recruiting/436280/*

Minimum Education Requirements

The quickly moving and often informal nature of the creative technology sector means that many companies did not have formal minimum education *requirements*. Many interviewees stated that—for domestic or international talent—in theory, it did not matter if employees had graduated from education institutions or were self-trained if they had the passion, work ethic, or proven ability to deliver results. This is particularly relevant for some of the artistic/creative roles, where self-taught employees were more commonly seen and more accepted, and the quality of their portfolios was the biggest deciding factor. By comparison, digital roles often did require at least a college diploma. Over 30% of studios noted that they did not have any minimum levels of education in place for new hires, however this also varied according to sub-sector. For example, only roughly 11% of video game studios noted having no minimum education requirements, compared to 44% of VFX studios. VFX is an interesting microcosm in regard to formal educational requirements. Because this is a relatively "new" and highly specialized field, formal educational pathways tend to be limited, namely for current-day senior talent that joined the industry decades ago. As a result, for VFX in particular, formal education was seen as less important in comparison to a candidate's previous experience and a demo reel.

Although there are rarely explicit formal education requirements, employees with no formal education are rare in practice. Interviewees noted that workers in the most in-demand roles often had a post-secondary education, with the majority having at least a college diploma. When it came to internationally sourced professionals, almost all possessed a post-secondary degree. This distinction is a reflection of immigration requirements,[119] rather than an employer-driven preference. Due to While relevant education or certifications vary depending on the specific role, examples of the degrees or diplomas deemed relevant to the sector include: fine art degrees, computer science degrees, video game design diplomas, 3D animation diplomas, 2D and digital art diplomas, visual effects diplomas and certificates, digital design diplomas, graphic design diplomas, and UX design diplomas, and in some cases, diplomas in film & television.

Figure 52: Minimum levels of education as described by industry interviewees, by sub-sector



119 *Most immigration streams for highly skilled professionals require that the applicant possess post-secondary education.*

Work-Integrated Learning

Work-integrated learning (WIL) encompasses a variety of practices and techniques designed to provide students with experiential learning throughout their studies. This can take the shape of co-ops, internships, apprenticeships, capstone projects, or even more informal mechanisms such as groupwork designed to solve real-life business problems. The idea behind work-integrated learning is to provide students with the ability to apply their learned skills and gain important "life skills" prior to fully entering the workforce. At the same time, businesses that take on WIL students gain access to skilled youth who can help them achieve their business goals.

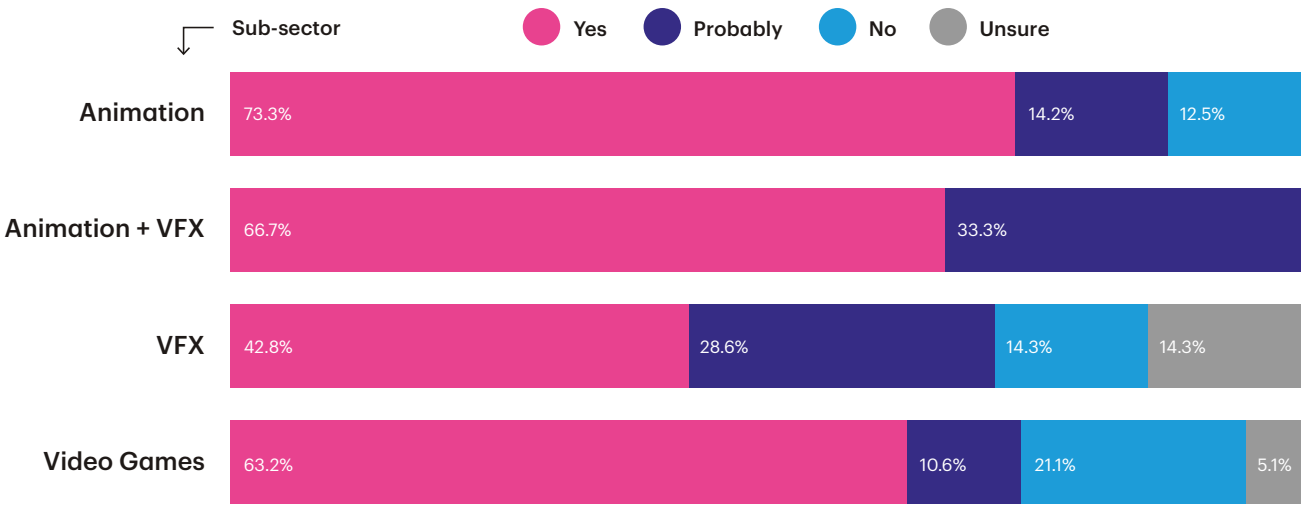
Importance of WIL

Both post-secondary institutions and employers in this study suggested that WIL students, relative to their non-WIL peers, demonstrated a higher competency level when entering the workforce. Students with WIL experience are seen as having "real world experience," a better understanding of workplace professionalism, better etiquette and understanding of the importance of project timelines, and greater confidence. Most of the studios interviewed also felt that WIL students have a "leg-up" in the workforce, stating that the more WIL experience they had during their studies, the more successful they would be upon fully entering the workforce. Nearly 95% of studios found WIL programs to be important. As one interviewee from an animation studio put it:

> *With WIL programs, they get to work in groups, to learn how the industry works, to experience the reality of it all.... Students will only benefit from experiences like this, even if they're struggling.*

Figure 53: Perceptions of WIL, according to industry interviewees, by sub-sector

Question asked: "Are grads with WIL experience more likely to be successful candidates for junior roles? (vs. those without WIL experience)"



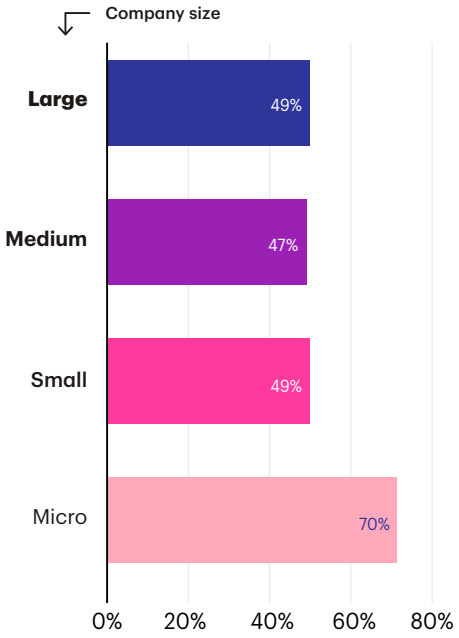
Frequency of WIL and Minimum Requirements for WIL Students

As a result of the perceived importance of WIL programs, it is no surprise that the majority (nearly 90%) of studios currently hire or have hired co-ops or interns. The studios that did not hire WIL students often made it clear that this was not for lack of desire; these interviewees, often with small studios, simply did not have the capacity to dedicate the necessary resources required to effectively supervise, train, and support the students.

Figure 54: Frequency of WIL hiring, according to industry interviewees

Question asked: "Does your studio hire students under a work-integrated learning (WIL) regime (e.g., co-ops, internships, etc.)"

Figure 55: Conversion of WIL students into full-time hires, according to industry interviewees, by company size



WIL Characteristics of Success and Conversion Rates

Although a general understanding of the industry and relevant course work was expected by studios that hire WIL students, many interviewees highlighted that WIL students who were most successful were often those with stronger "soft skills." Interviewees felt that the strongest WIL students were the ones that were able to display passion for the industry and their work, strong communication skills, agility and the ability to adapt to changing circumstances, a strong learning attitude, professionalism, and an openness to feedback.

Moreover, many studios expressed that they looked at WIL placements as an opportunity to vet potential hires and build their pipeline of talent. In short, the intention of WIL placements (for students in their final year) was usually to eventually convert the participants into employees. On average, studios reported a "conversion rate" (from WIL student to full-time hire) of approximately 50%.

Other Best Practices for Enhancing Education and Employability of Students

Leveraging insights gained from interviews with post-secondary interviewees, as well as secondary research on generally successful initiatives related to creative tech programs, a few best practices—both in Canada and abroad—stood out as key to developing skilled junior talent in the creative technology sector, beyond the use of work integrated learning mechanisms.

Although the primary avenue of junior talent development in tech-related fields more broadly is post-secondary education institutions, it is also worth considering the role of industry in bolstering the post-secondary supply pipeline. Best practices range from accessibility, to analytics, to program design, but all involve a clear focus on tangible outcomes in terms of the skill development, employability, and experiences of students.

Use of Analytics

Some training institutions have begun to make use of student data to measure their success and career outcomes, allowing them to improve their curriculum and develop more skilled junior talent. As the use of analytics, monitoring and evaluation, and data has become widespread in the business world, training institutions are beginning to follow suit. For example, by using predictive analytics to "improve enrollment practices, identify at-risk and struggling students, and streamline advising,"[120] Georgia State University "raised its six-year graduation rate from 32% in 2003 to more than 54% in 2017."[121]

Focus on Applied Skills and Employability

The success of bootcamp-style coding programs (such as Lighthouse Labs) has perhaps inspired a more direct focus on teaching applied skills in many disciplines. Post-secondary interviewees spoke of classroom projects that are modeled on how studios work, or that follow typical project pipelines, to help teach students project cycles and structures. They also aim to provide students with coursework that relates directly to the sorts of projects that they would perform in a job. Capstone projects, whereby students work on an applied group with an industry partner, are another method through which students are able to develop both soft skills associated with groupwork, and the hard skills required in the field. In all of these efforts, the objective is to bridge learning with the applied skills necessary to transform a student into a junior employee.

Beyond coursework that is designed to be as applied as possible, institutions may offer more general training related to job readiness, such as career development courses, career counselling, and job skills courses, all of which were brought up by post-secondary interviewees. One post-secondary interviewee noted that their program offers training on Canadian workplace standards and culture, for international students.

120 *"What a predictive analytics experiment taught 11 colleges about sharing data," Education Dive, 2019 https://www.educationdive.com/news/what-a-predictive-analytics-experiment-taught-11-colleges-about-sharing-dat/552986/*

121 *"Universities tap into predictive analytics to improve student outcomes," Study International, 2019, https://www.studyinternational.com/news/predictive-analytics-student-outcomes/*

Some academic programs offer multiple concentrations or areas of focus, allowing students to later work in more than one field, even if their course of study is relatively specialized. This may range from programs that offer degrees in both 2D and 3D animation, to degrees that cover a range of creative technology topics. An example of the latter is the University of Colorado Boulder's Bachelor's Degree in Creative Technology & Design, which offers specialized courses as part of a generalist creative technology degree.[122]

Enhancing Accessibility

When training institutions make their services more accessible, they expand the pool of talent that they develop, and thereby the pool of talent that industry can access. Most institutions interviewed noted that they actively try to engage with students from underrepresented groups. Engagement with such students is only a first step, however, institutions have many opportunities to ensure the success of underrepresented groups. Institutions do so by limiting program and associated costs where possible, and providing needs-based scholarships, thus providing opportunities for all students to focus on education and career skills rather than on paying for their education. This also helps to improve completion rates and speed. Similarly, institutions may look to simplify degree pathways and manage course offerings to avoid delayed graduation or incomplete degrees.[123] Institutions may also make their offerings more accessible by providing bridging programs, boot camps, and evening courses.[124]

Maintaining Industry Relevance and Connections

One necessary component for job readiness—particularly in rapidly evolving fields such as creative technology—is that students' skills are up-to-date with the latest industry standards. Educational institutions interviewed in this study noted a need to ensure that their programs were able to teach basic principles but were also adaptable enough to be altered when industry changes necessitated it. This sort of industry relevance involves teaching the most current types of creative software, hardware, and even project management and task tracking software used by industry.

A second, related effort is to connect students directly with industry. This is sometimes done by providing students with industry mentors. It can also entail having guest lectures from industry practitioners, or even by having industry practitioners as faculty members, involved in faculty, or assisting with curriculum design, all of which were noted by post-secondary interviewees.

Some institutions co-ordinate networking opportunities and events to allow students and employers to connect. Some training institutions even establish direct hiring connections with employers, so that students who finish their degree are directly considered for roles with said employer, immediately after the completion of their degree. Similarly, some institutions focus extensively on providing and maintaining strong alumni networks to support student career development.

122 *"Undergraduate Programs: Bachelor's Degree and Minor in Creative Technology & Design", Atlas Institute, University of Colorado Boulder, https://www.colorado.edu/atlas/academics/undergraduate*

123 *Steven Mintz, "Strategies for Improving Student Success", Inside Higher Ed, 2019, https://www.insidehighered.com/blogs/higher-ed-gamma/strategies-improving-student-success*

124 *Ibid.*

In some cases, there are more formalized arrangements. For example, Software Campus in Germany is built upon a collaboration between government, higher education institutions, and the tech industry to help young researchers become technology leaders through providing real-world industry projects. Partners like Deutsche Post, DHL, Siemens and SAP hope to help economic and management skills with technical knowledge for graduates.[125]

Industry Professional Development

Internationally, organizations are using a variety of different methods to develop new talent. Some small companies have emphasized flexibility and demonstrating their commitment to professional development by allocating a certain number of hours for staff professional development; for example, a UK micro firm provides a 20% development time commitment (for every 10 hours spend working with the company, 2 hours can be spent on their own courses or skills training).[126]

Other companies utilize more formal programs. In Korea, some large organizations have regimented training schedules with three-month orientations where new employees receive mentorship, hands-on learning, and performance evaluations. The use of mentorship and mixing of cross-generational teams is seen as useful for providing different employee perspectives and more variety of solutions. In addition to the development of technical competencies, there are also efforts to increase company fit and develop social skills.[127]

A study of talent management and development strategies in Asia noted that companies are increasingly adopting e-learning for their onboarding and training. While traditionally this has been used for corporate compliance, health and safety, or IT practices, increasingly it is being utilized for helping junior talent develop soft skills such as leadership, time management, communications, teamwork and client care.[128] It is best used as part of blended learning, integrating digital technology, coaching, and classroom learning. Other best practices identified include increasing a focus on management skills and identifying leadership potential from within the organization rather than looking externally to bring in new skills.[129]

125 *"High Tech Leadership Skills for Europe", e-skills EU, March 27, 2020: http://eskills-scale.eu/fileadmin/eskills_scale/all_final_deliverables/scale_e-leadership_agenda_final.pdf*

126 *Katarina Katja Mihelič, PhD, Global Talent Management -Best Practices for SMEs Working Paper, University of Ljubljana, January 2020, https://ec.europa.eu/research/participants/documents/downloadPublic?documentIds=080166e5cb9a876a&appId=PPGMS*

127 *Ibid.*

128 *"The Asian Talent Crunch - The Current Skills Shortages in Asia", Cegos Asia Pacific, accessed Oct 2020: https://www.slideshare.net/JeremyBlain/the-skills-shortages-in-asia*

129 *Ibid.*

COVID-19 and Creative Technology Education

While the COVID-19 pandemic has left a relatively minimal dent on the health of the creative technology sector in comparison to other sectors of the economy, it has significantly impacted post-secondary institutions that train and develop junior talent. While all institutions were forced to close their physical classrooms as part of a larger provincial shutdown, interviewees from BC's post-secondary institutions offering programs relevant to the creative technology sector noted that they reacted quickly to transition to online education delivery, with the goal of minimizing disruption to studies. Fortunately, early impressions are that this transition was navigated relatively smoothly, with students and teachers quickly adapting to online distance learning. Education institutions also highlighted their efforts to ensure access to the powerful, dedicated computer hardware required for some of these programs (whether by shipping hardware to students or providing remote access to essential hardware). Although for students based in rural or remote regions, challenges like internet access, speed, and quality of connectivity persist, this smooth transition was a result of having adaptable students and significant IT infrastructure already in place coupled with staff working "around the clock" to ensure minimal disruption. While this is new, uncharted territory (particularly for the small, specialized training institutions), many education providers were confident that they had been successful in providing a similar learning experience online as they would have in person.

That said, some programs are, by their nature, less conducive to digital transition. For example, such programs are tied to physical aspects of film work such as blue or green screen work, requiring some in-studio experience. Other operational challenges include collaboration and participation in lectures for international students who have temporarily left Canada (an example is a student joining lectures in the middle of the night to join fellow classmates).

Although post-secondary institutions are managing the transition to the best of their ability, many post-secondary interviewees noted a feeling of loss, primarily around personal interactions. Educators stated seeing a disruption of group projects, a loss of collaboration and comradery amongst students, and even the loss of informal gatherings that can help build relationships among students and help spur creativity.

Looking toward the future, some training institutions are exploring hybrid in-class/online models of learning. Although physical learning undoubtedly brings advantages to the learning experience, it remains to be seen when this can be done safely and effectively.

Image courtesy of Northwestern University

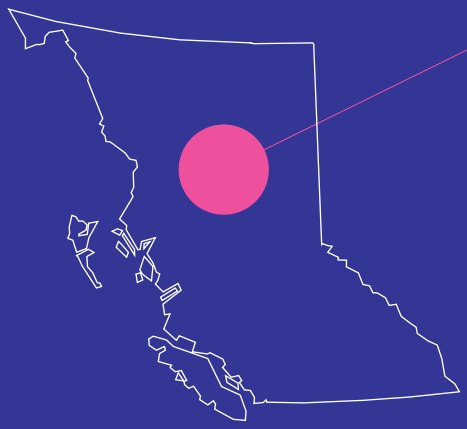
SECTION IX

REGIONAL PERSPECTIVES

Currently, with the exception of pockets of activity in cities like Victoria and Kelowna, the majority of studios in the creative technology sector are located in Vancouver or the Greater Vancouver Area (GVA). Yet, COVID-19 has undoubtedly reshaped traditional notions and practices of work, most profoundly the constraints on where work is conducted.

Owing to this shifting and evolving reality, there exists potential for the creative technology sector to expand beyond its hub in Vancouver in the future. This proliferation of remote work, coupled with necessary infrastructure like high-speed internet needed to sustain it, can open opportunities for high-quality employment in the creative technology sector all across BC.

To understand these opportunities, as well as challenges and obstacles, three regional focus groups were conducted across the province. Held virtually, the focus groups uncovered important insights from creative technology stakeholders in Northern BC, Interior BC, and Vancouver Island.



Northern BC Focus Group

Participants (six):

- Two founders (both originally from Northern BC, with creative technology companies located in Vancouver)
- One secondary school representative
- Two post-secondary representatives
- One economic development agency representative

The Creative Technology Sector and Talent Pipeline

Focus group participants noted a general lack of activity in this region, not just in the creative technology sector, but the technology sector as a whole. Interest in the creative technology sector at the student level was viewed as apparent, however all participants stated a challenge connecting this interest to tangible opportunities in the sector. This challenge was found to be two-fold: first, this was due to a shortage of educational resources available in the community to train and build talent; second—and more importantly—it relates to the lack of key creative technology leaders (i.e., founders, business leaders, technical talent) needed to drive industry growth in the region. The latter was especially highlighted as a hurdle, causing students to view a future in the sector and remaining in their region as mutually exclusive.

At the same time, both Founders noted that, as much as they would like to hire talent in Northern BC, running their businesses entirely in this region would not be feasible. Both experience a heightened need for skilled talent, and rely on a strong pipeline to produce it. The talent pipeline is currently found largely in Vancouver, with smaller pockets in other cities outside of the region.

Adding additional nuance, one Founder highlighted that, although full operation in the region is not feasible, there are certain roles within the company that can be performed by talent in the North—they are roles that are more generalist in nature. Here, the challenge rested with being able to effectively connect with talent in Northern BC, something that proved far more difficult than connecting with talent in Vancouver, other parts of Canada, or even internationally. This representative acknowledged that finding and recruiting talent across the province cannot be a one size fits all approach; to source talent from Northern BC, relationships with educational institutions, as well as other recruitment methods, are presumed to be key.

> *We would like to hire people from the North to help us grow, but we don't know how to connect with talent outside of Vancouver and Victoria. We need to work more with the schools [in the North] to have a more constant pipeline that we can leverage. We're trying to recruit the same way we recruit in Vancouver, but the message is lost by the time it gets to the North.*
>
> *– Founder*

Regional Change Brought on by COVID-19

While collectively acknowledging that it is too soon to tell how the COVID-19 pandemic will impact their region in the long-term, a few participants stated that some initial changes were beginning to surface. Primarily, participants believed that the pandemic, and more appropriately the rise of remote work that stemmed from the pandemic, would bring new skilled talent to their region.

The participant from the economic development agency stated that while not a definitive trend, since the pandemic, they have experienced a growth in calls or inquiries from talent considering moving to the region. This interest was exclusively from talent (broadly speaking, not tied to the creative technology sector) with remote work capabilities vs. businesses seeking to set up operations in the region. The sheer influx of people and population growth was seen as a positive feature that can potentially spur economic growth opportunities for the region.

> *We have seen an increase in people contacting us who don't want to live in crowded cities...generally, these people have jobs that they can do remotely. If they can set up here, great! We are more than happy to have them.*
>
> *– Northern BC economic development representative*

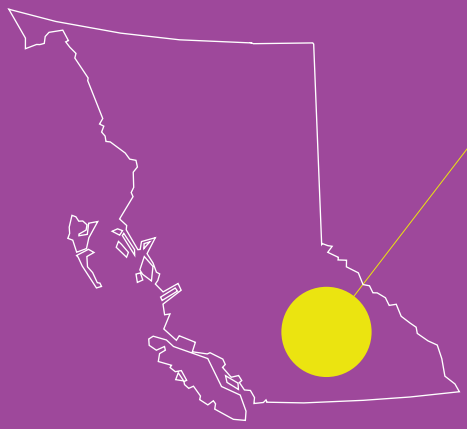
Another pandemic-inspired change that was articulated by a roundtable participant is on the topic of building the junior talent pipeline. Here, the participant, representing a post-secondary institution, highlighted the need to shift work-integrated learning models online. Tools like Riipen, which provide students with the ability to solve real-life business problems were seen as key in a future where in-person mentorship from employers may be limited.

> *We are using Riipen, and it's our hope that students will receive some really high-quality work integrated learning through the portal. It doesn't mean that [Riipen] is the only option here, but without these tools, I worry about how effective students will be when starting a career, given that they may not have the opportunity for mentorship, which historically has been in person.*
>
> *– Post-secondary representative*

Connectivity is King

Lastly, although participants viewed a potential influx of talent to the region as largely positive, several raised concerns about infrastructure and notably, internet connectivity. While connectivity was seen to be largely acceptable for most activities in cities like Prince George, other more remote communities often struggled. Northern communities in particular were seen to be especially vulnerable in a future where economic opportunities and employment prospects may largely rely on the ability to engage with the digital world.

> *On the eastern side of the Rocky Mountains, where we are, access to the internet hasn't reached the level where it can have a meaningful impact, allowing people to participate in the digital economy, or online learning. On top of quality concerns, internet access—in large part due to the geography—is also very costly. There is talk of next generation connectivity infrastructure like 5G, and I think this is really going to help us take part in this new economy.*
>
> *– Post-secondary representative*



Interior BC Focus Group

Participants (three):

Two secondary school representatives

One municipal representative

The Importance of Regional Presence

Participants all spoke to the changing nature of the economy as a whole, the growth in digitization, and of the scaling of the knowledge-based economy. While these changes were framed largely in the context of large city centres like Vancouver, some acknowledgement of this transformation and growth of the technology sector was noted for this region, namely in Kelowna.

> *Kelowna has changed a lot in the last five years, largely because the tech sector has grown so much there. Accelerating this would accelerate that brand of growth.*
>
> *– Municipal representative*

The municipal representative stated a belief that the pandemic and remote work would be something that contributes to the growth of this "brand" (as a tech hub) for Kelowna, while also possibly attracting more people to the region in general.

> *The pandemic has forced companies to make remote work an option. Now that the investment is has been made, I think it's going to change the dynamics of the workplace—it'll make it clear that people can work from further away.*
>
> *– Municipal representative*

Getting the Whole Experience

There was a general sense of optimism about the possibilities that remote work can bring to the region. However, one participant made the poignant point that this change cannot end with a mere influx of talent from city centres. To improve prospects for the region as a whole, this talent must be accompanied by business leaders that create and bring employment opportunities to the region.

> *Having [industry leaders] in your community is incredibly powerful for kids because it shows them a pathway forward. Vancouver is and seems like a very long way away from where I am. Having these people in your backyard instantly flips a switch for the talent pipeline. Youth in the region can build relationships with those people, and understand what is possible.*
>
> *– Secondary school representative*

> *It's a struggle to give kids the whole experience. Kids in Vancouver can get mentorship from these companies because the firms are locally based. Online mentorship programs are still new, and the biggest elephant in the room is that rural internet is bad. Many students struggle [because of it]. If I give my class a Creative Cloud licence and send them home to learn graphic design, some of them will not be able to do this because of the quality of internet at their home.*
>
> *– Secondary school representative*

Vancouver Island Focus Group

Participants (two):

- One creative technology business leader (working remotely from Nanaimo)
- One post-secondary representative

Building Creative Technology Energy

Participants in this focus group regarded the activities in Vancouver Islands' creative sector as largely based in Victoria. This notion was echoed by a belief that the sector in parts of the Island was lacking.

> *There is a lack of direction for the sector here. It doesn't have enough energy to create a market. There isn't a flow-through of skilled talent, or companies [willing to set up here] to move this forward. These are the realities here, but oftentimes the message from government is just 'try harder'.*
>
> *– Creative technology business leader*

This participant went further to explain that the lack of skilled talent impacts business development, which in turn, impacts the availability of skilled talent once again. To put it plainly, skilled talent—particularly in a sector where contract work is a norm—wants to be based where there are plentiful employment opportunities. The smaller the ecosystem, the more difficult it is for businesses to attract talent, retain that talent, and successfully operate. COVID-19 and the rise of remote work was viewed as something that may eventually change this reality.

The Future is Virtual

Similar to the other regional focus groups, connectivity infrastructure and services were highlighted once again as key considerations for economic opportunities and future success. The creative technology representative framed this in the context of infrastructure needed to support a growing digital economy and population, while the post-secondary representative highlighted the impact of connectivity on access to education.

> *If there continues to be an influx of people moving to Nanaimo due to the cost of living, it's reasonable to believe that there will be an increasing number of people who want to work in the digital economy. The infrastructure—connectivity and otherwise—is not currently on par with Vancouver or Victoria.*
>
> *– Creative technology representative*

Although this was the goal, the same representative acknowledged challenges in being able to "give kids the whole experience". Here, a central concern that surfaced was connectivity and internet infrastructure in more remote or rural communities.

> *We have had to change—pivot is what we call it—and move online, with the pandemic. Overall, we have managed this transition relatively well, but of course there are nuances. For example, some students who do not have good internet access are struggling...*
>
> *– Post-secondary representative*

SECTION X

BEYOND TALENT:

HOW TO HELP BC'S CREATIVE TECHNOLOGY SECTOR SUCCEED

While access to necessary talent is key to the continued success of BC's creative technology ecosystem, other factors play a role in helping it grow and reach higher levels of global competitiveness.

Recommendations as to what the sector could do better to compete vary depending on sub-sector, number of years in operation, company size, business model etc., but a few clear themes emerged throughout this study. Visibility, tax incentives, immigration program adjustments, financial support, and increased collaboration between BC's post-secondary education institutions and industry are all key considerations that can build a stronger creative technology sector in BC.

Recommendation	Collaborating Stakeholders	
Comprehensive tax credits	Provincial (BC) government	(lead)
	Creative technology sector	(support)
Increased visibility for the sector	Provincial (BC) government	(lead)
	Creative technology sector	(lead)
	Industry associations (BC)	(support)
	Research bodies	(support)
	Post-secondary institutions	(support)
	Creative technology talent	(support)
Grants and other financial support	Provincial (BC) government	(lead)
	Federal government	(lead)
	Creative technology sector	(support)
Immigration program reform	Provincial (BC) government	(lead)
	Federal government	(lead)
	Creative technology sector	(support)
Post-secondary & industry collaboration	Post-secondary institutions	(lead)
	Creative technology sector	(lead)
	Creative technology talent	(support)
Improved rural broadband connectivity	Canadian telecom providers	(lead)
	Federal government	(lead)
	Rural communities	(lead)
	Research bodies	(support)
Creative technology mentoring program for secondary school students	Creative technology sector	(lead)
	Creative technology talent	(lead)
	Secondary school administrators	(lead)
Prioritizing diversity and inclusion	Creative technology sector	(lead)
	Post-secondary institutions	(lead)
	Organizations supporting underrepresented groups	(lead)

Image: 'The LEGO Movie 2 crew from Animal Logic's Vancouver Studio'

Comprehensive Tax Credits

The notion of maintaining or increasing tax credits was frequently referred to during this research as a method of boosting the competitiveness of BC's creative technology sector. Well over half of interviewees mentioned tax credits as a key contributor to their ability to hire talent and scale their businesses. Many industry interviewees also made unprompted comparisons to other jurisdictions like Quebec during interviews, which they viewed as offering more comprehensive and competitive credits.

The British Columbia Interactive Digital Media Tax Credit enables some employers (namely video game) in the creative technology or interactive digital media space to claim 17.5% of BC eligible salary and wages.[130] Other tax credits, particularly those used by animation and VFX companies include the Production Services Tax Credit (PSTC), and the Digital Animation, Visual Effects and Post-Production (DAVE) credit. PSTC and DAVE allow eligible businesses to offset 28% and 16% of eligible labour costs,[131] respectively.[132] Compare this to the Quebec Tax Credit for Film Production Services (QPSTC). This credit offers a flat 20% deduction for all eligible expenses incurred by an organization undertaking production work in Quebec.[133] The credit also allows for an additional 16% "bonus" or "top up" to cover animation and visual effects expenses, specifically.[134] Like the 20% deduction, the 16% bonus applies to all eligible expenses,[135] not exclusively to labour. Even at surface-level, assuming a one-to-one comparison of wages and all expenses, the difference between QCPSTC and the equivalent BC options is material. Some studios estimate that when factoring in differences between the cost of labour and all expenses, the gap can fall anywhere from 10% to 15%. Despite being the Canadian pioneer of creative technology, differences like these play a central role in BC's ability to compete for work and talent. When combined with a lower cost of living in cities like Montreal, several industry interviewees noted that BC is losing its competitive advantage. Business opportunities in other jurisdictions were thought to be increasingly attractive, in large part because of these attractive incentives.

Some industry interviewees took a softer tone, saying that BC needn't necessarily have the same robustness of tax credits as other provinces. While the current tax credits do lag some competing provinces, the impact of COVID-19 on the overall economy coupled with recent events in other provinces casts the survivability of these credits into question.

130 *"British Columbia interactive digital media tax credit," Government of Canada, April 25, 2020, https://www.canada.ca/en/revenue-agency/services/tax/businesses/topics/corporations/provincial-territorial-corporation-tax/british-columbia-provincial-corporation-tax/british-columbia-interactive-digital-media-tax-credit.html*

131 *Eligible labour costs must be ones associated with animation, VFX, or post-production activities and can be used in combination (the former for productions that do not meet Canadian content criteria)*

132 *"Producing in Canada: A guide to Canadian film, television, and interactive digital media programs", Dentons.*

133 *"Refundable tax credit for film of television production services", Government of Quebec, July 2018, https://www.sodec.gouv.qc.ca/wp-content/uploads/guidelinesrefundable-tax-credit-for-film-production-services.pdf?v=3a01f99c868d26dd5460b112fab78d8e*

134 *Ibid*

135 *Ibid*

Alberta's Interactive Digital Media Tax Credit once offered a 25% refundable tax credit for labour costs associated with interactive digital media activities, but in 2019 it was phased out.[136] This was a move that many interviewees believed would stall the further development of Alberta's creative technology sector and worried about the prospect of something similar happening in BC. Clear messaging to indicate that the BC government does not intend to cut the current tax credit was considered critical during this time of grave economic uncertainty.

> *What the BC government can do is make us feel like the tax credit—and thereby the industry—is supported. We need clear messaging to know that what we have, although not perfect, is not at risk.*
>
> *– Animation studio interviewee*

Visibility of the Sector

A second identified need is bringing more visibility to the sector. This involves making clear what the creative technology sector is and highlighting its opportunities. Several interviewees (from both industry and post-secondary institutions) felt that creative technology, despite its substantial economic and labour-market contributions to the province, was often simply regarded as a small component of tech as a whole—or worse, as a "quirky offshoot," as described by Brenda Bailey, formerly of DigiBC.[137]

The thousands of high-quality jobs produced by the sector every year in British Columbia, its impact on the provincial and Canadian economy, its needs, and its other relevant trends should be continually monitored, tracked, and documented. The current practice of lumping these successes under the umbrella of the tech sector functions to dilute the sector's overall "value" and can discourage domestic workers from seeking employment in the sector.

> *This industry provides unbelievable wages, which is critical, especially because it's so expensive to live here. I really want the province to take us more seriously—there's so much opportunity to expand the creative technology sector in BC.*
>
> *– Animation studio interviewee*

Interviewees highlighted that efforts to raise awareness are important because of the "network effects" of a large and robust creative technology sector. International talent is attracted to BC because it is a mature sector, offering significant opportunities for employment and career growth. These network effects are particularly important in creative technology, as they can bring attention to BC's existing successes, while also enticing new talent to pursue careers in the field.

136 *"Interactive Digital Media Tax Credit (IDMTC)," Government of Alberta, August 13, 2020, https://www.alberta.ca/interactive-digital-media-tax-credit.aspx#:~:text=The%20IDMTC%20offers%20a%2025,digital%20media%20and%20gaming%20products*

137 *Alexandra Cutean, "BC's Creative Tech Sector Drives Economic Growth and Jobs in Canada," Digital Think Tank by ICTC, June 30, 2020, https://medium.com/digitalthinktankictc/bcs-creative-tech-sector-drives-economic-growth-and-jobs-in-canada-6a34449bdceb*

Grants and Other Financial Supports

Wage subsidies are instruments that can help studios hire junior talent or supplement training. In an industry repeatedly described by interviewees as "cutthroat," it is often difficult to find the resources to invest in hiring and training, particularly when it comes to junior talent, which by nature, requires more direct mentoring and training. Many interviewees noted that it can take six months before a junior employee (i.e., someone straight out of a post-secondary program) becomes profitable to a company. This time and financial investment can be difficult for studios to support—particularly in times of economic uncertainty. Moreover, investing time in training junior-level talent is particularly challenging for smaller studios with smaller margins. Wage subsidies cannot offset the time investment needed to train junior talent, but for many small companies attempting to scale, it can be a crucial support system to offset the financial investment needed to support these opportunities.

Another type of useful financial support mechanism is grants specifically geared towards subsidizing in-house training developed and delivered by existing staff (vs. external consultants). This specialized training can be used to support skill development for internal staff, train new entrants, and even improve equity among studios, by leveraging best practices to integrate underrepresented groups into the sector.

> *Grants or other incentives to subsidize in-house training would be very useful. At our studio, we have our own in-house training, but we can afford it. A lot of smaller studios can't. If some of the smaller studios could invest more in internal training than they do, we would have a more rapidly advancing talent pool. I think the same is true for advancing diversity in the workforce... it's pretty easy to hit a brick wall of knowledge on what do so, where to go, and what resources to access. To integrate underrepresented groups via subsidized training that helps get them into our industry would be huge.*
>
> *– Animation studio interviewee*

Immigration Program Reform

Immigration is critical for the creative technology sector in British Columbia and was among the most-discussed topics during interviews with industry. Discussions on immigration tended to take two directions: extending or simplifying existing programs; and re-working the post-graduation work permit.

Small adjustments related to existing programs can be most useful for micro, small and, in some cases, medium-sized studios without extensive experience in the space or dedicated teams assigned to supporting newcomers in making the transition to Canada. Particularly, small adjustments to the Labour Market Impact Assessment (LMIA) for non-exempt applications may be beneficial. Although it is not one of the most common immigration streams for creative technology studios, it was still relevant, and interviewees with experience using the LMIA noted that the process was often unclear, time consuming, and costly. Streamlining this process, or even creating "how to" toolkits for it, would prove useful.

Another adjustment can include extending, or making permanent, the BC Provincial Nominee Program. BC PNP was one of the most frequently used channels for sourcing international talent.

> *The government should extend or make permanent the BC PNP pilot.*
>
> *– VFX studio interviewee*

Finally, many industry interviewees noted challenges with the current post-graduation work permit (PGWP). In its current state, this stream is not one that was used by any of the studio representatives in the study. Described by some as the "dark underbelly" of creative technology education in the province, international students are often not aware that completing their costly studies in BC does not guarantee them a chance to remain in the province. While the work permit can technically be valid for up to three years, the reality of the short nature of post-secondary programs geared toward the creative technology sector (most of them being under two years) often means that graduating students are only eligible to stay in Canada for another year or less. Moreover, private schools such as Vancouver Film School or Lost Boys Studios—regardless of their strong reputation for building top-tier junior talent for the creative technology sector—are not eligible programs under the PGWP.

> *"It's critical that we can quickly move talent at all levels. Extending the post-graduation work permits to programs offered by Vancouver Film School, for example, would be very useful. We are missing out on so much junior talent without this—and most of the graduates want to stay in Canada!*
>
> *– VFX studio interviewee*

Image courtesy of Eastside Games

Post-Secondary and Industry Collaboration

Tailored educational programming, combined with real-life industry experience and mentorship, is key for the creative technology sector, and central to developing strong workforce-ready talent.

Expansion of Seats in Existing Post-Secondary Institutions

"Expansion" of existing educational programs can be viewed through two lenses: volume and curriculum. From the perspective of volume, many industry interviewees noted that additional seats for the province's well-regarded computer science programs (for developing strong software engineers/programmers) would be useful. The same need was also articulated by post-secondary institutions in this space, many articulated that the demand (applications) for software engineering programs had increased significantly over the past years. Moreover, software engineers/programmers are in-demand across not only the entire creative technology sector, but across the tech sector, and the general economy—competition for this talent stream in particular, is fierce. As one industry interviewee put it:

> *It's not like there are unemployed software engineers sitting around in Vancouver.*

When it came to curriculum development, many interviewees—both from industry and post-secondary institutions—suggested that a closer collaboration between educational program developers, namely for artistic/creative talent, and industry experts would yield better curricula that accurately reflects the real-time needs of industry. Although all post-secondary institutions have advisory boards comprised partly of industry representatives to help shape curriculum, the general consensus from interviewees overall was that efforts must be extended beyond this.

Despite the increased development of short-duration training across various industry lines, it is currently unclear whether this is a strategy that can work well for the creative technology sector. Industry interviewees were split on this topic. Some believed that programs should be expanded in duration to allow students to develop more specialized skillsets, while others felt that shorter and more "hands on" programs were crucial to churn out skilled juniors at a faster rate. Despite this dichotomy, all interviewees both from industry and post-secondary institutions agreed that more consultation with industry leaders was needed to shape curricula that could better prepare students for a job in the sector. This closer collaboration could include bringing on industry representatives to provide students with knowledge on which careers in the sector are most in demand (for example, students could benefit from understanding that Riggers are in much higher demand than other roles and plan accordingly). This understanding can also come in the form of teaching students about pipelines, what a "day in the life" would look like for a given role, as well as even just providing an honest view of the nature of the sector itself, such as the high propensity for temporary contracts in some sub-sectors (animation and VFX in particular).

> *The business model is one that is not always built for retention. It's built for ramp up, ramp down.... A good portion of jobs are contract based. Schools could do a way better job of preparing students for the reality of the sector. It's not different anywhere, and yet people are shocked and upset when their contracts end. As employers, we don't try to hide it—there's no point. Schools could do a spectacularly better job of preparing students for the workforce they're entering so we don't have artists who are upset that they have to always go from project to project. There's absolutely a level of "disgruntledness" when they learn that we have to let people go—even though it's never been different, anywhere. I would be more than happy to work with the schools to actually talk to students about how the business model works and let them know what they can expect.*
>
> *– Animation studio interviewee*

Novel Apprenticeship and Co-op Ideas

Apprenticeships, internships, and co-ops were viewed positively by the majority of interviewees, and around the world work-integrated learning is viewed as a crucial contributor to skilled junior talent. A study by the University of Waterloo—Canada's post-secondary leader for work-integrated learning—found that WIL programs are advantageous to both students and employers. For students, WIL can allow them to determine their "fit" within a potential career, gains skills and knowledge relevant to the workplace, and develop their network; for employers, WIL allows the opportunity to "pre-screen" potential future hires, train the next generation of talent, and even offer existing employees the opportunity to gain new skills and competencies via the supervision of WIL students.[138]

138 *Norah McRae, et al. "Work-Integrated Learning Quality Framework, AAA", University of Waterloo, https://uwaterloo.ca/work-learn-institute/sites/ca.work-learn-institute/files/uploads/files/wil_quality_framework_-_aaa_-_for_posting.pdf*

Nearly all industry interviewees viewed WIL programs as beneficial to their businesses and the sector as a whole, with a few speculating about new programs that can help young grads gain the practical skills needed to transition into careers. One industry interviewee proposed the creation of a "Digital Apprentice Program." Such a program could imitate the management training programs for young graduates at many large companies (for example SAP), where participants spend a few months in many different departments to gain a broad knowledge of operations. In such a program, a young graduate might work at four firms or numerous branches of one firm in two years, testing out various companies and subfields. This gives the graduate a chance to survey the business landscape while incumbent firms can test new graduates without a hiring commitment.

Apprenticeships and co-ops are also valuable from the perspective of accelerating career advancement from junior levels to mid-level (especially valuable given that mid-level talent is in shorter supply than junior talent). Whether industry or government-led, novel apprenticeship programs could potentially help juniors gain the skills needed to transition into mid-level talent faster.

Rural Broadband and the Need for (Internet) Speed

The vast majority of creative technology studios are located in Vancouver or the Greater Vancouver area (nearly 87% according to ICTC calculations) where internet speeds tend to be high, and connectivity challenges are minimal. However, the onset of large-scale remote work brought on by COVID-19 has undoubtedly led to the breaking down of some previously existing barriers to work that were location-based. Today, it is entirely feasible that skilled talent in rural or remote communities across Canada can participate in employment opportunities in the creative technology sector, without needing to move to Vancouver to do so. Prior to the pandemic, the Acron, a US-based organization focused on the advancement of remote work, found that that some rural communities in the US were "leaning in" to the possibilities of remote work, using it as a means to attract remote knowledge workers that are seeking alternative to the city.[139] Some had gone as far as to offer remote workers benefits or financial incentives to move to their areas. Although not quite to this degree, many of the representatives from remote or rural communities consulted in this research echoed this sentiment of the move to remove work being a positive development, and one that can potentially attract more skilled talent to their regions.

139 *Ben Butz-Widener, "Rural towns are leaning into remote work, and it might save them", Acorn, April 18, 2019, https://www.acorn.work/rural-towns-are-leaning-into-remote-work-and-it-might-save-them/*

However, in order to take full advantage of this opportunity, existing issues of rural connectivity must be addressed. Inadequate internet connectivity or insufficient speed can act as a deterrent for not only attracting remote workers to these regions, but also potentially curtailing existing residents and students of these communities to participate in the new borderless digital economy. A recent study by the Canadian Internet Registration Authority (CIRA) found that in 2020, download speeds in rural Canadian communities were measured at 3.78 Mbps on average, compared to 44.09 Mbps in urban centres.[140]

> *The biggest elephant in the room is that rural internet is bad.*
>
> *– Secondary school interviewee*

Mentorship Program with Secondary Students

Although further and in-depth consultation with regions outside of the Greater Vancouver Area are required in order to gain a fulsome picture of specific needs and opportunities, regional focus groups brought to light a unique opportunity for building the next generation of skilled talent outside of main city centres.

Mentorship programs—whether in-person or virtual—between talent working in the creative technology sector with secondary school students can prove valuable in building supply pipelines across BC. Specifically providing students outside of city centres with such mentorship can be crucial to offer insight into the opportunities that exist in the sector and how it can translate to their region. Forming these connections prior to students entering post-secondary programs may be further beneficial, allowing students across BC to make informed decisions on their post-secondary training in alignment with employment opportunities. This may be particularly useful for students located in regions where "traditional" sectors like forestry or mining (which are undergoing significant disruption due to technology) tend to dominate.

Prioritizing Diversity and Inclusion

The modern school of thought on organizational diversity has purely economic roots. In 1987, US Secretary of Labour William Brock commissioned a study, *Workforce 2020*.[141] The purpose of this study was to identify the impending demographic changes that would take shape in the US, and to understand how those changes would impact the labour market.

140 *CIRA, "New Internet Performance Data Shows the Staggering Scale of Canada's Urban-Rural Digital Divide", CIRA, 2020, https://www.cira.ca/newsroom/new-internet-performance-data-shows-staggering-scale-canadas-urban-rural-digital-divide*

141 *Richard W. Judy, Carol D'Amico, "Workforce 2020 – Work and Workers in the 21st Century", Hudson Institute, 1987.*

Although the authors of this report did not intend for their work to spawn a "diversity industry",[142] their findings clearly articulated the economic rationale for businesses to embrace it. Demographic trends like slow population growth and ageing workforces meant that to thrive, businesses would simply need to find new pools of talent, and diverse recruitment could achieve this. *Workforce 2020* positioned diversity not as a "nice thing to do", but as an obvious economic choice.

In this study, studios and post-secondary institutions were questioned on areas pertaining to diversity and inclusion. Topics of investigation included, among others, the portion of women employed in key roles, of Indigenous employees or students, of people with disabilities and accommodations requested or made, and even of relationships with organizations that support underrepresented groups. With the exception of information about women in key roles or educational programs, the answers to these questions were largely unknown, and in many cases, uncollected and undocumented. Only half of studios were aware of how many Indigenous employees they had, or how many employees with disabilities. Similar results were found with respect to post-secondary institutions.

In BC, employers may not ask prospective or existing employees about their physical or mental abilities beyond the scope of their ability to perform job duties.[143] Similar rules prevent employers from asking employees questions about place of origin, sexual orientation, religion, or family status.[144] Although employees may voluntarily disclose this and other information, such legislation is key to preventing discrimination in the workplace. That said, employers may still decide to collect data (with consent from employees) on workforce composition for the purpose of promoting human rights, preventing systemic barriers, diagnosing problems, and developing actionable strategies to tackle them.[145] In the context of truly furthering efforts that will drive diversity and inclusion, data is key.

Many studios in this study acknowledged a data gap. Internally (at the studio level), nearly all interviewees pointed to insufficient or ineffective data collection[146] related to diversity and inclusion. However, studios expressed a belief that their specific challenges were not unique—that the gap was endemic to the entire creative technology sector. In other words, although many individual studios believed themselves to be unsuccessful when it came to accurately capturing and tracking this data, there was an overarching perception that everyone is in the same boat. Analyzing interviewee responses in aggregate, this perception appears to be accurate.

142 *Ibid.*

143 *Shelly Hourston, "Disclosing Your Disability: A Legal Guide for People with Disabilities in BC", Disability Alliance BC, May 2016, https://disabilityalliancebc.org/wp-content/uploads/2017/06/DisclosureGuide.pdf p.12*

144 *"Know your rights as a job applicant", WorkBC, https://www.workbc.ca/jobs-careers/find-jobs/your-rights-as-a-job-applicant.aspx*

145 *"Count me in!", Ontario Human Rights Commission, http://www.ohrc.on.ca/sites/default/files/attachments/Count_me_in%21_Collecting_human_rights_based_data.pdf*

146 *Includes a lack of knowledge on what variables to collect data on (i.e., which questions to ask), in addition to data collection itself.*

Creative technology companies and the post-secondary institutions that feed their talent pipeline must understand where they are starting from in order to measure progress as they move forward. Building reasonable and actionable targets must be based in more than a desire to affect change—obtaining data-driven insights is an essential step on the journey of building a more diverse and inclusive workforce.

In addition to the need to address these acknowledged gaps in current data collection—at the individual and sectoral level—all studios in this study also expressed a strong desire to "do more" in the immediate term; to support and exemplify diversity and inclusion in their workforce.

Studios brought to the forefront two main priorities of focus: partnerships, and policy development. Developing, or in some cases expanding, partnerships with key organizations that work directly with underrepresented groups is deemed necessary. Interviewees felt that facilitating dialogue with such groups was a crucial starting point. Organizations that support employment pathways for women, Indigenous communities, and people with disabilities were noted by numerous studios as specific partners of interest. Policy shifts encapsulate both development and expansion. The majority of studios in this study do not have formal diversity and inclusion policies in place. Some (usually large studios) do, but oftentimes they relate mostly to the recruitment process. Only a very small portion of studios have diversity and inclusion policies that extend beyond recruitment to include other aspects like employee development, career progression, and retention.

Studios in this sector inherently understand the value of diversity and inclusion—after all, it is reflected in their customer base and is cornerstone to business success. Now is the time to take that same level of appreciation for marketplace-driven diversity and turn it inward: to ensure that the creative technology workforce, like its customers, is diverse and inclusive.

Conclusion

This report, Benchmarking the Creative Technology Ecosystem in British Columbia, serves as a comprehensive overview of British Columbia's creative technology sector. Relying on insights from a range of sources, including in-depth key informant interviews with representatives from industry and post-secondary institutions, this report provides a robust picture of the current state of the creative technology sector in the province, its needs, and future opportunities.

Accounting for more than 10,000 high-quality jobs, the 49 studios interviewed in this study showcase that the creative technology sector is a significant economic and labour-market contributor to the province of British Columbia, as well as the larger Canadian economy. Continued growth is anchored in its ability to compete on an increasingly global playing field. Talent is at the crux of the sector's competitiveness. Although the quality of BC-based talent is strong, with local workers having skills and competencies comparable to global creative technology hubs like Los Angeles or the Bay Area, the challenge is volume. Simply put, available talent supply is insufficient to meet the scaling needs of industry. Moreover, this labour crunch could be exacerbated by the long-term impacts of COVID-19. Although VFX has seen a contraction since BC's pandemic measures took hold, animation and video games have witnessed an unprecedented surge in demand. It remains to be seen how the COVID-19 pandemic will be controlled, yet many experts believe that our new normal will be digital first.[147] With that comes the demand for high-quality digital content. BC's creative technology sector companies need a robust, reliable, and industry-ready talent pipeline that can enable them to secure new work, develop IP, and to grow internationally.

For decades, the creative technology sector has been an important driver of British Columbia's GDP and employment. By optimizing policy and securing a strong pipeline of skilled talent, BC's creative technology sector can thrive in the emerging digital-led global economy.

147 *Olaf Acker, Dr. Clement Mengue, Neil Siri, "A digital technology agenda driving an accelerated transition to the new normal," Strategy, June 15, 2020, https://www.strategyand.pwc.com/de/de/implications-of-covid-19/digital-technology-agenda.html*

Appendix

I Research Methodology

This research study was formed using mixed-methods research of both a secondary and primary nature.

Secondary Research

The secondary research component of this project included a robust literature review, offering a detailed understanding of the industries that shape the creative technology sector: videogame, VFX, animation, and XR. Secondary data sets (e.g., Statistics Canada's Labour Force Survey, Canadian census data, data from the Canadian Survey of Disability, data from BC Stats on the technology sector, data from the Entertainment Software Association, the Vancouver Economic Commission, and the Province of BC) were also analyzed to understand market trends pertaining to job growth, wages, economic impact, employee demographics, and immigration. Webscraping was used to identify the number and location of studios across BC. Webscraping for jobs and skills leveraged primary research (and therefore is described below), but NOC (occupational classification) definitions are provided for comparability with previous and future provincial labour market research. NOC classifications of the creative technology sector and their prevalence across economic region are provided in Appendix VI.

Given the dynamic nature of these fields, recent sector developments were monitored in BC, nationally, and internationally. The emergence of the COVID-19 pandemic added additional considerations for this research. This spurred a second phase of literature review in late summer, incorporating new developments that included impacts on each industry, the evolving impacts on revenue and talent, and considerations tied to the rise of remote and flexible work environments.

Primary Research

The primary research component of this project was based on the following:

- 49 key informant interviews with industry leaders from the creative technology sector. Of the 49 interviews, 25 were with video game companies, 16 were with animation companies (3 being companies that perform both animation & VFX), and nine were with VFX companies (3 being companies that perform both VFX & animation). The industry interviewees also represented businesses that varied in size (from micro to large).
- 10 key informant interviews with representatives from relevant post-secondary institutions that train and supply talent relevant to the sector. The 10 interviews conducted extracted data from 24 key post-secondary programs relevant to the creative technology sector. The interviewees also represented a mixture of public and private institutions, which varied in size, composition, and focus areas.

- One online employer survey disseminated to industry leaders from the creative technology sector, specifically for the purpose of understanding headcount fluctuations within sub-sectors, as well as the characteristics associated with sectors that experience ramp up and ramp down periods within a given year. 33 of the 49 industry interviewees completed this survey.
- Three regional focus groups conducted with representatives from Northern BC, Vancouver Island, and Interior BC. The Northern BC focus group had six participants, while the Vancouver Island and Interior BC focus group hosted two and three participants, respectively.
- Webscraping to identify the monthly volume of job postings for 60 in-demand jobs, as identified by interviewees and the project advisory committee, along with their critical skills.
- Webscraping of supply from three jurisdictions (BC, Los Angeles, Bay Area) to identify differences in skill quality among supply groups.
- Four advisory committee meetings, attended by an advisory committee comprised of over 20 representatives from industry and post-secondary institutions in BC's creative technology sector.

Structure of Key Informant Interviews: Both sets of key informant interviews were highly structured and explored a series of standardized questions (to provide useful comparison points and quantitative data). The questionnaire used for interviews with industry representatives was 45-questions long. These interviews often lasted between one to two hours. The questionnaire used for post-secondary institutions was 27-questions long, and lasted between 45 minutes and one hour. Where permission was provided by the interviewee, ICTC recorded and transcribed each interview. Where permission was not provided by the interviewee, ICTC took detailed notes. Combined, these datasets were then analyzed and coded to identify key themes and noteworthy examples and sentiments.

Structure and purpose of the Online (Headcount) Survey: The headcount survey was developed halfway through the primary research in order to obtain granular insights on staff numbers at creative technology companies. Because some sub-sectors—primarily animation and VFX—can see significant within-year headcount fluctuations, depending on phases of project cycles, this survey was developed to extract insights on levels of fluctuation, and ramp up/ramp down periods. Survey takers were asked to provide monthly employment data (if available), or highest and lowest headcounts during a year, including peak and low periods. A total of 33 of 49 employers responded to this survey. In order to obtain information from a broader segment of the creative technology sector on fluctuation periods, this survey was also sent to relevant studios that did not participate in the interviews. Unfortunately, there was no uptake from this group.

Webscraping process utilizing primary research: ICTC utilized web scraping to gather data from numerous job boards and websites of employers in order to extract additional data on in-demand jobs. Machine learning was utilized to remove duplicated jobs across job boards, cluster responses, and extract skills across four different categories: creative/artistic, digital/technical, production, and design. This process identified job counts per month in BC for over 60 unique job titles, alongside skills and competences associated with key roles. Web scraping was also used to extract valuable information on talent composition in BC. This was referenced for comparability in contrast to other key jurisdictions: Los Angeles and the Bay Area. Because the volume of creative technology talent in BC is comparable in total volume to that of Los Angeles and the Bay Area, a province-to-city comparison was utilized, instead of comparing BC to California.

Structure and purpose of the Advisory Committee: A project advisory committee was developed to guide this study and validate results. The advisory committee was comprised of over 20 members, primarily from industry and post-secondary institutions that support BC's creative technology sector. The committee met four times throughout the course of this study to assess and validate findings, and provide feedback, alongside suggestions for data and other resources. The committee was also attempted to be leveraged to weight critical skills and competencies per job, using a "skill scorecard". This scorecard allowed committee members to select jobs that they were most comfortable/able to provide an assessment of skills and competencies for, then choose from a dropdown list of identified skills and competencies related to each occupation. This information was to be utilized to assign importance ratings for each competency and skill (i.e., very important, somewhat important, etc.) however, due to low response rate, this was not possible. Yet, utilizing the feedback that was provided by some members of the committee, ICTC was able to remove outdated software applications that were noted in job postings, as well as include additional skills, competencies and applications that were not listed in job postings.

II Limitations of Research

The creative technology sector is large and often comes with varying definitions. Although the sector was defined according to four main industries in this report (animation, VFX, video games, and XR), this is not necessarily consistent with other existing definitions of the sector, which can include anything from live-action film to advertising. As a result, few secondary data sets proved useful to extract information on economic impact, employment or any other characteristics pertaining to the creative technology sector in BC. Estimates of employment and studio volume and location in this report were put together leveraging webscraping by ICTC, and information from DigiBC. Standardization in definition of the sector is crucial to future data collection, tracking, and trend monitoring. This report can serve as a foundational basis upon which to begin and continue these efforts.

Webscraping was used to identify job volume, competencies, skills, and applications associated with in-demand jobs. While this data was shared with the advisory committee, some important limitations exist when it comes to relying on data sourced via job postings. First, as was described by industry interviewees, not all jobs are posted, and job boards are not always the go-to method for sourcing talent. Therefore, it is expected that job postings do not represent the total volume of jobs available in the sector each month. Moreover, job postings do not list when one posting is intended to represent multiple jobs; sometimes they note sourcing for "roles" vs. "a role", but there is no way of knowing whether the plurality of the posting refers to two or 100 roles. Competency, skill, and application data leveraging job postings can be a useful proxy for overall skill profiles. However, as noted by feedback provided by advisory committee members that participated in the weighting exercise, job postings do not always reference the most in-demand skills and competencies, nor the most up to date and frequently used software applications. Assessment and validation from experts in the field is always a crucial step to round out skill analyses from job postings. This feedback was provided to ICTC from the advisory committee, and incorporated into the study, however a higher volume or responses would have proven useful. Lastly, skill profiles using job postings cannot provide an analysis of skill weights (even though it is commonly accepted that different skills and competencies are weighted differently for each job). Due to this, ICTC attempted to conduct a skill weighting exercise with the advisory committee in order to provide gradients of importance to each identified skill. While some committee members participated, ultimately the sample of responses was too low (two) to be included. Further research on this topic with a significant amount of time dedicated to sourcing skill weights would prove beneficial.

Data on the ratio of international vs. domestic talent across the entire BC creative technology sector (i.e., the 135 companies) is not available, as not all companies were surveyed, and employment details of this nature are not publicly available.

Another limitation is the lack of data available pertaining to student outcomes from BC's post-secondary institutions that offer programs for the creative technology sector. Interviewees were able to provide general indications on graduation rates and employment prospects following graduation, but granular data per program was not available. Many post-secondary interviewees noted challenges in "tracking" students after graduation, a hurdle that is further exacerbated by the contract-based nature of the industry, which means that graduates may be employed by various companies over relatively short periods of time. At the same time, very few specific certifications were mentioned by employers or post-secondary representatives as relevant to this study. The certifications that were highlighted included AWS for some software engineering roles (namely those working on cloud computing), and NIST or CIISP for the very small subset of employers who stated hiring for cybersecurity roles. Although it is possible that certain niche occupations may require, or benefit from, certifications, identifying any relevant data or trends on this matter would require further research.

There are also some inherent challenges regarding samples used in this research. While the volume of interviews is significant (representing 36% of all studios, and nearly 40% of all relevant post-secondary institutions), there are inherent limitations as to which companies agreed to be interviewed, or surveyed. It is possible that respondents may represent a non-random, self-selecting sample. This research attempts to capture as much labour market information as possible for the creative technology sector, but further research is required to accurately monitor ongoing changes or to examine specific areas or roles in greater depth.

Although three focus groups were conducted with representatives living in areas outside of the main hubs of creative technology activity in BC, unfortunately due to the pandemic, participation in these discussions was low. Initially, these focus groups were planned to be held in person, and conducted in a fashion of a fulsome roundtable discussion, followed by in-person interviews between ICTC and local industry and other stakeholders.

To facilitate high levels of participation, these were to be multi-day catered events where ICTC and DigiBC staff would be available to conduct interviews, facilitate group discussions, and answer questions. In the past, these types of activities have proven very successful—for example, a community roundtable event hosted by ICTC in Ottawa during November 2019 attracted participation from over 30 prominent local stakeholders, who provided their feedback and insights on key research questions. There was no reason to believe when these activities were first planned in January 2020 that ICTC's and DigiBC's combined connections and networks across BC would not yield a high rate of participation. Unfortunately, the onset of COVID-19 shifted these plans immensely, the most notable shift being to a virtual format. This also came at a time where industry and community representatives across the province shifted their priorities, some focusing on immediate survivability and staffing planning. As a result, participation was limited in the regional focus groups. Although some interesting insights were discovered, more research is required to truly understand the opportunities, challenges, and potential future trends of BC's economic regions as they pertain to the creative technology sector.

Lastly, COVID-19 and subsequent economic shutdowns and slowdowns were experienced after this project already began and research tools were finalized. As a result, interview questions did not directly seek to capture pandemic impacts—although some conversations naturally emerged during the interview process. While some immediate COVID-19 impacts are noted across various sub-sectors in this study (i.e., the surge in demand for animation and video games, contraction of demand for VFX), these are simply initial insights and are not meant to represent any long-term or potential future trends. Further research is required to fully understand and document the impacts of COVID-19 on the creative technology sector in BC.

Length of service was another variable that was attempted to be uncovered in this study. While some information was highlighted regarding length of individual contracts (although this varied by company and sub-sector), ICTC was not able to extract information on how long employees in BC's creative technology sector tend to spend in a role or at a company. It is assumed that the contract nature of many jobs may produce workers that spend less time in a given role than in other sectors (particularly non-tech sectors), there is insufficient data to confirm or negate this assumption at the time.

III Creative Technology Sector in BC – Studios and Locations

Table A-1 below shows the specific location of creative technology businesses in BC, across the three main sub-sectors that lead it: Video games, Animation, VFX. This data was collected by ICTC in November 2020 via webscraping, and is complemented by existing data from DigiBC. As a result, this data differs from that of the data published in 2019 via other reports and literature. Although this data set will require continuous updating in order to ensure that new entrants into the ecosystem are documented, it is considered to be the most accurate and up to date at the time of completion.

Table A-1: Video game, animation, VFX studio business counts and locations in BC

Sub-Sector	Location (City)	Location (Region)	Business Count
Video games	Vancouver	Mainland	57
	Victoria	Vancouver Island	7
	Burnaby	Mainland	5
	Kelowna	Thompson-Okanagan	3
	New Westminster	Mainland	2
	Qualicum Beach	Vancouver Island	1
	Langley	Mainland	1
	West Vancouver	Mainland	1
	Nanaimo	Vancouver Island	1
	Prince George	Cariboo	1
Total Video games			**79**
Animation	Vancouver	Mainland	21
	Burnaby	Mainland	2
	Victoria	Vancouver Island	1
	Kelowna	Thompson-Okanagan	1
Total Animation			**25**
VFX	Vancouver	Mainland	29
	Victoria	Vancouver Island	2
Total VFX			**31**
TOTAL ALL SUB-SECTORS			**135**

The early-stage nature of the sub-sector, along with the reality that XR applications are found across numerous sectors of the economy (not just the creative technology sector), makes it challenging to accurately identify the volume and location of XR companies in BC. Yet, the identification of "future jobs" by industry interviewees in this study point to a future where XR plays a significant role in the employment prospects of the creative technology sector over the coming years.

Table A-2 provides an overview the location of BC-headquartered XR companies. This data was collected by ICTC in early 2020, and therefore does not include post-pandemic impacts on this sub-sector. Moreover, there is possibility of overlap between companies in this sub-sector and those in other sub-sectors—notably gaming—which may utilize XR technology. Location data was collected by companies that were headquartered in BC in early 2020, although an additional 27 companies were found to be operating in BC at the time, which were headquartered outside of province, or outside of the country. Location data for these other companies (headquartered outside of BC) is not available, although it is assumed that many are located in Vancouver.

Table A-2: XR studio business counts and location in BC

City	Business Count
Vancouver	90
Victoria	7
Other (including Kelowna and Qualicum Beach)	3
Total BC headquartered	100
Other internationally owned with operations in BC	19
Other domestically owned with operations in BC	8
Total headquartered outside of BC	27
Total operational in BC	**127**

Source:" Spanning the Virtual Frontier: Canada's Immersive Technology Ecosystem", ICTC 2020.[148]

Image courtesy of Pirahna Games

IV Skills and Applications for In-demand Artistic/Creative, Digital/Technical, Production, and Design jobs

148 *Tyler Farmer, Mairead Matthews, "Spanning the Virtual Frontier: Canada's Immersive Technology Ecosystem", ICTC, August 2020, https://medium.com/digitalthinktankictc/spanning-the-virtual-frontier-9381c1da2395*

Table A-3: Competencies and Skills: Creative/Artistic Roles

Top Creative/Artistic Jobs

Job	Competencies	Specific Applications
Technical Artist	Animation Texturing 3D Modelling Character animation Scripting UV Mapping Visual effects Environment art Lighting Rigging Shading Digital painting Compositing Motion Capture Motion graphics Concept art Rendering 3D rigging 3D animation Digital photography Pipelines Substance design Oil painting	Maya Photoshop 3D Studio Max Preforce Unity 3D Zbrush MEL JavaScript MotionBuilder ActionScript Unreal Editor Unreal Engine 4 Mudbox HTML Java Git Marvelous Designer Python JSFL Django SketchUp Illustrator PHP Blender Particle Effects Visual Studio Powershell Linux JSON CSS Maxscript Jscript Nuke Node.js MongoDB

Job	Competencies	Specific Applications
Storyboard Artist	Storyboarding Illustration Character animation Traditional animation Digital illustration Character design Layout Concept design Background art 3D animation Storytelling Conceptual art Visual storytelling 2D animation Sketching Facial animation	Photoshop Toon Boom TVPaint Storyboard Pro

Job	Competencies	Specific Applications
Shader Writer	Lighting Visual Effects Look development Shading Rendering Compositing Pipeline development Digital Compositing Digital painting Texture painting Scripting 3D rendering Modelling	Maya Nuke Renderman Python MEL Mental Ray Katana C++ Vray Linux Git Java Unreal Engine 4 Zbrush Mudbox Jira Arnold Katana Mari
Job	**Competencies**	**Specific Applications**
Modeller	3D modelling Texturing Animation Character modelling Rendering Character animation Texture painting Digital sculpting Character rigging Surfacing Figure drawing Facial expression animation UV layout Pre-visualization Environment modelling Hard surface modelling Facial rigging Prop modelling Elastic reality Cloth simulation UV Layout Topology Optimizing models (naming, grouping, etc.)	Maya Zbrush Mudbox Nuke Python MEL Marvelous Designer Modo
Job	**Competencies**	**Specific Applications**
Match Move Artist	Visual effects Compositing 3D modelling Animation Rotoscoping Lighting Texturing Character animation	Maya Nuke PFTrack 3D Equalizer After Effects Photoshop Matchmover Zbrush

	Video editing	Premiere
	Look development	MEL
	Matte painting	Final Cut Pro
	Rendering	Bijou
	Motion tracking	Mudbox
	Motion capture	Linux
	Object tracking	Maya Dynamics
	Colour correction	Unreal Engine 4
	Environment art	Renderman
	Matchmoving	Blender
	UV mapping	Python
	3D animation	Flash
	Pre-visualization	VRay
	Camera tracking	Mari
	Lens mapping	Motion Builder
	Concept art	Katana
	Integration of live action and CGI	VEX
	Prop modelling	MAM
	Drone photography	Houdini
	2D tracking	Unity
	Shell scripting	

Job	**Competencies**	**Specific Applications**
Lighting TD	Lighting	Maya
	Texturing	Nuke
	Compositing	Photoshop
	Visual effects	After Effects
	Shading	Renderman
	Look Development	Mental Rayt
	Animation	Katana
	3D Modelling	Vray
	Matte painting	Python
	Post-production	Mari
	Storyboarding	3D Studio Max
	CG lighting	Linux
	Digital photography	Houdini
	3D animation	Realflow
	Surfacing	MEL
	Pipeline development	Cinema 4D
	Photography	Arnold
	Traditional fine arts (e.g., painting)	Clarisse
		Mantra
	Cinematography	Unreal Engine
		PF Track
		Blender
		Amazon Redshift
		Gaffer

Job	**Competencies**	**Specific Applications**
Gameplay Animator	Character animation	Maya
	Video game design	MotionBuilder
	Storyboarding	3D Studio Max
	Game development	MEL
	Character rigging	Photoshop
	Visual effects	Premiere
	Layout	Unity 3D
	Modelling	Unreal Editor

	Compositing	Perforce
	Keyframe animation	Unreal Engine 4
	Creature animation	Zbrush
	Character design	Toon Boom
	Rendering	TVPaint
	Concept art	C++
	Pre-visualization	Flash
	2D animation	C#
	SaaS	Blender
	Facial rigging	Python
	Game engines	
	Mobile game development	
	Facial performance capture	
	Skinning	
	Social game development	

Job	**Competencies**	**Specific Applications**
FX Artist	Visual Effects	Maya
	Animation	Houdini
	Compositing	Nuke
	Texturing	3D Studio Max
	Digital Compositing	Realflow
	3D Modelling	MEL
	Shading	Python
	Data analysis	C++
	Cloth simulation	Particle Effects
	Cinematics	Maya Dynamics
	Digital painting	Vray
	Pre-visualization	Fume FX
	Studio lighting	Phoenix FSD
	Camera operation	Renderman
	Rendering	DMM
	UV Mapping	Mantra
	Matchmoving	Katana
	Colour Grading	OpenVDB
	Visual storytelling	SOuP
	Fluid simulation	Final Cut Studio
	Rigid body dynamics	Rayfire
	2D effects	Bitfrost
		Marmoset
		Maya Fluids
		Maxscript

Job	**Competencies**	**Specific Applications**
Environment Artist	Texturing	Maya
	Environment art	Zbrush
	Lighting	3D Studio Max
	Texture painting	Photoshop
	Animation	Substance Designer
	UV Mapping	Substance Painter
	Low Poly modelling	Unreal Engine 4
	Digital sculpting	Mudbox
	Shading	Perforce
	Rigging	Nuke
	Rendering	Unity
	World shaping	Unreal Editor

	Digital painting	Houdini
	Conceptual art	Vray
	Prop modelling	Marmoset
	Wireframing	Unity 3D
	Compositing	Mari
	Physical-based rendering	Python
	Look development	JavaScript
		Flash
		HTML
		CryEngine 3
		MMO
		Premiere
		CSS
		After Effects

Job	Competencies	Specific Applications
Concept Artist	Illustration	Maya
	Concept art	Illustrator
	Storyboarding	After Effects
	Digital painting	Zbrush
	Texturing	InDesign
	Matte painting	Premiere
	Digital art	Keyshot
	Concept development	Nuke
	Traditional animation	Sketchup
	Digital sculpting	TVPaint
	Typography	Fusion 360
	Sketching	Fume FX
	Layout	Vray
	Visual design	Blender
	Compositing	Octane
	Shading	Unity
	Landscape design	Toon Boom
	Environment art	Corel Painter
	Figure drawing	Photoshop

Job	Competencies	Specific Applications
Compositor	Visual effects	Nuke
	Animation	Maya
	Digital compositing	Photoshop
	3D modelling	Premiere
	Texturing	Mocha
	Character animation	PFTrack
	Matte painting	Zbrush
	Storyboarding	Avid Media Composer
	Editing	Houdini
	3D Animation	Flash
	Sound design	Digital Fusion
	Motion design	Renderman
	Environment modelling	Shotgun
	Motion graphics	Toon Boom
	3D rendering	Mudbox
		MEL

Job	Competencies	Specific Applications
Rigger	3D modelling	Maya
	Visual effects	Python
	Facial rigging	MEL
	Pipeline development	XSI
	Scripting	C++
	Motion capture	3D Studio Max
	User interface design	Motionbuilder
	Phython scripting	Linux
		JavaScript
		C#
		PyQt
		Shotgun
		Github
		JSON
		Node.js
		Ftrack
		JIRA
		Unity

Job	Competencies	Specific Applications
CG Supervisor	Visual effects	Maya
	Animation	Nuke
	Lighting	Photoshop
	Texturing	After Effects
	Look development	MEL
	Digital compositing	Shake
	Character animation	3D Studio Max
	Rendering	Zbrush
	Pre-visualization	Python
	VFX Supervision	Katana
	Rigging	Mudbox
	Creative direction	Houdini
	Creative design	MotionBuilder
	Problem solving	Premiere
	Cloth design	Arnold
	Matte painting	Blender
	Team leadership	Renderman
	Video editing	Substance Painter
	Post-production	Perforce
	Special effects	Syntheyes
	3D animation	nCloth
	3D rendering	SketchUp
	Digital art	Rayfire
	Fur design	VRay
	Tracking	Unreal Engine
	Pipeline development	Mari
	Skinning	JIRA
	Consulting	Qube
	VR	Redshift
	Hard surface modelling	Katana
	Optimization	
	UV mapping	
	Simulation	
	Concept design	
	Shader writing	
	Team management	

Job	Competencies	Specific Applications
CFX Artist	Animation	Maya
	Visual effects	Photoshop
	Rigging	Nuke
	3D modelling	Houdini
	Dynamic simulation	MEL
	UV mapping	Xgen
	Cloth simulation	Mudbox
	Lighting	Ornatrix
	Painting	Katana
	Surfacing	Softimage
	CG grooming	Particle Effects
		MotionBuilder
		nCloth
		Lightwave
		Yeti
		Max Script
		RV
		Shotgun

Job	Competencies	Specific Applications
3D Animator	3D Modelling	Maya
	Animation	Unreal Engine 4
	Storyboarding	Unity
	Illustration	Unity 3D
	3D character rigging	Python
	Video editing	Unreal Engine 3
	Digital sculpting	RV
	Character rigging	Shotgun
	Character design	TV Paint
	Knowledge/shooting reference	Harmony

Job	Competencies	Specific Applications
2D Animator	Illustration	Maya
	Character animation	Photoshop
	Storyboarding	Unity 3D
	Digital painting	Zbrush
	Concept art	Premiere
	Compositing	InDesign
	Character design	Substance Painter
	Lighting	Sketchbook Pro
	Motion graphics	Mudbox
	Sketching	VRay
	Rendering	Blender
	Conceptual art	SPINE 2D
	Background art	Marmoset
	Page layout	Action Script
	Environment art	MEL
	Sculpting	Perforce
	Wireframing	Swift
	Character rigging	PFTrack
	2D animation	
	Illustration	

Table A-4: Competencies and Skills: Production Roles

Top Production Jobs

Job	Competencies	Specific Applications
Technical Art Director	Visual effects	Maya
	Lighting	Perforce
	Animation	Photoshop
	3D Modelling	Python
	Character animation	Zbrush
	Rigging	MotionBuilder
	VFX supervision	Renderman
	Pipeline development	Shotgun
	Creative direction	Nuke
	Product evaluation	VRay
	Team leadership	Houdini
	Project management	Katana
	Problem solving	Arnold
	Video editing	Swift
	Look development	Perimere
	Workflow design	Maxscript

Job	Competencies	Specific Applications
Motion Capture Director	Animation	Unity 3D
	3D modelling	Maya
	Texturing	MotionBuilder
	Production management	
	Project management	
	Character animation	
	Rigging	
	Storyboarding	

Job	Competencies	Specific Applications
Development Director	Project planning	Perforce
	Team leadership	JIRA
	Agile project management	MMO
	Change management	Maya
	Quality assurance	SDLC
	Requirements analysis	XML
	Business analysis	MS Project
	User experience	Google Adwords
	Business process improvement	HTML
	Testing	CRM
	Vendor management	.NET
	Process improvement	Java
	Outsourcing management	CSS
	Operations management	DirectX
	Release management	HTML5
	Integration	Seapine Test Track pro
	Requirements gathering	Linux
	Budget management	Sharepoint
	Financial modelling	Hansoft
	Copy Editing	
	Creative problem solving	
	Systems analysis	
	Project plans	
	Market research	
	Resource management	
	Prototyping	

Job	Competencies	Specific Applications
Art Director	Animation Concept design Creative direction Texturing Illustration Storyboarding Set design Directing Storytelling Digital painting Motion graphics 3D Modelling Matte painting Environment art Computer playback Conceptual art Background art User Interface Design Look development Concept development	Photoshop Unreal Engine 3 Maya Flash SketchUp Shader Creation

Job	Competencies	Specific Applications
Producer	Post-production Project management Team building Production management Pre-production Budgeting Product management Knowledge management VFX coordination Content development	MS Project JIRA Shotgun Sharepoint

Job	Competencies	Specific Applications
Director	Project management Concept design 3D rendering Budgeting Market research Team building Character animation Production management Communication	Photoshop Maya

Job	Competencies	Specific Applications
Layout Supervisor	Character animation Visual effects Layout Storyboarding Pre-visualization Lighting 3D modelling Digital illustration Problem solving Concept design Art direction Keyframe animation Look development Team Mentoring Team leadership Cinematography	3D Studio Max Glimp Photoshop

Table A-5: Competencies and Skills: Digital Roles

Top Digital/Technical Jobs

Job	Competencies	Specific Applications
Software Engineer / Programmer	Game development Game programming Gameplay programming Game design Software development AI Scripting Mobile game design Level design User interface design Game mechanics Gameplay systems Database design Animation User experience design	C++ C# Java Unity 3D Python PHP Git JavaScript iOS Unreal Engine 4 CSS SQL Node.js JIRA 3D Studio Max Maya HTML5 Linux Blender
Unreal Programmer	Game design Gameplay programming Level design Software development	C++ Unreal Engine 4

Job	Competencies	Specific Applications
Unity Programmer	Game design Gameplay design Game development User interface design Gameplay programming 3D modelling User experience design Rigging Unity Analytics	Unity 3D C# C++ Mudbox Kanban Java JavaScript CSS Maya Flex JIRA Linux HTML
UI Programmer	**Competencies**	**Specific Applications**
	User interface design Frontend coding User experience design Software development Game design	Unreal Engine 4 C++ Python
Systems Programmer	**Competencies**	**Specific Applications**
	Web development Software design Object-oriented-programming Backend development QA Network programming Agile methodologies Game programming	XML Java Unreal Engine 4 Git JIRA C# Linux Perforce JavaScript Unity3D
Server Programmer	**Competencies**	**Specific Applications**
	Database management Agile methodologies Software development Backend coding Database design ETL	Perforce HTML Maven C++ SQL JavaScript .Net C# Tableau Java Eclipse Python

Job	Competencies	Specific Applications
Pipeline TD	Animation	Maya
	Visual effects	Python
	Compositing	Nuke
	Lighting	C++
	Texturing	Linux
	3D Modelling	PyQt
	Pipeline development	JavaScript
	Character rigging	Git
	Shading	Mari
	UV mapping	Unity3D
	Digital compositing	PFTrack
	Rendering	Fume FX
	3D rendering	jQuery
	Look development	PySide
	Rotoscoping	VMWare
	User interface design	Eclipse
	Texture art	Shake
	Facial animation	Maxscript
	Shell scripting	Arnold
	Pipeline improvement	Katana
	Data structures	Unreal Engine 4
	Facial rigging	
	Matte painting	
	VFX pipeline	
	AI	
	Plugin development	
	Autorigging systems	
	Simulations	
	Process automation	
	Cleaning code	
	Skinning	
	API development	
	Real-time rendering	
	Online research	

Job	Competencies	Specific Applications
Online Programmer	DevOps	C++
	Agile methodologies	JavaScript
	Game design	C#
	Test automation	XML
		Unity 3D
		HTML5
		Java
		MongoDB
		Azure

Job	Competencies	Specific Applications
Motion Capture Programmer	Motion capture 3D modelling Post-production Visual effects Texturing Game development UV mapping Pre-visualization Motion editing Pre-production Rigging Shell scripting	Maya Zbrush MotionBuilder Nuke Unreal Engine 4 3D Studio Max Renderman Mari Premiere Perforce MotionBuilder Linux Illustrator Unity 3D Matchmover MEL
Mobile Developer	NLP Gameplay programming Socket programming Interface building Rendering Game development Game logic Neural networks AI Machine learning	C++ Linux Open AL Open GL Python XML JSON Unity3D
Graphics Programmer	Game design Gameplay programming Game developing Graphic design	Perforce Unity 3D Unreal Engine 4
Gameplay Programmer	Game development Game design Level design Game mechanics Cross-platform development Mobile game development Social game development Game audio implementation Debugging Multiplayer game development Rapid prototyping Machine learning 3D graphics Multithreading	C++ C# Perforce Unity ActionScript Python Unity 3D Unreal Engine 4 Action Script 3.0 Flash Subversion SQL JIRA Open GL Mercurial Maya

Job	Competencies	Specific Applications
Audio Programmer	Gameplay programming Game design Cross-platform development Game mechanics Multithreading AI	Perforce C++ C# Python Ruby Java .NET SQL JavaScript VB.NET Open GL JIRA XML Unity 3D

Table A-6: Competencies and Skills: Design Roles

Top Design Jobs

Job	Competencies	Specific Applications
UX Designer	User interface design User experience design Graphic design Web design Interaction design Typography Wireframing Usability design User research User flows Frontend coding Usability testing Digital illustration Colour grading Mockups Concept design Colour correction Accessibility design Discovery Motion design Iconography Vector illustration Custom journey mapping	Photoshop Illustrator Maya After Effects InDesign JavaScript HTML5 Axure Premiere Zbrush Adobe XD Perforce Unreal Editor Sketch React.js JavaScript Google analytics Unreal Engine 4 Unity Valve Hammer Editor Github Python Bootstrap Visio Java

Job	Competencies	Specific Applications
UI Designer	User interface design Graphic design Illustration Web design	Photoshop Illustrator Flash InDesign

	User experience design	Photoshop
	Interaction design	Illustrator
	Game design	Flash
	Wireframing	InDesign
	Layout	After Effects
	Conceptual art	Maya
	Frontend coding	Premiere
	Brand development	PHP
	Concept development	CSS
	User experience prototyping	ActionScript
	Pixel art	HTML
	Usability testing	Zbrush
	Mockups	Sketch
	Colour theory	HTML5
	Visual identity design	Java
	Accessibility testing	Perforce
	User flow development	MySQL
		inVision
		Swift
		Corel Draw
		Axure
Job	**Competencies**	**Specific Applications**
Systems Designer	Game design	Maya
	Level design	Unity 3D
	Gameplay design	Photoshop
	Game mechanics	C++
	QA	C#
	Scripting	Flash
	Sound reinforcement	Unreal Engine
	Graphic design	Java
	Sound design	.NET
	UX design	JavaScript
		Unity
Job	**Competencies**	**Specific Applications**
Narrative Designer	Creative writing	Unity 3D
	Screenwriting	Unreal Editor
	Narrative development	Unreal Engine 4
	Storytelling	Photoshop
	Scripting	Perforce
	Story editing	Tableau
	Researching	SQL
	Copy editing	Zbrush
	Dialogue writing	Action Script
	Voice casting	Git
	Mission design	
	Fiction writing	
	Proofreading	
	Text editing	
	User interface design	
	Cinematic design	
	Narrative analysis	
	Non-linear editing	
	Story design	
	Digital storytelling	

Job	Competencies	Specific Applications
Mission Designer	Game development Gameplay design Scripting Level design Game mechanics 2D art Narrative development Low Poly modelling Game Scripting UV mapping	Maya Perforce Unreal Engine 4 C# Photoshop Unity 3D JIRA Illustrator Zbrush Substance Painter 3D Coat C++ Premiere Python After Effects DevTrack

Job	Competencies	Specific Applications
Level Designer	Game design Gameplay design Game mechanics 3D modelling UV mapping Multiplayer game design Storyboarding Animation Character design Narrative development Creative writing Low poly modelling Lighting Game art Storytelling User interface design Concept design Research Blueprint development Game scripting Texture painting World building Landscape design Screenwriting Character modelling Interactive design UV mapping Branching narrative development Level architecture design Post-production Game testing	Maya Unreal Engine 4 Unity 3D JIRA C# Zbrush DevTrack Premiere Game Maker Mudbox Hero Engine

Job	Competencies	Specific Applications
Gameplay Designer	Game design Game development Level design Game mechanics Game balance design Multiplayer game design Mission design World building User interface design Concept development User experience design Game scripting Game testing	Unity 3D Perforce Photoshop Unreal Engine 4 C# Maya Mission Scripter C++ Visio Java JIRA

Job	Competencies	Specific Applications
Campaign Designer	Level design Game mechanics Gameplay design World building Game scripting Software documentation	Maya Unreal Engine 4 Unreal Editor Perforce

V Educational Institutions in BC offering Creative/Artistic Training and Digital/Technical Training

This data was aggregated via interviews with post-secondary institutions and industry representatives in this study, general online research, and from leveraging resources provided by Education Planner BC. This list does not factor in quality of training, or program outcomes. It is merely a resource to understand the number of institutions that offer some form of relevant training for the creative technology sector.

Creative/Artistic and Design

LaSalle College
Vancouver Film School
Lost Boys
Centre for Digital Media
Capilano University
Langara College
Okanagan College
Vancouver Community College
Think Tank
Emily Carr University of Art + Design
Fairleigh Dickson University
College of New Caledonia
BCIT
Camosun College
Northern Lights College
Selkirk College
Vancouver Institute of Media Arts (VanArts)
Vancouver College of Art + Design
University of British Columbia
Vancouver Island University
Kwantlen Polytechnic
Thompson Rivers University

Digital/Technical

BCIT
Camosun College
Coast Mountain College
College of New Caledonia
Douglas College
Kwantlen Polytechnic
Langara College
Nicola Valley Institute of Technology
North Island College
Northeastern University
Northern Lights College
Okanagan College
Selkirk College
SFU
Thompson Rivers University
UBC
UNBC
University of the Fraser Valley
University of Victoria
Vancouver Community College
Capilano University
Vancouver Island University
Columbia College
Fraser International College
Fairleigh Dickson University

Production

Langara College
Vancouver Film School
UBC
BCIT

Number of “seats” per program is not available, as this information is not published by post-secondary institutions. Some representatives from post-secondary institutions interviewed in this study provided estimates of seat numbers for their programs, although these figures ranged. Digital/technical areas of study, namely at larger institutions, tended to have relatively large class sizes, accommodating up several hundred students. Artistic/creative, production, and design programs tended to have smaller class sizes, sometimes under 20.

VI Occupational (NOC) Breakdown for the Creative Technology Sector Across Economic Regions in BC

Table A-7 indicates average 2019 employment within the creative technology sector across the various economic regions of British Columbia. Tables A-8 and A-9 segment this data by gender as well as age.

This data is meant to be utilized to provide a very broad understanding of employment in creative technology-related occupations in each region, while understanding that these NOCs are also found in other areas of the economy. Moreover, NOC categorizations are not the same nor comparable to specific jobs. For example, NOC 5241 Graphic designers and illustrators is an occupational grouping under which 100 different possible occupations are listed. The possible jobs in this grouping include some that are relevant to the creative technology sector (like 3D animator), alongside numerous irrelevant and in some cases, very outdated jobs (i.e., bank note designer, wallpaper colourist). The employment figures next to each NOC below represent that occupational grouping (including both relevant and irrelevant jobs) across the economy (i.e., not limited to the creative technology sector), not specific jobs.

Despite their shortcomings, NOCs are still utilized by the creative technology sector to a limited extent. In instances where talent is sourced internationally, immigration applications require that specific jobs need to be "mapped" to existing NOCs.

Table A-7: Employment in creative technology NOCs by BC census subdivision

Location	NOC	Description	2019 Jobs
Vancouver Island and Coast	2173	Software engineers and designers	550
Vancouver Island and Coast	2174	Computer programmers and interactive media developers	2,936
Vancouver Island and Coast	2283	Information systems testing technicians	111
Vancouver Island and Coast	5131	Producers, directors, choreographers and related occupations	158
Vancouver Island and Coast	5223	Graphic arts technicians	23
Vancouver Island and Coast	5225	Audio and video recording technicians	96
Vancouver Island and Coast	5241	Graphic designers and illustrators	682
Vancouver Island and Coast		**Sum**	**4,556**
Lower Mainland--Southwest	2173	Software engineers and designers	9,991
Lower Mainland--Southwest	2174	Computer programmers and interactive media developers	15,327
Lower Mainland--Southwest	2283	Information systems testing technicians	1,586
Lower Mainland--Southwest	5131	Producers, directors, choreographers and related occupations	2,972
Lower Mainland--Southwest	5223	Graphic arts technicians	1,453
Lower Mainland--Southwest	5225	Audio and video recording technicians	1,807
Lower Mainland--Southwest	5241	Graphic designers and illustrators	9,361
Lower Mainland--Southwest		**Sum**	**42,497**
Thompson--Okanagan	2173	Software engineers and designers	198
Thompson--Okanagan	2174	Computer programmers and interactive media developers	769
Thompson--Okanagan	2283	Information systems testing technicians	103
Thompson--Okanagan	5131	Producers, directors, choreographers and related occupations	70
Thompson--Okanagan	5223	Graphic arts technicians	29
Thompson--Okanagan	5225	Audio and video recording technicians	89
Thompson--Okanagan	5241	Graphic designers and illustrators	406
Thompson--Okanagan		**Sum**	**1,664**

Location	NOC	Description	2019 Jobs
Kootenay	2173	Software engineers and designers	24
Kootenay	2174	Computer programmers and interactive media developers	114
Kootenay	2283	Information systems testing technicians	23
Kootenay	5131	Producers, directors, choreographers and related occupations	18
Kootenay	5223	Graphic arts technicians	5
Kootenay	5225	Audio and video recording technicians	13
Kootenay	5241	Graphic designers and illustrators	48
Kootenay		**Sum**	**246**
Cariboo	2173	Software engineers and designers	26
Cariboo	2174	Computer programmers and interactive media developers	127
Cariboo	2283	Information systems testing technicians	21
Cariboo	5131	Producers, directors, choreographers and related occupations	24
Cariboo	5223	Graphic arts technicians	3
Cariboo	5225	Audio and video recording technicians	12
Cariboo	5241	Graphic designers and illustrators	73
Cariboo		**Sum**	**286**
North Coast	2173	Software engineers and designers	17
North Coast	2174	Computer programmers and interactive media developers	47
North Coast	2283	Information systems testing technicians	8
North Coast	5131	Producers, directors, choreographers and related occupations	18
North Coast	5223	Graphic arts technicians	1
North Coast	5225	Audio and video recording technicians	1
North Coast	5241	Graphic designers and illustrators	40
North Coast		**Sum**	**132**
Nechako	2173	Software engineers and designers	10
Nechako	2174	Computer programmers and interactive media developers	32
Nechako	2283	Information systems testing technicians	6
Nechako	5131	Producers, directors, choreographers and related occupations	0
Nechako	5223	Graphic arts technicians	0
Nechako	5225	Audio and video recording technicians	0
Nechako	5241	Graphic designers and illustrators	14
Nechako		**Sum**	**61**
Northeast	2173	Software engineers and designers	11
Northeast	2174	Computer programmers and interactive media developers	45
Northeast	2283	Information systems testing technicians	6
Northeast	5131	Producers, directors, choreographers and related occupations	13
Northeast	5223	Graphic arts technicians	2
Northeast	5225	Audio and video recording technicians	8
Northeast	5241	Graphic designers and illustrators	65
Northeast		**Sum**	**150**

Table A-8: Percent employment by gender in creative technology NOCs and BC economic region

Location	NOC	Description	Female	Male
Cariboo	2173	Software engineers and designers	0%	100%
Cariboo	2174	Computer programmers and interactive media developers	0%	100%
Cariboo	2283	Information systems testing technicians		
Cariboo	5131	Producers, directors, choreographers and related occupations	22.2%	77.8%
Cariboo	5223	Graphic arts technicians		

Location	NOC	Description	Female	Male
Cariboo	5225	Audio and video recording technicians	0%	100%
Cariboo	5241	Graphic designers and illustrators	25%	75%
Cariboo		**Total**	**12%**	**88%**
Kootenay	2173	Software engineers and designers	0%	100%
Kootenay	2174	Computer programmers and interactive media developers	14.8%	85.2%
Kootenay	2283	Information systems testing technicians		
Kootenay	5131	Producers, directors, choreographers and related occupations	20%	80%
Kootenay	5223	Graphic arts technicians		
Kootenay	5225	Audio and video recording technicians	0%	100%
Kootenay	5241	Graphic designers and illustrators	56.8%	43.2%
Kootenay		**Total**	**29.8%**	**70.2%**
Lower Mainland--Southwest	2173	Software engineers and designers	14.7%	85.3%
Lower Mainland--Southwest	2174	Computer programmers and interactive media developers	16.6%	83.4%
Lower Mainland--Southwest	2283	Information systems testing technicians	36%	64%
Lower Mainland--Southwest	5131	Producers, directors, choreographers and related occupations	31.5%	68.5%
Lower Mainland--Southwest	5223	Graphic arts technicians	19.6%	80.4%
Lower Mainland--Southwest	5225	Audio and video recording technicians	15.9%	84.1%
Lower Mainland--Southwest	5241	Graphic designers and illustrators	47.3%	52.7%
Lower Mainland--Southwest		**Total**	**25.9%**	**74.1%**
Nechako	2173	Software engineers and designers		
Nechako	2174	Computer programmers and interactive media developers	0%	100%
Nechako	2283	Information systems testing technicians		
Nechako	5131	Producers, directors, choreographers and related occupations		
Nechako	5223	Graphic arts technicians		
Nechako	5225	Audio and video recording technicians		
Nechako	5241	Graphic designers and illustrators	66.7%	33.3%
Nechako		**Total**	**50%**	**50%**
North Coast	2173	Software engineers and designers		
North Coast	2174	Computer programmers and interactive media developers		
North Coast	2283	Information systems testing technicians		
North Coast	5131	Producers, directors, choreographers and related occupations	100%	0%
North Coast	5223	Graphic arts technicians		
North Coast	5225	Audio and video recording technicians		
North Coast	5241	Graphic designers and illustrators	50%	50%
North Coast		**Total**	**66.7%**	**33.3%**
Northeast	2173	Software engineers and designers		
Northeast	2174	Computer programmers and interactive media developers	0%	100%
Northeast	2283	Information systems testing technicians		
Northeast	5131	Producers, directors, choreographers and related occupations	0%	100%
Northeast	5223	Graphic arts technicians		
Northeast	5225	Audio and video recording technicians		
Northeast	5241	Graphic designers and illustrators	88.9%	11.1%
Northeast		**Total**	**57.1%**	**42.9%**
Thompson--Okanagan	2173	Software engineers and designers	12.2%	87.8%
Thompson--Okanagan	2174	Computer programmers and interactive media developers	13.6%	86.4%
Thompson--Okanagan	2283	Information systems testing technicians	0%	100%
Thompson--Okanagan	5131	Producers, directors, choreographers and related occupations	28.9%	71.1%
Thompson--Okanagan	5223	Graphic arts technicians	18.2%	81.8%
Thompson--Okanagan	5225	Audio and video recording technicians	10.5%	89.5%
Thompson--Okanagan	5241	Graphic designers and illustrators	43.8%	56.2%
Thompson--Okanagan		**Total**	**24.8%**	**75.2%**

Location	NOC	Description	Female	Male
Vancouver Island and Coast	2173	Software engineers and designers	13.2%	86.8%
Vancouver Island and Coast	2174	Computer programmers and interactive media developers	12.7%	87.3%
Vancouver Island and Coast	2283	Information systems testing technicians	40%	60%
Vancouver Island and Coast	5131	Producers, directors, choreographers and related occupations	27.1%	72.9%
Vancouver Island and Coast	5223	Graphic arts technicians	0%	100%
Vancouver Island and Coast	5225	Audio and video recording technicians	10.5%	89.5%
Vancouver Island and Coast	5241	Graphic designers and illustrators	52.9%	47.1%
Vancouver Island and Coast			**25.2%**	**74.8%**

Table A-9: Percent employment by age grouping in creative technology NOCs and BC economic region

Location	Description	NOC	15-24	25-34	35-44	45-54	55-64	65-74	75+
Cariboo	Software engineers and designers	2173	0.0	0.0	57.1	42.9	0.0	28.6	0.0
Cariboo	Computer programmers and interactive media developers	2174	14.3	14.3	14.3	50.0	0.0	0.0	0.0
Cariboo	Information systems testing technicians	2283							
Cariboo	Producers, directors, choreographers and related occupations	5131	0.0	66.7	0.0	0.0	22.2	0.0	0.0
Cariboo	Graphic arts technicians	5223							
Cariboo	Audio and video recording technicians	5225	50.0	0.0	0.0	0.0	0.0	0.0	0.0
Cariboo	Graphic designers and illustrators	5241	12.5	37.5	37.5	12.5	12.5	12.5	0.0
Cariboo	**Total**		**12.0**	**28.0**	**24.0**	**24.0**	**8.0**	**8.0**	**0.0**
Kootenay	Software engineers and designers	2173	15.4	23.1	0.0	23.1	15.4	0.0	0.0
Kootenay	Computer programmers and interactive media developers	2174	0.0	22.2	44.4	22.2	0.0	0.0	0.0
Kootenay	Information systems testing technicians	2283							
Kootenay	Producers, directors, choreographers and related occupations	5131	0.0	0.0	40.0	30.0	0.0	0.0	0.0
Kootenay	Graphic arts technicians	5223							
Kootenay	Audio and video recording technicians	5225	20.0	20.0	20.0	50.0	0.0	0.0	0.0
Kootenay	Graphic designers and illustrators	5241	6.8	25.0	38.6	15.9	11.4	4.5	0.0
Kootenay	**Total**		**6.7**	**21.2**	**33.7**	**23.1**	**6.7**	**1.9**	**0.0**
Lower Mainland--Southwest	Software engineers and designers	2173	6.6	37.1	29.8	19.7	6.2	0.6	0.1
Lower Mainland--Southwest	Computer programmers and interactive media developers	2174	9.2	34.4	29.6	19.1	7.0	0.7	0.1
Lower Mainland--Southwest	Information systems testing technicians	2283	13.1	29.7	27.4	21.1	7.4	1.1	0.0
Lower Mainland--Southwest	Producers, directors, choreographers and related occupations	5131	6.4	25.8	26.7	26.2	10.4	3.7	0.5
Lower Mainland--Southwest	Graphic arts technicians	5223	12.8	39.7	35.2	6.7	2.8	1.1	0.0
Lower Mainland--Southwest	Audio and video recording technicians	5225	11.6	40.1	26.7	13.8	6.3	1.9	0.0
Lower Mainland--Southwest	Graphic designers and illustrators	5241	8.2	40.2	26.6	16.6	6.9	1.4	0.0
Lower Mainland--Southwest	**Total**		**8.4**	**36.0**	**28.5**	**18.7**	**7.0**	**1.3**	**0.1**
Nechako	Software engineers and designers	2173							
Nechako	Computer programmers and interactive media developers	2174	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nechako	Information systems testing technicians	2283							
Nechako	Producers, directors, choreographers and related occupations	5131							
Nechako	Graphic arts technicians	5223							
Nechako	Audio and video recording technicians	5225							
Nechako	Graphic designers and illustrators	5241	33.3	0.0	33.3	50.0	0.0	0.0	0.0
Nechako	**Total**		**25.0**	**0.0**	**50.0**	**37.5**	**0.0**	**0.0**	**0.0**

Location	Description	NOC	15-24	25-34	35-44	45-54	55-64	65-74	75+
North Coast	Software engineers and designers	2173							
North Coast	Computer programmers and interactive media developers	2174							
North Coast	Information systems testing technicians	2283							
North Coast	Producers, directors, choreographers and related occupations	5131	0.0	0.0	0.0	0.0	0.0	0.0	0.0
North Coast	Graphic arts technicians	5223							
North Coast	Audio and video recording technicians	5225							
North Coast	Graphic designers and illustrators	5241	0.0	50.0	50.0	50.0	0.0	0.0	0.0
North Coast	**Total**		**0.0**	**66.7**	**33.3**	**33.3**	**0.0**	**0.0**	**0.0**
Northeast	Software engineers and designers	2173							
Northeast	Computer programmers and interactive media developers	2174	0.0	0.0	100.0	0.0	0.0	0.0	0.0
Northeast	Information systems testing technicians	2283							
Northeast	Producers, directors, choreographers and related occupations	5131	0.0	66.7	0.0	0.0	0.0	66.7	0.0
Northeast	Graphic arts technicians	5223							
Northeast	Audio and video recording technicians	5225							
Northeast	Graphic designers and illustrators	5241	0.0	33.3	22.2	44.4	0.0	0.0	0.0
Northeast	**Total**		**0.0**	**50.0**	**28.6**	**28.6**	**0.0**	**14.3**	**0.0**
Thompson--Okanagan	Software engineers and designers	2173	6.1	22.4	44.9	18.4	12.2	0.0	0.0
Thompson--Okanagan	Computer programmers and interactive media developers	2174	15.0	25.0	28.6	17.1	10.7	2.9	0.0
Thompson--Okanagan	Information systems testing technicians	2283	0.0	50.0	0.0	50.0	0.0	0.0	0.0
Thompson--Okanagan	Producers, directors, choreographers and related occupations	5131	10.5	15.8	23.7	23.7	10.5	0.0	0.0
Thompson--Okanagan	Graphic arts technicians	5223	0.0	0.0	0.0	18.2	18.2	36.4	0.0
Thompson--Okanagan	Audio and video recording technicians	5225	0.0	21.1	21.1	42.1	0.0	21.1	0.0
Thompson--Okanagan	Graphic designers and illustrators	5241	13.8	24.6	24.6	23.1	11.5	0.0	1.5
Thompson--Okanagan	**Total**		**11.8**	**23.0**	**27.4**	**21.5**	**10.7**	**3.1**	**0.5**
Vancouver Island and Coast	Software engineers and designers	2173	2.6	25.0	38.8	23.7	7.2	0.0	1.3
Vancouver Island and Coast	Computer programmers and interactive media developers	2174	7.7	25.4	29.8	20.4	12.7	2.2	0.0
Vancouver Island and Coast	Information systems testing technicians	2283	0.0	33.3	43.3	13.3	10.0	0.0	0.0
Vancouver Island and Coast	Producers, directors, choreographers and related occupations	5131	4.3	34.3	21.4	12.9	14.3	7.1	2.9
Vancouver Island and Coast	Graphic arts technicians	5223	0.0	20.0	20.0	40.0	20.0	0.0	0.0
Vancouver Island and Coast	Audio and video recording technicians	5225	10.5	13.2	15.8	28.9	13.2	10.5	0.0
Vancouver Island and Coast	Graphic designers and illustrators	5241	6.3	23.1	27.7	22.3	15.5	2.9	0.8
Vancouver Island and Coast	**Total**		**6.0**	**25.1**	**29.9**	**21.2**	**12.7**	**2.7**	**0.7**