STUDENT CAPSTONE REPORT

Understanding the Tech Equity Gap in Long Beach

A comprehensive project submitted in partial satisfaction of the requirements for the degree Master of Urban & Regional Planning

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Disclaimer

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Executive Summary

The purpose of the research is to develop a deeper understanding of the aerospace and technology workforce environment in Long Beach. It examines disparities in employee representation and wages across demographic variables, namely race, ethnicity, and gender. Findings then inform recommendations for stakeholders to address existing gaps.

Qualitative interviews were first conducted with 'ecosystem stakeholders', such as educational institutions and organizations, employment agencies, community-based organizations, and City departments, as well as corporate stakeholders to inform an overview of perceived challenges to nurturing equity in the Long Beach technology workforce. Results indicated that a lack of diversity in candidate pools, inadequate internal education such as training on conducting interviews for inclusive hiring, and demographic disparities in candidate pools by position and salary were all significant barriers to hiring for equity.

A quantitative analysis of racial, gender, and ethnic disparities in the representation and earnings of Long Beach's resident technology workforce also revealed several important takeaways. To name a few, representation, rather than wages, is the biggest contributor to gaps in gross earnings, women are the most underrepresented in the Long Beach resident technology workforce, and aerospace and healthcare are uniquely represented industries in the City.

The combined research ultimately informed a number of recommendations. Corporate stakeholders should develop their own frameworks and definitions for equity, thoroughly train staff members and hiring managers on how to reach defined goals, conduct and publish metrics and progress reports for public viewing to increase accountability, and focus on hiring and retention of underrepresented groups especially in high-ranking, high-salaried roles. City and public sector agencies should use the traction gained by aerospace publicity to broaden the focus of their programs to more technology industries and apply representation and wage data to steer funding. Ecosystem partners should focus on foundational youth education and partner early in a student's academic career to successfully support the transition from the classroom to the workforce. Most importantly, all stakeholders should develop meaningful connections and relationships with community members to drive equity efforts.

Introduction

In recent years, Long Beach has experienced a reemergence of its aerospace industry and a general influx of young tech companies. Economic development in these sectors has resulted in a concentration of intellectual and financial capital as well as a substantial increase in job opportunities, all of which have the potential to greatly benefit Long Beach residents. However, it remains in question who this growth benefits and how to ensure reinvestment into the community of Long Beach.

To this end, the City currently runs a Smart City Initiative that prioritizes equitable, resident-centered solutions in data and technology by supporting programs that pair tech training and smart city development. These include the LB Co-Lab, a new pilot program that will identify neighborhood needs from community working groups and request product proposals from local tech companies. Resident-participants will also receive professional training in skills such as software development, data analytics, and UX design. Additionally, the City has partnered with Long Beach Unified School District (LBUSD) to create the Space Beach Teacher Externship Program, a professional development program for K-12 teachers to organize clear aerospace career pathways for students.

As Long Beach continues to expand and improve programs aimed at redistributing tech-generated benefits, it will be important to develop partnerships with the growing number of aerospace and tech companies locating within the City's limits.

Literature Review

The project seeks to understand the current state of the tech workforce environment in Long Beach and inform potential educational programs for bridging gaps in wages and representation. This requires an investigation of literature to document and report the growth progression of tech industries in Long Beach and existing equity-oriented resources and programs.

Literature pulled from a variety of sources assesses City of Long Beach programs, statistics on the share of tech jobs in Long Beach and wage averages, and Science, Technology, Engineering, and Math (STEM) educational pipeline development.

Technology Industry Growth and Existing Conditions

Multiple sources note the distinct reemergence of the aerospace industry in Long Beach.[1] A base of Amelia Earhart in the 1920s and launchpad of aviator Archibald Hoxsey in his high-altitude world-record breaking flight in 1910, Southern California, and particularly Los Angeles, experienced a boom in aerospace companies taking root within the City around the 1950s.[2] These companies specialized primarily in the production of military and commercial aircrafts, a segment of the industry now thought of as traditional aerospace manufacturing.[3] Some traditional companies, such as Boeing Co. and Northrop Grumman, still own and operate facilities in and around Long Beach used for this type of manufacturing.

However, in only the last few years, Long Beach has seen a new class of aerospace companies purchase land in the City. Newer companies, such as Relativity Space, Virgin Orbit, Rocket Lab USA, and others are industry innovators primarily involved in the manufacturing of space craft. The concentration of space companies in Long Beach makes sense considering the existing local talent pool in Long Beach and other nearby cities (e.g., Northrop Grumman is based in Redondo Beach, and Space X – the first private organization to send a manned spacecraft into orbit – is based in Hawthorne). "Unparalleled talent" was cited by Tim Ellis, Chief Executive and Co-founder of Relativity Space, a company working to manufacture rockets using 3D printers, in a statement on his decision to move the company from Inglewood to Long Beach and to later expand its headquarters by a million square feet.[4]

California State University Long Beach (CSULB), led by professor and chair of Economics at CSULB and director of the Office of Economic Research, Seiji Steimetz, cite research on just how impactful recent aerospace growth has been to Long Beach's economic development and the City's overall workforce. Steimetz is also responsible for coining a new nickname for the City – "Space Beach". According to the California Employment Development Department, aerospace industry employment in Long Beach increased by 48%, from 2,800 to 4,200 jobs, between 2018 and 2020.[5] While aerospace industry employment makes up about 1% of total employment in Los Angeles County, it comprises 2.7% of employment in Long Beach. And if job postings, which rose 120% in the region from 105 in January 2021 to 279 in July of the same year, are considered an indicator, aerospace jobs as a share of the overall market will continue to rise rapidly.[6]

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[1] e.g., California State University Long Beach. *CCPHIT Consortium*; Knutsen. (2019); Rubio-Licht. (2021).
[2] Knutsen. (2019); Rubio-Licht. (2021).
[3] Rubio-Licht. (2021).
[4] Ibid.
[5] Hernandez and Steimetz. (2021); Rubio-Licht. (2021).
[6] Rubio-Licht. (2021).

An unignorable factor in studying this growth and its impacts on the City's residents is the lucrative nature of aerospace jobs on the whole. While, as cited previously, aerospace jobs make up 2.7% of total employment in Long Beach, they account for 5.2% of the City's payroll.[7]

Aerospace in Politics and the Media

In recent years, the growing number of aerospace startups headquartered in Long Beach has been accompanied by increased public attention to the industry. In January of this year, Rex Richardson, the newly elected mayor of Long Beach, released his 100-day plan for the City, entitled The Opportunity Beach Agenda. Within the report, he outlined strategies for various goals related to community safety and health, education, sustainability, economic development, and housing.

In the 100-day plan, Richardson identifies five growth industries that will be key to Long Beach's economic future, one of those being aerospace. He also outlines the "Grow Long Beach Initiative", a strategy to develop partnerships with the Long Beach Accelerator – an early-stage business mentorship program, the Long Beach Economic Partnership – an economy-focused community based organization, and the Long Beach Center for Economic Inclusion – a nonprofit community development corporation, in supporting 100 new startups in the City as a strategy to bolster the success of aerospace and other designated industries – ports/logistics/supply chain, entertainment and hospitality, healthcare and hospitals, and educational institutions.[8] As of a progress report released by the Mayor's Office on April 24th, 2023, the City has now established the Long Beach Strategic Growth Fund with an initial investment of $25 million and established partnerships with seven local economic development organizations.[9]

A proponent of aerospace industry development in the media, on March 2nd Richardson also spoke at the 'Space Beach' Panel Program organized by the Long Beach Area Chamber of Commerce. The panel featured industry representatives from several startups including Relativity Space, Rocket Launch, SpinLaunch, Vast Space, Virgin Orbit, along with two larger, well-established firms, Boeing and GXO, Inc., who spoke on the direction of the industry and its impact on economic development in Long Beach.[10]

[7] Hernandez and Steimetz. (2021); Rubio-Licht. (2021).
[8] City of Long Beach. (2023, January 10).
[9] City of Long Beach. (2023, April 24).
[10] Long Beach Area Chamber of Commerce. (2023).

Nevertheless, aerospace startups, and startups in general, are at risk of collapse based on product performances that must attract and retain investors who may not be well informed about the industry's unique technological challenges to securing economic returns. Just recently, Virgin Orbit, a highly regarded aerospace startup that spoke in March at the 'Space Beach' Panel Program, failed in April of this year following an unsuccessful launch and was forced to lay off 700 employees, 85% of its workforce.[11] On the heels of SpaceX's significant success – the company launched 61 times last year, in spite of earlier failed missions – in 2020, national investment in aerospace reached $7.6 billion, a 16% increase from 2019, topping off a 6-year growth trend since 2015.[12] However, in 2022, investment fell by a dramatic 58%, and the aerospace industry saw its lowest levels of investment since 2013.[13] While aerospace may still be experiencing growth and investment in Long Beach, stakeholders involved in efforts to expand support for aerospace and startups as a path towards broader growth and employment in the City should factor in the precarity of success for such companies, the threats their failure may pose to local job security, and potentially disproportionate impacts of layoffs among demographic groups.

Existing Programs and Partners

Along with this growth have come several Community-Based Organizations (CBOs), educational organizations, local government agencies, and private stakeholders motivated by the opportunity to support and guide the development of this young industry. These have resulted in a mix of tech-oriented partnerships and programs.

The City of Long Beach itself includes a robust Technology and Innovation Department of around 200 people. Its Smart Cities team particularly zeroes in on the stated goal of leveraging technology and data in service of residents.[14] The Long Beach Smart Cities Initiative has already launched pilot programs with the goal of integrating resources brought by tech companies into City life. Programs are designed to pair tech training with smart city and public service development. One such program, Pitch Long Beach! provides an opportunity for the City to partner with private sector stakeholders to develop innovative technologies for city service delivery by allowing local vendors to pitch project ideas to be implemented as pilot programs.[15] In 2022, the City also launched the LB Co-Lab program, which will identify neighborhood needs from community working groups and request product proposals from local tech companies.

[11] Q.ai. (2023).
[12] Davenport. (2023).
[13] Ibid.
[14] City of Long Beach. *Smart City Initiative*.
[15] City of Long Beach. *Pitch Long Beach!.*

Resident-participants will also receive professional training in skills such as software development, data analytics, and UX design.[16]

The City also runs educational pipeline and workforce development programs outside of its Technology and Innovation Department. These include a partnered effort with Long Beach Unified School District (LBUSD) and the Pacific Gateway Workforce Innovation Network, a public employment assistance agency serving Long Beach, Signal Hill, and the Los Angeles Harbor communities, to create the Space Beach Teacher Externship Program, a professional development program for K-12 teachers who are trained to organize and facilitate clear, easy-to-navigate aerospace and technology career pathways for students.[17]

Other key partnerships have been initiated by CBOs. The Long Beach Economic Partnership Quarterly Forum is a series of conferences organized to discuss the future of the City's aerospace and technology industries and features talks by university and government officials coupled with industry leaders. The Economic Forum is run by the Long Beach Economic Partnership (LBEP), an organization of local professionals aiming to expand economic opportunities and grow business in the City, alongside the Long Beach State Office of Economic Research and the City of Long Beach Economic Development Department.[18]

CSULB also demonstrates its commitment to supporting the expansion of tech industries by publishing research and collaborating with partners to create programs such as the Economic Forum. The university strives towards equity in tech, and as a result, is among the top universities in the nation in awarding STEM degrees to minority students.[19] Additionally, the university runs student training programs such as the CCPHIT Consortium, which was formed to address racial gaps that exist in the public health informatics and technology sector. The Consortium includes California community colleges, California State University campuses, and the University of California, who work together to provide culturally relevant, equity-focused public health informatics curricula and an on-the-job training program to remove barriers to workforce access.[20]

Lessons in Methodology

While these programs and partnerships are an important starting point, and CSULB has achieved relative success in providing a diverse group of students with STEM training, these efforts should

[16] City of Long Beach. *LB Co-Lab.*
[17] City of Long Beach. (2022).
[18] California State University Long Beach. *Workforce*; Long Beach Economic Partnership. (2021, June 17).
[19] California State University Long Beach. (2018, August 13).
[20] California State University Long Beach. *CCPHIT Consortium.*

be considered critically. One question to explore is whether students from Long Beach are taking part in CSULB STEM programs. In addition, the extent to which university partnerships and projects include and engage the surrounding community varies. A study assessing CSULB's effectiveness in engaging community members in the research process was conducted this year by CSULB professors. The research context for the study was similar to that of this project in that it explored the question of 'Development for Whom?' and analyzed methods of engaging with community members in addressing the impacts of urban redevelopment on neighborhoods of color in Long Beach.[21] One major driver of such change is the enlarged role of technology in the City, both in employment opportunities and city service delivery. Therefore, any profile on existing conditions in the tech workforce environment in Long Beach would be remiss not to constantly engage with and represent residents and neighborhood-based CBOs as critical stakeholders.

The concept for this study is loosely based off a study by HR&A Advisors on the technology workforce ecosystem in New York City, originally published in 2014, and updated in 2017, 2020, and 2022.[22] The project's goal is to promote policies that contribute to a more inclusive tech workforce in the City, which aligns well with the goal of this research.[23] While not to be relied on wholly, the study offers up some useful practices in the way of methodology. For research purposes, the "tech ecosystem" is divided by HR&A Advisors into four categories of jobs: tech jobs within tech industries, non-tech jobs within tech industries, tech jobs within non-tech industries, and non-tech jobs within non-tech industries. Only the first three are considered "technology jobs".[24] Providing a definition of "technology jobs" is vital to producing a focused body of research, and the goal of the study should be centered when doing so. Our research aims to inform methods of increasing employment diversity and resident employment in the technology sector in Long Beach. Therefore, while methodology used here does not exactly mimic that of the HR&A study, a clear definition of technology occupations is key to a statistical analysis designed to assist City's stakeholders and decision makers working to craft well-targeted educational and job training pipelines.

Preliminary Takeaways

While current literature begins to provide a high-level understanding of the aerospace workforce profile in Long Beach, it requires supplementation in major areas. One avenue for future research is an examination of the City's general technology workforce environment,

[21] Lopez et al. (2022)
[22] HR&A Advisors, Inc. (2014); HR&A Advisors, Inc. (2017); HR&A Advisors, Inc. (2020); HR&A Advisors, Inc. (2022)
[23] HR&A Advisors, Inc. (2022)
[24] Ibid.

including technology jobs within the aerospace industry, within other tech-classified industries, and within non-tech industries.

Additional research is also needed to understand the details of who participates in Long Beach's tech workforce and other initiatives to integrate technology solutions into the City's fabric. While information is reported on overall workforce share and average salary estimates, there is limited study and a lack of quantification of the demographic characteristics of the workforce, such as race, ethnicity, gender, and employee city of residence.[25] This data can have enormous implications for supporting economic growth in Long Beach that is guided by principles of equity and inclusivity. Similarly, while the literature identifies, and is in large part composed by a number of stakeholders, additional work must be done to identify community-based organizations that exist within the City and seek their guidance.

[25] Hernandez and Steimetz. (2021); Rubio-Licht. (2021).

Methodology

Quantitative Research Design

The quantitative portion of the report analyzes the technology workforce ecosystem in Long Beach using occupational data classified by the U.S. Census Bureau Standard Occupational Classification (SOC) System. Disparities in employee wages and representation across demographic variables, specifically gender, race, and ethnicity, are examined using data provided by the U.S. Census Bureau of Labor Statistics (BLS) and compiled by Chmura Economics and Analytics, LLC, a national labor market database and research software tool (JobsEQ).

The definition of a "technology occupation" for the purposes of this study follows closely the method of classification employed by HR&A Advisors in their original report The New York City Tech Ecosystem: Generating Economic Opportunities for all New Yorkers and all subsequent updates. Amended as necessary to reconcile differences in SOC coding and available occupations, the list of occupations evaluated (*Appendix B*) have been selected based on meeting at least one of the following three criteria:

(1) produces tech;
(2) facilitates the use of tech by others; and/or
(3) would cease to exist without the presence of tech

In analyzing occupation diversity statistics throughout the report, technology occupations are subset to examine specific characteristics of two samples of occupations: the top ten highest paid technology occupations and the top ten most common technology occupations (*Appendix B*). 'The top ten most common technology occupations subset' allows us to learn about demographic diversity of the majority (61%) of technology workers in Long Beach using a condensed, more manageable dataset (10 occupations versus 50 occupations). 'The top ten highest paid technology occupations' subset allows us to draw conclusions about the demographic composition of Long Beach workers who are benefitting the most from the City's technology sector.

Qualitative Research Design

A qualitative component of this study consists of stakeholder insights on hiring experiences and company-led equity efforts. Another purpose of conversations with stakeholders is to inform helpful data points to explore as part of the quantitative analysis.

Technology and aerospace companies as well as ecosystem stakeholders, including non-profits, community-based organizations, and City departments, have agreed to provide insights to contribute to the qualitative portion of this report. Participants responded to a short list of questions by email or speaking on the phone. Responses are summarized in the report with consent from the participant but never attributed.

The discussion questions were as follows:

- How would you characterize your experiences in hiring, especially in gender- and race-inclusive hiring and hiring locally? OR What do you see as the biggest challenges and barriers to nurturing equity in Long Beach's technology ecosystem?
- How has your company approached Diversity, Equity, and Inclusion (DEI) in the workplace? OR What is your role in advancing equity in the Long Beach technology workforce? What related programs or initiatives do you manage?
- What types of data would be helpful to inform your DEI efforts?
- How can the local technology ecosystem (such as the City of Long Beach and other local agencies) support your DEI and local hire goals? OR How can local technology companies support DEI and local hire goals?

Stakeholder participants and potential community partners include:

Ecosystem Stakeholders

- Long Beach City College – a community college offering a wide range of educational programs, career training, and transfer pathways to four-year universities
- Pacific Gateway Workforce Innovation Network – a regional organization dedicated to connecting job seekers with employment opportunities, providing workforce development services, and supporting economic growth in the Long Beach and Los Angeles County area
- Long Beach Technology and Innovation Department – a municipal entity responsible for driving technological advancements, fostering innovation, and implementing digital strategies to enhance services and quality of life for residents in Long Beach
- STEM Advantage – a nonprofit organization that empowers underrepresented students by providing mentorship, scholarships, and internships in the fields of science, technology, engineering, and mathematics (STEM)
- Long Beach Economic Partnership – a collaborative organization focused on cultivating economic growth, attracting investment, and supporting businesses in the city of Long Beach

Corporate Stakeholders[26]

- Odys Aviation – "a sustainable aviation company building vertical take-off and landing aircraft to cut travel time in half on the world's busiest routes"[27]
- Boeing – a multinational aerospace company that designs, manufactures, and sells commercial airplanes, defense systems, and space exploration technologies

[26] A limitation is that the three companies interviewed are all aerospace companies and their insights may not closely reflect the experiences of hiring teams in other industries.
[27] https://www.odysaviation.com/

- Relativity Space – a cutting-edge aerospace company that specializes in 3D printing and manufacturing of rockets for the purpose of revolutionizing the space industry

Findings and Analysis

Stakeholder Insights – Qualitative Research Results

Hiring for Equity

Overall, stakeholders cited a lack of diversity in candidate pools as one of the greatest barriers to hiring for equity. Participants noted that the industry has a widespread lack of diversity, particularly in terms of gender, there can be some difficulty in sourcing talent locally for positions that require unique skill sets, and the diversity of talents pools may vary across office locations. Hiring managers also vary from location to location and some offices may require additional training. Training employees in how to conduct interviews that facilitate inclusive hiring is one method of internal education used by a respondent to support a diverse set of employees. Employers have also seen candidate pools vary distinctively across positions and levels. For example, there are patterns in the racial/ethnic/gender makeup of employees that differs for technicians, versus engineers, versus management.

Barriers to Education and Training

Similarly, non-corporate stakeholders, such as community-based organizations, educational organizations, and local government, cited skill sets and diverse representation in talent pools as two of the greatest barriers to nurturing equity in the tech workforce. Most participants in this group are part of organizations whose purpose involves increasing diversity, equity, and inclusion in the technology space in Long Beach. In this role, non-corporate stakeholders have a complementary perspective of the talent pipeline because of their efforts in training and supporting the emerging workforce. A common theme throughout participant responses was the challenge of reaching the most underserved portions of the population. There are a number of programs run by local organizations which offer career-development training for low-income community members, dislocated workers (unemployed), adults, and youth, including those in foster care or who experience housing insecurity.

Nevertheless, training programs designed to teach candidates technology-based skill sets, both common and specialized, while removing financial barriers along with barriers to language and equipment access are ultimately self-selective. A candidate's participation in a program is ultimately dependent on many factors. These include some level of academic experience to supplement with skills learning. Participants in this research cited that many students graduating from high school are not only underprepared to enter the job market, but also are not at the level necessary to enter state university, community college, or even short-term training programs. According to local stakeholders, while Long Beach has high graduation rates, a number of high-school aged students transfer to storefront schools to complete their education. These schools, outside of Long Beach Unified School District (LBUSD), vary in quality and often don't have the same level of resources as the school district. Other determinants of ability to participate in education and training programs are as basic as one's knowledge that these opportunities exist as well as having the capacity to pursue them. For youth or adults dealing

with more pressing challenges, career development training isn't an accessible option. For these reasons, a large portion of the population is still "hidden".

What Should be Done?

Early Education

Because a basis of knowledge greatly improves a candidates' chances in being successful in training and certification programs as well as entering the job market, stakeholder participants recurringly reported awareness of, and early education applied towards, technology opportunities as a vital equity solution.

A general consensus was that this connection should be achieved through partnerships between organizations, especially corporate stakeholders themselves and educational institutions. The experience of participants in this research supports a belief that companies need to understand the local workforce and candidate pools, the community's access to resources, and how to navigate equity issues through connection with schools and universities.

Relationship Building

To stakeholder participants, a key component of effective early outreach and education about technology career opportunities is the ability of youth and community members to connect with representatives of these careers on a personal level. This can be accomplished by companies making individuals who can relate to populations that are underrepresented accessible, so that youth can hear from technology employees who look like them and share similar backgrounds. Another way to build credit with the community could be for companies to partner with community organizations that are trusted by community members. These don't necessarily need to be technology organizations so long as they can provide a conduit from residents to professionals in technology roles. Other programs that stakeholders mentioned could be helpful to companies looking to form connections with the emerging resident workforce are internship programs, apprenticeships, mentorships, mock interviews, and career day opportunities. To this end, some corporate stakeholders currently offer workshops and youth field trips to facilities. Another mentioned the usefulness of something as simple as providing information on industry-specific topics, such as what a security clearance entails.

Takeaways

Conversations with stakeholders emphasized three primary ideas about how to improve equity in the Long Beach technology workforce:

1. One of the most impactful solutions towards diversifying the technology candidate pool is the building of relationships between local organizations and technology companies.

2. Youth engagement is especially important because a strong foundation in high school education tends to be a strong predictor of a candidate's success moving forward in training/certification programs and securing a career in technology.

3. Tech companies must internally train hiring managers and team members on a company-held framework for equity, existing disparities, and how to proactively connect with local organizations.

Quantitative Research Results: Occupation Diversity[28]

Tech Occupations in Proportion to the Total Workforce

A total of 277,270 residents of Long Beach are registered as working in Long Beach according to U.S. Census Standard Occupational Classification (SOC) data. Of these, 12,371 residents, or 4.5%, fall into the category of technology workers as defined by the study.[29]

Overall Technology Earnings

Within technology occupations as defined by the study, the top 10 most represented occupations among residents of Long Beach are as follows:

Table 1.1: 10 Most Common Tech Jobs among Long Beach Residents

	Percent (of subset)	Value	Average Annual Wages
Software Developers	31.6%	2,377	$132,700
Computer Occupations, All Other	13.9%	1,046	$101,300
Computer and Information Systems Managers	11.5%	863	$181,800
Computer User Support Specialists	11.4%	859	$69,100
Computer Systems Analysts	8.9%	668	$121,300
Network and Computer Systems Administrators	5.2%	392	$102,000
Electrical Engineers	4.6%	344	$131,600
Industrial Engineers	4.5%	335	$114,700
Telecommunications Equipment Installers and Repairers (Except Line Installers)	4.3%	322	$71,000

[28] All occupation diversity data is at the ZCTA geographic scale. "Long Beach Zip Codes" are a compilation of zip codes that fall within or intersect the City of Long Beach (*Appendix A*).
[29] Source: Chmura Economics and Analytics, LLC

Software Quality Assurance Analysts and Testers	4.2%	313	$104,900
10 Most Common Tech Jobs	100%	7,518	$121,600
Total – All Occupations (Tech and Non-tech)		277,270	$70,300

Source: Chmura Economics and Analytics, LLC

These occupations represent 7,518 residents of Long Beach, or 61% of residents working in technology occupations. This subset allows us to capture demographic data about the majority of technology workers in Long Beach using a somewhat representative and more manageable dataset. Within the top ten most common occupations listed above, all but two occupations pay an average annual salary of over $100,000, and all occupations pay an annual salary above the City's median household income of $66,410 and well above the per capita income of $33,607 (*Table 1.1)*.[30] That is to say, the majority of technology workers living in the City of Long Beach are making well over the average annual per capita and even median household income for the City.

Further, three of these top ten occupations, which represent the majority of the City's technology workers, rank in the top ten most lucrative technology occupations for employees working in the City (*Table 1.2)*.[31] Software Developers, the most represented technology occupation among residents, are the fifth highest paid occupation among all employees working in Long Beach. In accordance, the average annual income ($121,600) among the top ten most represented technology occupations (representing 61% of tech workers) is high even compared to the average for all technology workers living in the City ($112,600).[32] In other words, of all technology workers living in Long Beach, most tend to work in especially lucrative occupations.

Table 1.2: Top 10 Highest Earning Tech Jobs among Long Beach Residents

	Percent (of subset)	Value	Average Annual Wages
Computer and Information Systems Managers	18.7%	863	$181,800
Computer and Information Research Scientists	0.7%	32	$153,400
Computer Hardware Engineers	2.3%	105	$152,000
Aerospace Engineers	3.8%	174	$143,800
Software Developers	51.6%	2,377	$132,700
Electrical Engineers	7.5%	344	$131,600
Electronics Engineers, Except Computer	4.8%	221	$130,500

[30] Salary data is based on employees working as opposed to living in Long Beach, whereas employee data is based on employees living in Long Beach Because we do not know if all those employed in technology jobs in Long Beach are living in Long Beach, these numbers can provide a limited proxy for average annual wages within each occupation.

[31] This subset allows us to draw conclusions about the demographic composition of Long Beach technology workers who are earning the most.

[32] This average was calculated by Chmura Economics and Analytics, LLC and differs from the average calculated and used in the pay gap analysis section of this paper later on.

Nuclear Medicine Technologists	0.5%	21	$128,900
Computer Network Architects	5.4%	251	$128,000
Information Security Analysts	4.8%	219	$123,900
10 Highest Earning Tech Jobs	100%	4,606	$142,400
Total – All Occupations (Tech and Non-tech)		277,270	$70,300

Source: Chmura Economics and Analytics, LLC

Representation Gaps - Race

Table 2.1: Long Beach Race Demographics

	Percent	Value
White	49.4%	228,163
Black or African American	12.6%	58,238
American Indian and Alaska Native	0.8%	3,659
Asian	12.8%	59,270
Native Hawaiian and Other Pacific Islander	0.6%	2,710
Total Population		462,081

Source: Chmura Economics and Analytics, LLC

Table 2.2: Race Demographics for Technology Occupations

	White	Black	American Indian	Asian	Pacific Islander	Average Annual Wages
Technology Occupations	55.0%	7.1%	0.4%	30.2%	0.6%	$112,600
Total – All Occupations (Tech and Non-tech)	61.6%	13.6%	1.0%	15.0%	0.9%	$70,300

Source: Chmura Economics and Analytics, LLC

Of all technology workers living in Long Beach, the two most represented race groups are White, 55%, and Asian, 30.2% (*Table 2.2*). Compared to the race breakdown of the total employed workforce in Long Beach, all race groups are underrepresented in technology occupations, except for Asians, who are overrepresented.[33] Asians and Whites are also overrepresented in comparison to total City population demographics, while Black and American Indian City residents are underrepresented in the tech workforce (*Table 2.1 - Long Beach Race*

[33] Race versus Ethnicity: Census race categories include 'White', 'Black or African American', 'American Indian and Alaska Native', 'Asian', 'Native Hawaiian and Other Pacific Islander', 'Some Other Race', and 'Two or More Races', the sum of which is 100% of the population. Census ethnicity categories include 'Hispanic or Latino (of any race)', and 'Non-Hispanic or Latino', the sum of which is 100% of the population. Members of either ethnicity category may be of any race. Therefore, race and ethnicity are not mutually exclusive and are analyzed in their own right throughout the report. Ethnicity section follows.

Demographics).[34] In both total occupations and technology occupations, Whites are most highly represented.

Table 2.3: Race Demographics for 10 Most Common Technology Occupations

	White	Black	American Indian	Asian	Pacific Islander	Average Annual Wages
Software Developers	35.6%	3.3%	0.1%	55.4%	0.3%	$132,700
Computer Occupations, All Other	53.6%	10.5%	0.2%	27.9%	0.5%	$101,300
Computer and Information Systems Managers	57.6%	5.4%	0.4%	31.0%	0.5%	$181,800
Computer User Support Specialists	55.7%	8.1%	0.4%	25.1%	0.8%	$69,100
Computer Systems Analysts	55.3%	8.7%	0.2%	28.8%	0.3%	$121,300
Network and Computer Systems Administrators	62.1%	6.6%	0.2%	23.3%	0.4%	$102,000
Electrical Engineers	56.7%	3.9%	0.2%	37.9%	0.3%	$131,600
Industrial Engineers	58.9%	5.0%	0.5%	32.3%%	0.8%	$114,700
Telecommunications Equipment Installers and Repairers (Except Line Installers)	66.5%	12.8%	0.8%	8.5%	2.0%	$71,000
Software Quality Assurance Analysts and Testers	52.3%	5.1%	0.1%	40.6%	0.1%	$104,900
10 Most Common Tech Jobs	50.1%	6.3%	0.3%	36.8%	0.5%	$121,600
Total – All Occupations (Tech and Non-tech)	61.6%	13.6%	1.0%	15.0%	0.9%	$70,300

Source: Chmura Economics and Analytics, LLC

Software developers are the most represented technology occupation for residents and the second-highest paid technology occupation at an average of $132,700 annually. Software developers are also the group with the highest Asian representation of any technology occupation at 55.4% of employees and the lowest White representation of any technology

[34] American Indian and Alaska Natives, and Native Hawaiian and Other Pacific Islanders are similarly represented in the technology workforce and total population. In both groups, as well as total employed residents, each group accounts for less than 1% of the total population. In order to avoid extrapolation, the representation of these groups in technology occupations is not explicitly analyzed. The following 'Pay Gap Magnitude' section, which uses precise calculations to estimate salaries weighted by representation, includes data points for both of these groups. The category 'Two or More Races' is left out of all analysis because we are interested in qualitative rather than quantitative race characteristics.

occupation at 35.6% of employees (*Table 2.3*). Because software developers alone comprise almost 20% of all technology workers living in Long Beach, attention should be paid specifically to achieving more balanced representation and pay equity within this profession, whether that means targeting related certificate programs for the emerging workforce or having software engineers from underrepresented groups speak at local schools among other interventions.

The occupation in the top ten most represented technology occupations with both the highest Black (12.8%) and White (66.5%) representation is Telecommunications Equipment Installers and Repairers (Except Line Installers).[35] This occupation is also the second-lowest paid of the group, with $71,000 in average annual wages. This occupation earns on average $110,800 dollars below the highest-paid occupation, Computer and Information Systems Managers, who make $181,800 per year on average. White (57.6%) followed by Asian (31%) workers are the most highly represented among Computer and Information Systems Managers. Alone, analyzing and comparing how race and pay rates relate among the most common technology occupations cannot provide concrete conclusions, but it can indicate directions for further research within and across specific occupations of interest.

Table 2.4: Race Demographics for Top 10 Highest Earning Technology Occupations

	White	Black	American Indian	Asian	Pacific Islander	Average Annual Wages
Computer and Information Systems Managers	57.6%	5.4%	0.4%	31.0%	0.5%	$181,800
Computer and Information Research Scientists	51.3%	5.3%	0.2%	36.1%	0.4%	$153,400
Computer Hardware Engineers	40.1%	5.2%	0.4%	51.4%	0.8%	$152,000
Aerospace Engineers	68.3%	2.7%	0.5%	24.3%	0.9%	$143,800
Software Developers	35.6%	3.3%	0.1%	55.4%	0.3%	$132,700
Electrical Engineers	56.7%	3.9%	0.2%	37.9%	0.3%	$131,600
Electronics Engineers, Except Computer	57.0%	3.9%	0.2%	37.6%	0.3%	$130,500
Nuclear Medicine Technologists	67.3%	8.8%	0.3%	18.2%	0.6%	$128,900
Computer Network Architects	54.8%	11.4%	0.4%	21.9%	0.6%	$128,000
Information Security Analysts	67.0%	8.5%	0.2%	15.2%	0.4%	$123,900

[35] This representation has the highest Pacific Islander representation of the subgroup at 2.0%. In all the others, representation for this group is below 1%. In all ten most represented technology occupations, American Indian representation does not reach 1%. Please see previous note about sample size.

10 Highest Earning Tech Jobs	46.5%	4.5%	0.2%	43.4%	0.4%	$142,400
Total – All Occupations (Tech and Non-tech)	61.6%	13.6%	1.0%	15.0%	0.9%	$70,300

Source: Chmura Economics and Analytics, LLC

For every Black technology worker within the top ten highest paying technology jobs, there are 10.33 White workers employed and 9.64 Asian workers employed (*Table 2.4*). Compared to the total employed population in Long Beach, Black representation within this subset is 66% lower.

Representation Gaps - Ethnicity

Table 3.1: Long Beach Ethnicity Demographics

	Percent	Value
Non-Hispanic/Latino	56.8%	262,278
Hispanic or Latino (of any race)	43.2%	199,803
Total Population		462,081

Source: Chmura Economics and Analytics, LLC

Table 3.2: Ethnicity Demographics for Technology Occupations

	Non-Hispanic/Latino	Hispanic or Latino	Average Annual Wages
Technology Occupations	76.0%	24.0%	$112,600
Total – All Occupations (Tech and Non-tech)	56.2%	43.8%	$70,300

Source: Chmura Economics and Analytics, LLC

A significant feature of Long Beach's population profile is a high representation of residents that identify as Hispanic/Latino. This group of nearly 200,000 residents comprises 43.2% of the population (*Table 3.1*). This representation is reflected closely in the City's workforce, where 43.8% of workers identify as Hispanic or Latino (*Table 3.2*). However, within technology jobs in the City, Hispanic/Latino representation is nearly halved (24%).

Table 3.3: Ethnicity Demographics for 10 Most Common Technology Occupations

	Non-Hispanic/Latino	Hispanic or Latino	Average Annual Wages
Software Developers	84.7%	15.3%	$132,700
Computer Occupations, All Other	73.8%	26.2%	$101,300
Computer and Information Systems Managers	82.2%	17.8%	$181,800

Computer User Support Specialists	71.2%	28.8%	$69,100
Computer Systems Analysts	78.8%	21.2%	$121,300
Network and Computer Systems Administrators	80.9%	19.1%	$102,000
Electrical Engineers	86.8%	13.2%	$131,600
Industrial Engineers	85.0%	15.0%	$114,700
Telecommunications Equipment Installers and Repairers (Except Line Installers)	42.6%	57.4%	$71,000
Software Quality Assurance Analysts and Testers	75.2%	24.8%	$104,900
10 Most Common Tech Jobs	78.6%	21.4%	$121,600
Total – All Occupations (Tech and Non-tech)	56.2%	43.8%	$70,300

Source: Chmura Economics and Analytics, LLC

If we again look at the subgroup of the top ten most common technology occupations among City residents (*Table 3.3*), Hispanic and Latino representation (21.4%) is even lower than in total technology jobs. The occupation with the highest representation of Hispanic/Latino residents is Telecommunications Equipment Installers and Repairers (Except Line Installers), of which 57.4% identify as such, and the occupation with the lowest is Electrical Engineers, of which only 13.2% identify as Hispanic/Latino.

Telecommunications Equipment Installers and Repairers (Except Line Installers) receive the second lowest average annual income of the subgroup and Electrical Engineers receive the third highest, with a $60,600 wage gap between the two. The workforce of the highest paid occupation of the ten, Computer and Information Systems Managers, are composed of 17.8% Hispanic/Latino residents and the lowest paid occupation, Computer User Support Specialists, are 28.8% Hispanic/Latino. Even from a preliminary search for patterns within a representative sample, there is an apparent correlation between low levels of Hispanic/Latino representation within high-salaried technology jobs and vice-versa. Still, further research is needed to substantiate trends in earnings and representation.

Table 3.4: Ethnicity Demographics for Top 10 Highest Earning Technology Occupations

	Non-Hispanic/Latino	Hispanic or Latino	Average Annual Wages
Computer and Information Systems Managers	82.2%	17.8%	$181,800
Computer and Information Research Scientists	82.6%	14.4%	$153,400
Computer Hardware Engineers	85.5%	14.5%	$152,000
Aerospace Engineers	78.9%	17.1%	$143,800
Software Developers	84.7%	14.3%	$132,700
Electrical Engineers	86.8%	13.2%	$131,600
Electronics Engineers, Except Computer	87.0%	13.0%	$130,500
Nuclear Medicine Technologists	82.0%	18.0%	$128,900
Computer Network Architects	83.4%	16.6%	$128,000
Information Security Analysts	77.1%	22.9%	$123,900
10 Highest Earning Tech Jobs	83.8%	16.2%	$142,400
Total – All Occupations (Tech and Non-tech)	56.2%	43.8%	$70,300

Source: Chmura Economics and Analytics, LLC

For every Hispanic/Latino technology worker employed within the top ten highest paying tech occupations, there are 5.17 non-Hispanic/Latino workers (*Table 3.4*). Similar to Black workers, compared to the total employed population in Long Beach, Hispanic representation within this subset is 63% lower.

Representation Gaps - Gender

Table 4.1: Long Beach Gender Demographics

	Percent	Value
Male	49.3%	227,632
Female	50.7%	234,449
Total Population		462,081

Source: Chmura Economics and Analytics, LLC

Table 4.2: Gender Demographics for Technology Occupations

	Male	Female	Average Annual Wages
Technology Occupations	76.5%	23.5%	$112,600
Total – All Occupations (Tech and Non-tech)	52.3%	47.7%	$70,300

Source: Chmura Economics and Analytics, LLC

In comparison to male representation levels in the total population of Long Beach (49.3%) as well as the total employed resident workforce (52.3%), men are significantly overrepresented among technology employees living in Long Beach, comprising 76.5% of this workforce (*Table 4.1;Table 4.2*). Conversely, women make up less than a quarter (23.5%) of the City's resident technology workforce, which is well below female representation levels in both the City's total population and the City's total employed workforce.[36]

Table 4.3: Gender Demographics for 10 Most Common Technology Occupations

	Male	Female	Average Annual Wages
Software Developers	81.4%	18.6%	$132,700
Computer Occupations, All Other	77.3%	22.7%	$101,300
Computer and Information Systems Managers	77.0%	23.0%	$181,800
Computer User Support Specialists	77.6%	22.4%	$69,100
Computer Systems Analysts	65.7%	34.3%	$121,300
Network and Computer Systems Administrators	83.1%	16.9%	$102,000
Electrical Engineers	93.2%	6.8%	$131,600
Industrial Engineers	78.3%	21.7%	$114,700
Telecommunications Equipment Installers and Repairers (Except Line Installers)	87.5%	12.5%	$71,000
Software Quality Assurance Analysts and Testers	71.2%	28.8%	$104,900

[36] This study uses data compiled by the U.S. Census Bureau, which has yet to address additional gender classifications. More accurate data should be collected that captures more detailed and accurate population demographics.

10 Most Common Tech Jobs	78.8%	21.2%	$121,600
Total – All Occupations (Tech and Non-tech)	52.3%	47.7%	$70,300

Source: Chmura Economics and Analytics, LLC

Out of the top ten technology occupations held by residents of Long Beach, which comprise approximate 61% of the technology workforce, no occupation is represented by a female majority (*Table 4.3*). Compared to the average for all technology occupations, representation of women among these ten is also lower than among all technology occupations.

The occupation from this subset with the highest percentage of women is Computer Systems Analysts at 34.3%, while women are least represented among Electrical Engineers at 6.8%. Of these ten, Computer Systems Analysts and Electrical Engineers are both within the top four highest paid occupations. Earning an average of $121,300 and $131,600 respectively, these jobs compensate well over the average annual wages for all occupations and on par with average earnings for the top ten most common tech jobs. While it may be useful in some cases to compare types or characteristics of technology professions with high to low levels of female representation, further research is needed to better understand and define trends in earnings and representation.

Table 4.4: Technology Occupations with Majority Female Representation

	Male	Female	Average Annual Wages
Surgical Technologists	19.7%	80.3%	$143,800
Diagnostic Medical Sonographers	28.1%	71.9%	$132,700
Nuclear Medicine Technologists	28.2%	71.8%	$131,600
Medical and Clinical Laboratory Technologists	28.7%	71.3%	$130,500
Cardiovascular Technologists and Technicians	28.8%	71.2%	$128,900
Radiologic Technologists and Technicians	32.5%	67.5%	$128,000
Magnetic Resonance Imaging Technologists	38.3%	61.7%	$123,900
Technology Occupations	76.0%	24.0%	$112,600
Total – All Occupations (Tech and Non-tech)	52.3%	47.7%	$70,300

Source: Chmura Economics and Analytics, LLC

While Census SOC codes do not correspond neatly with North American Industry Classification System (NAICS) codes (e.g., computer user support specialists may work within a number of industries), technology occupations with majority female employees unanimously occur within medical and healthcare industries.

Employees of the only seven primarily female occupations make up 7% of the total technology workforce. One of these occupations, Nuclear Medicine Technologists, earns equal to or above the average annual wages for all technology occupations ($112,600), while the occupation with the highest proportion of female to male workers, Surgical Technologists, earns on par with the average for all employed City residents ($70,300), and a third majority female technology occupation, Medical and Clinical Laboratory Technologists, earns slightly below the total employed City average (*Table 4.4*).[37] While female-dominant technology occupations span the pay scale, all but one earn below the average salary of technology workers in general.

Table 4.5: Gender Demographics for Top 10 Highest Earning Technology Occupations

	Male	Female	Average Annual Wages
Computer and Information Systems Managers	77.0%	23.0%	$181,800
Computer and Information Research Scientists	77.2%	22.8%	$153,400
Computer Hardware Engineers	86.8%	13.2%	$152,000
Aerospace Engineers	85.1%	14.9%	$143,800
Software Developers	81.4%	18.6%	$132,700
Electrical Engineers	93.2%	6.8%	$131,600
Electronics Engineers, Except Computer	93.2%	6.8%	$130,500
Nuclear Medicine Technologists	28.2%	71.8%	$128,900
Computer Network Architects	92.8%	7.2%	$128,000
Information Security Analysts	84.8%	15.2%	$123,900
10 Highest Earning Tech Jobs	82.8%	17.2%	$142,400
Total – All Occupations (Tech and Non-tech)	52.3%	47.7%	$70,300

Source: Chmura Economics and Analytics, LLC

[37] Reminder: the average annual wages for all technology occupations used here was calculated by Chmura Economics and Analytics, Inc. and differs from the average calculated and used in the pay gap analysis section of this paper later on.

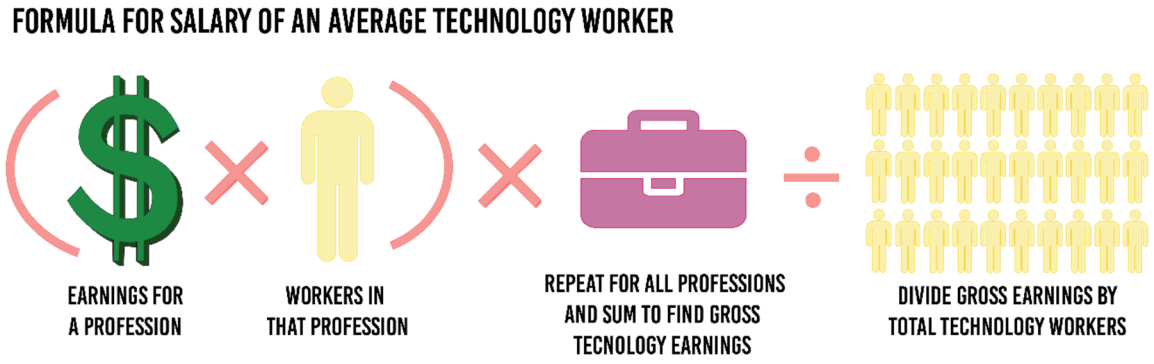
Of the top ten highest-paid technology professions in Long Beach, the only primarily female occupation is Nuclear Medicine Technologists, and three of the ten highest-salaried occupations, Electronics Engineers (except computers), Electrical Engineers, and Computer Network Architects, employ less than 10% women (*Table 4.5*). Similar to Black and Hispanic workers, compared to the total employed population in Long Beach, female representation among the top 10 highest paid tech jobs is 64% lower.

Previously, we inferred that technology workers living in Long Beach tend to work in especially highly paid occupations based on a number of the most lucrative technology occupations in the City also being among the most common. Further supporting this conclusion, the top ten highest-paid (of 50 total) technology occupations make up over a third (37%) of the City's total technology workforce.

Nevertheless, female representation especially suffers in this sample, indicating that the most lucrative technology jobs, a sizable portion of all tech jobs in Long Beach, are overwhelmingly occupied by men. For every female employee occupying one of these high paying roles, there are 4.8 men.

Quantitative Research Results: Pay Gap Magnitude

Clear trends of pay gaps based on race, ethnicity, and gender are demonstrated by the above tables. However, a more thorough earnings analysis can be conducted by weighting the average salary for each profession by its number of employees as a proportion of the total technology workforce.



For example, we can report how much less the average woman in tech earns annually compared to men and multiply this to calculate how much money female technology employees on the whole are losing each year in Long Beach as a result of the gender pay gap. Using annual average wages for each profession compared to the annual average salary for all tech jobs, we can also estimate what proportion of men are in professions that make above the annual average pay for a technology worker versus the proportion of women in professions that make above this amount.

Based on data for the number of employees in the technology workforce (12,371) and average annual wages for each technology profession, the average annual salary for a technology worker in Long Beach is $109,403.42.[38] Per year, technology jobs pay $1,353,391,126.64 to residents of Long Beach.

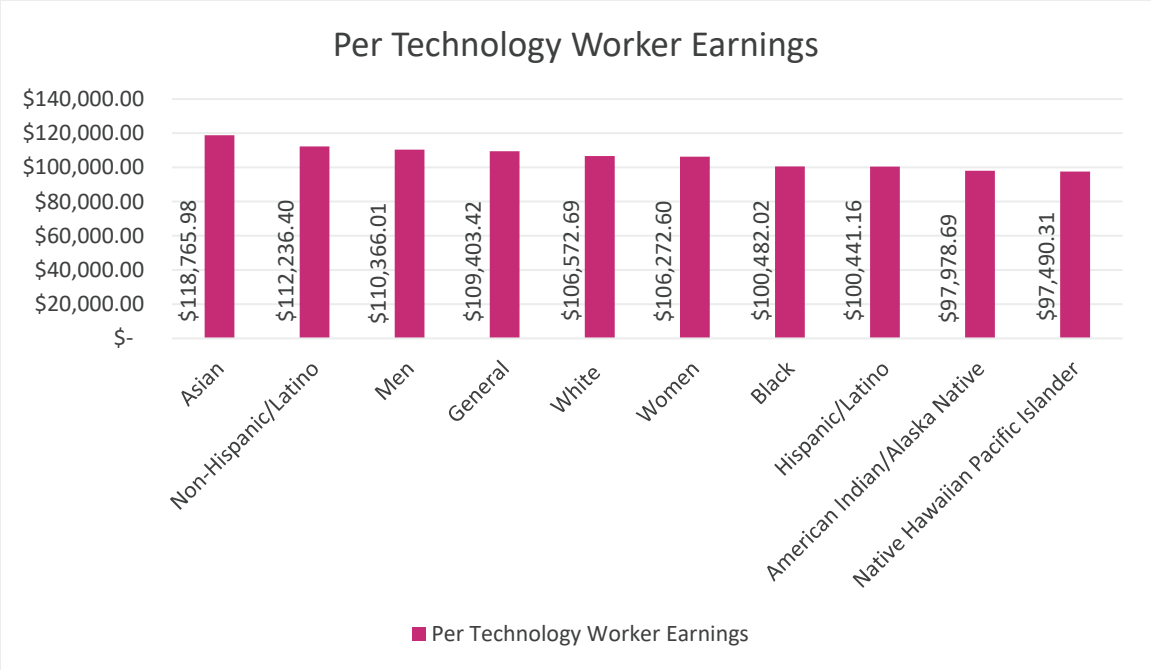


Figure 1. Per Technology Worker Earnings by Demographic Group (Descending Order)

[38]Pay gap magnitude calculations are based on the full technology occupation data set including all 50 occupations (representation gap data, analyzed earlier, uses subsets). This average was calculated by dividing gross annual earnings for all technology occupations by the number of technology workers. Gross earnings were calculated by assuming each individual within a profession makes the average for that profession. This calculation differs from the average calculated by Chmura Economics and Analytics, Inc. and used in the earlier occupation diversity section of this paper.

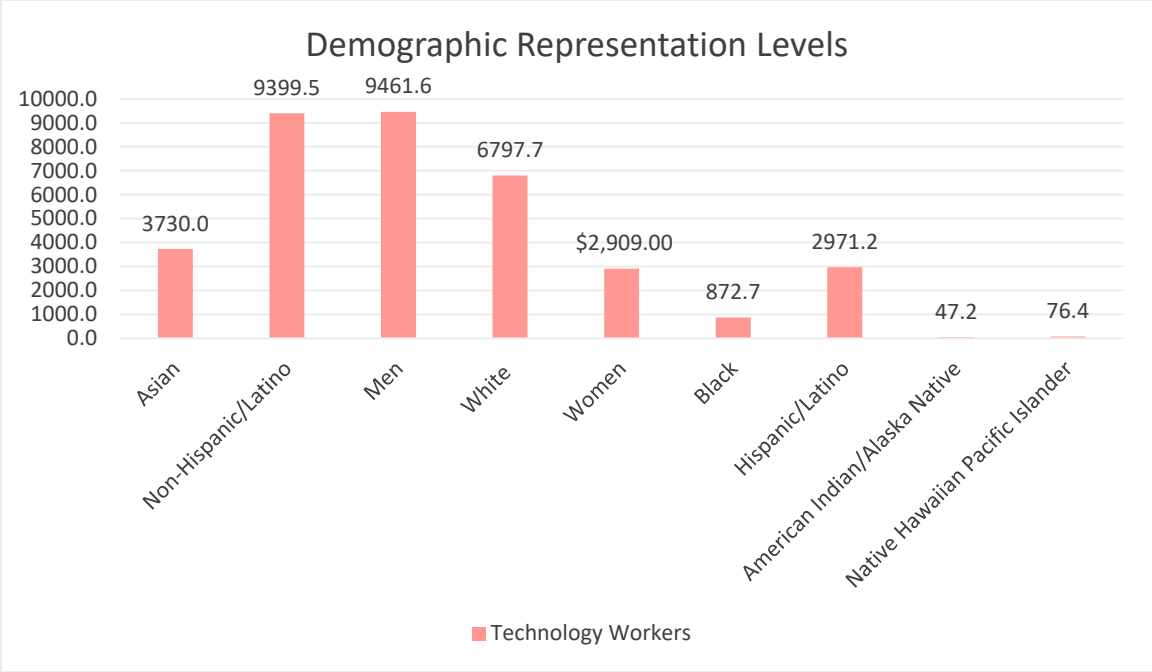


Figure 2. Per Technology Worker Earnings by Demographic Group (Descending Order)

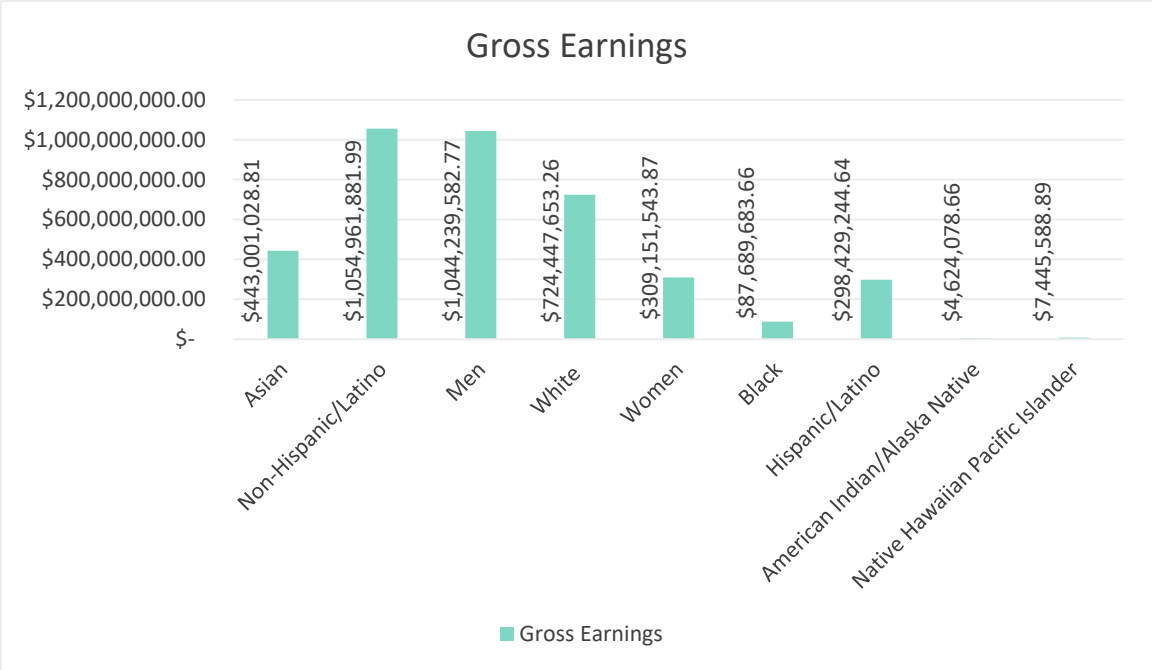


Figure 3. Gross Earnings by Demographic Group

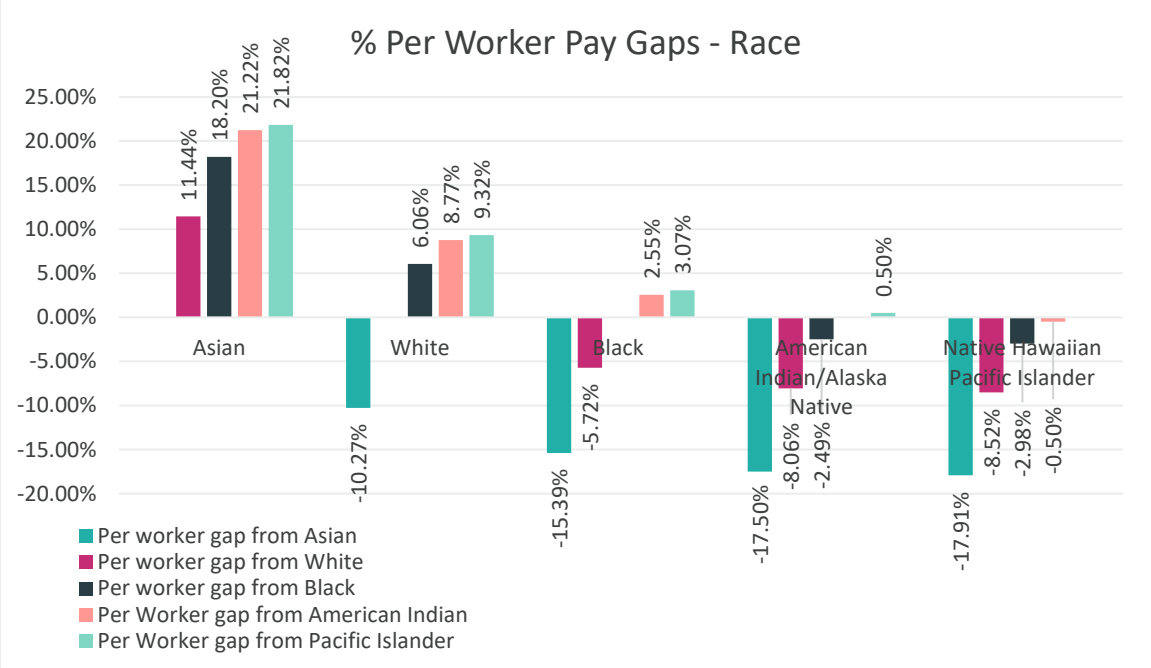


Figure 4. Per Worker Pay Gap – Race

Pay Gap: Race

32.73% of annual technology earnings for Long Beach residents go to Asian workers who represent 30.15% of the technology workforce. This group's proportion of earnings (*Figure 3*) exceeds representation (*Figure 2*) because the average salary for an Asian technology worker living in Long Beach is $118,765.98 (*Figure 1*), which is 11.4% higher than the salary of a white technology worker (*Figure 4*) and 8.6% higher than the average salary of a technology worker in general. While Asian technology workers have a higher average salary, White workers account for 53.53% of annual total earnings for Long Beach residents in technology, because they're more highly represented in the workforce. White tech workers comprise 54.95% of the City's total, making them slightly overrepresented when compared with the City's population demographics.

7.05% of technology workers living in Long Beach are Black, while 12.6% of total residents are Black. The Black technology workforce (*Figure 2*) is an underrepresentation of the City's demographics by about 44%. The proportion of total technology earnings (*Figure 3*) going to Black workers is even lower at 6.5% due to an average annual salary of $100,482.02 for this group (*Figure 1*). This represents a 15.4% decrease from the Asian average salary and a 5.7% decrease from the White average salary (*Figure 4*). As a result of the White to Black per worker salary gap, Black technology workers residing in Long Beach are losing $5,315,269.14 annually, and, as a result of the Asian to Black per worker salary gap, Black technology workers residing in Long Beach are losing $15,956,240.61 in gross earnings annually.[39]

[39] Gross earnings gaps are calculated by taking the difference between the total gross earnings of a race group compared to their potential gross earnings if each worker were to earn the same annual salary as

0.8% of Long Beach residents identify as American Indian and Alaska Native and 0.6% of residents identify as Native Hawaiian and Other Pacific Islander. Within technology occupations, American Indians and Alaska Native representation drops by half to 0.4% while Native Hawaiian and Other Pacific Islander representation remains proportional to broader City demographics at 0.6%.

The proportion of total technology earnings (*Figure 3*) in the City that go to American Indian and Alaska Native workers (*Figure 2*) is 0.34% due to an average annual salary of $97,978.69 for this group (*Figure 1*). This salary per worker constitutes a 17.5% decrease compared to Asian technology workers and an 8.0% decrease compared to White technology workers (*Figure 4*). As a result of the Asian to American Indian/Alaska Native per worker salary gap, American Indian and Alaska Native technology workers living in Long Beach are losing $981,051.14 in gross earnings (*Figure 3*) annually, and, as a result of the White to American Indian/Alaska Native per worker salary gap, American Indian and Alaska Native technology workers living in Long Beach are losing $405,591.70 in gross earnings annually.

Similarly, 0.55% of total technology earnings in the City go to Native Hawaiian and Pacific Islanders, which is less than their representation in these occupations (*Figure 2*) because of the group's annual average salary of $97,490.31 (*Figure 1*), which is 17.9% less than the Asian average salary for tech workers and 8.5% less than the White average salary for tech workers (*Figure 4*). As a result of the Asian to Native Hawaiian/Pacific Islander per worker salary gap, Native Hawaiian and Pacific Islander technology workers living in Long Beach are losing $1,624,878.59 in gross earnings (*Figure* 3) annually, and, as a result of the White to Native Hawaiian/Pacific Islander per worker salary gap, Native Hawaiian and Pacific Islander technology workers living in Long Beach are losing $693,644.81 in gross earnings annually.

Pay Gap: Ethnicity

Tech workers that identify as Hispanic/Latino receive a relatively low salary of $100,441.16 per year (*Figure 1*) which is 10.51% less than the salary made by Non-Hispanic tech workers. Hispanic and Latino workers also make up only 24.02% of the City's technology workforce, meaning they are underrepresented by about 44% in the tech workforce compared with the general population of Long Beach, where Hispanic/Latino residents account for 43.2% of the community. Because of the salary disparity from that of the average technology worker and low representation levels (*Figure 2*), Hispanic/Latino tech workers receive only 22.05% of the City's gross annual technology earnings (*Figure 3*). This group also loses the most as a result of their difference in salary from Non-Hispanic/Latino tech workers, averaging $35,045,854.10 in losses annually.

Hispanic/Latino tech workers are also a group with a relatively small proportion of workers (comparable to the proportion for Black workers) making over the average general tech worker

another race group. White and Asian workers are used as references for comparisons because they hold the highest salaries among race categories and are the two most represented race categories in technology occupations.

salary of $109,403.42. Just 34.13% of Hispanic and Latino tech workers make over this amount, while 51.93% of Non-Hispanic and Latino workers earn annual wages exceeding the general average.[40] 63.65% of Asian technology workers make over the average annual wages, the highest proportion of any demographic, while 42.30% of White workers, 34.22% of Black workers, 28.75% of American Indian/Alaska Native workers, and 28.44% of Native Hawaiian/Pacific Islander workers make over this average. 50.28% of men in tech make over the average salary for a tech worker living in Long Beach compared to 39.14 % of women.

Pay Gap: Gender

22.84% ($309,151,543.87) of total annual technology earnings go to women, who make up 23.52% of the technology workforce and 50.7% of Long Beach residents. This indicates that the annual salary for women ($106,272.60) is slightly below the average for a technology worker in general (*Figure 1*), and that women in Long Beach are underrepresented in the technology workforce by over 50%. Women in tech earn 3.7% less than the male average salary of $110,336.01 annually. As a result of this pay gap, female technology employees in Long Beach on the whole are losing $11,907,918.38 per year.

Major Takeaways

1. Representation, rather than wages, is the biggest contributor to gaps in gross earnings based on gender, race, and ethnicity.

The average salaries for technology occupations among any demographic group studied are well over the City average median household and per capita incomes, and average salaries for each demographic group studied (by race, gender, ethnicity) only deviate from the aggregate average salary for all tech workers in Long Beach by about $12,000 at most. Therefore, the largest annual gross earnings gaps result from huge disproportionalities in representation across demographic groups.

2. The greatest gross annual loss in earnings is suffered by Hispanic workers, who experience significant combined representation disproportionalities and wage gaps.

The disparities in representation and pay that Hispanic/Latino technology workers experience as compared to Non-Hispanic/Latino workers as well as the vast mismatch in the proportion of these workers to the total Hispanic/Latino population of Long Beach may be the most urgent. While women suffer with similarly low representation, Hispanic/Latino salaries are among the lowest of the demographic groups included in this report, leading to a $35 million dollar loss in annual earnings based on the ethnicity pay gap.

[40] These statistics are calculated assuming each tech worker earns the average for their respective profession. The sum of workers in each profession which earns over the general average is then reported as a proportion of total workers in the demographic group.

3. American Indian/Alaska Native and Native Hawaiian/Pacific Islander technology workers tie for the lowest average annual salaries of the Long Beach resident technology workforce, followed by Black and Hispanic/Latino technology workers.

Representation and gross earnings aside, in efforts to close the per individual pay gap, American Indian/Alaska Native and Native Hawaiian/Pacific Islander technology workers should be a priority, earning an approximate averaged salary of $97,930 annually, the largest negative difference from the average salary of $109,403.42 made by a resident technology worker in Long Beach. Black and Hispanic/Latino technology workers should also be a priority, as each earns close to $100,500 annually. Depending on how stakeholders choose to define and address issues of equity in the workforce, individual pay gaps may be of primary importance.

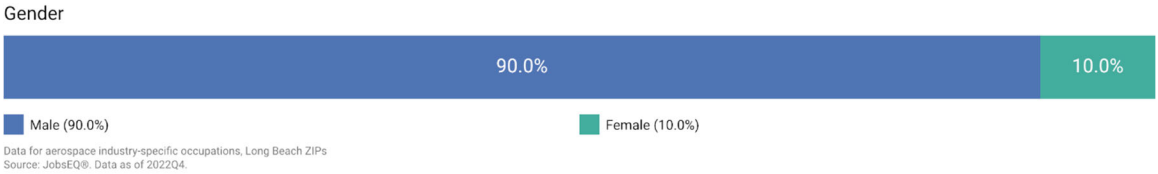
4. Women are the most underrepresented in the Long Beach resident technology workforce.[41]

Women were also the most common group aerospace companies interviewed for this report spoke about when asked about representation gaps and challenges. Among aerospace engineers that are residents of Long Beach, only 14.51% are women, and among aerospace technicians, only 13.18%. On the other hand, women represent a majority of workers in some healthcare roles and seem to be represent a majority within a number of healthcare roles. However, only nuclear medicine technologists, of which 71.8% are women, make over either average found for a technology worker living in Long Beach ($109,403.42), with a salary $128,900. Further, only 21 Long Beach residents hold this position and a total of 15 women work as nuclear medicine technologists. On the other hand, between 177 and 178 women work as medical and clinical laboratory technologists, the majority-female occupation with the greatest absolute representation and greatest total earnings of the seven, and this role earns only $69,700 annually, which is much lower than the average salary for a technology worker and even lower than the average salary for an employed resident of Long Beach ($70,300). Generally, there is a trend of majority female-occupied technology positions making below-average salaries. Within the seven majority-female technology jobs, women make an annual average salary of $80,235.39.

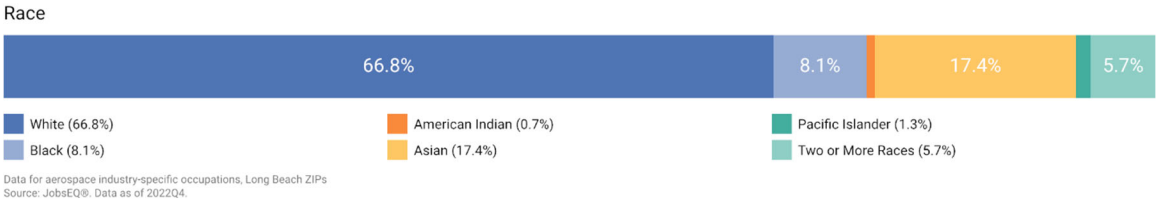
[41] Reminder: American Indian/Alaska Natives and Native Hawaiian/Pacific Islanders were not included in analyses of representation.

5. Aerospace and Healthcare are unique industries employing Long Beach residents.

Gender in Aerospace-Specific Technology Occupations[42]



Race in Aerospace-Specific Technology Occupations



Ethnicity in Aerospace-Specific Technology Occupations

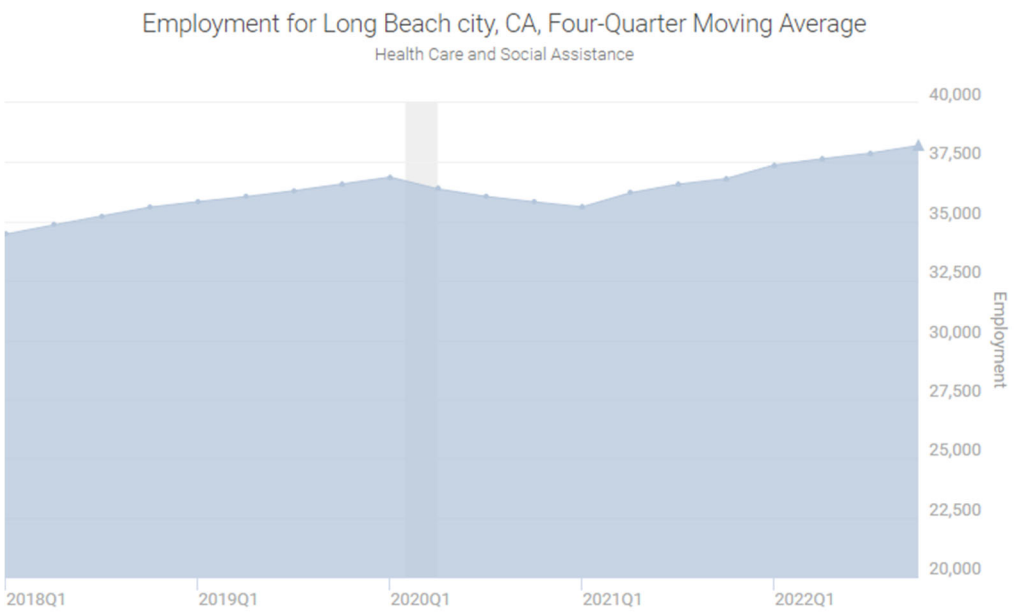
Consistent with qualitative findings, aerospace and healthcare are two major industries recognized by stakeholders in Long Beach and in existing literature. Aerospace is also significant in requiring more esoteric and non-transferable skills as compared to broader technology careers, which has somewhat limited candidate pools, making it difficult for hiring managers at aerospace companies to achieve diversity, especially in aerospace-specific roles. This is reflected by the low rates of female employees (10%) in aerospace industry-specific roles (as defined here) than those for technology workers in general (23.52%).

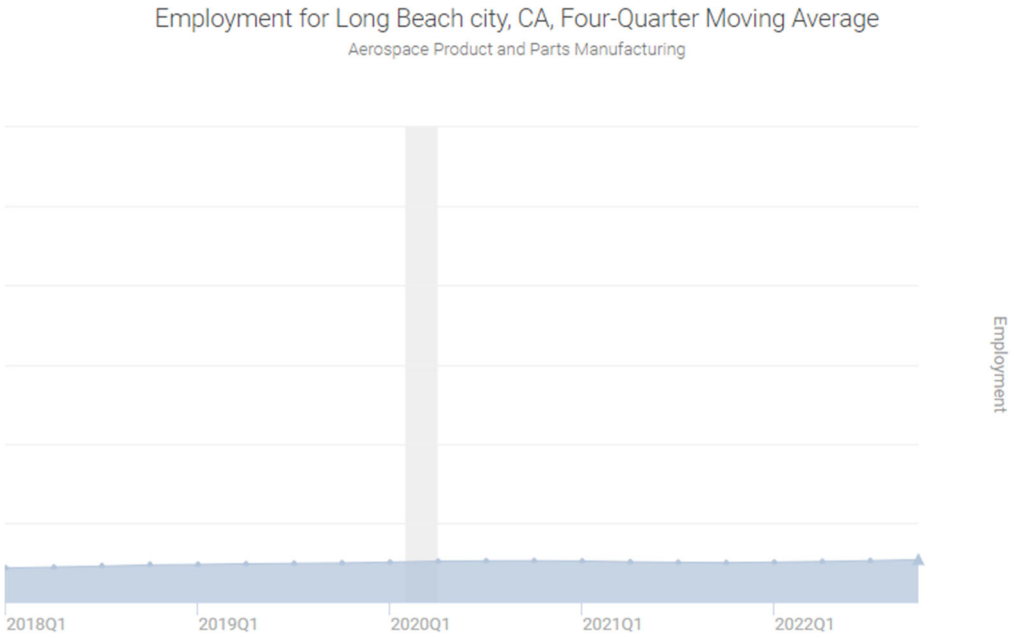
However, perhaps surprisingly, the aggregate of these occupations has higher rates of representation of Black tech workers (8.1%) and Hispanic tech workers (38.4%) than in technology roles in general.[43] These rates are still below population demographic levels (12.6% and 43.2% respectively).

[42] 'Aerospace Industry-Specific Occupations' are an aggregate of aerospace engineers, aerospace technicians, and avionics technicians.

[43] These statistics describe representation in an aggregate of roles (defined in the previous note) that are likely to require specialized skills in a prominent industry. It is important to keep in mind that demographic representation for each of these roles varies as do their relative pay rates.

Aerospace and Healthcare Industry Growth[44]





Employment growth data also indicates that these two industries have been growing steadily in recent years, with the exception of a decrease in healthcare employment in 2020 likely as a

[44] Industries in the below section are classified by NAICS code (*Appendix C*).

result of the impacts of COVID on talent availability and demand.[45] Healthcare and Social Assistance rose 10.8% from 34,461 (18.8% of the total workforce) employed in 2018Q1 to 38,200 (20.7% of the total workforce) employed in 2022Q4. Aerospace employment growth has risen at a higher rate but represents a much smaller portion of the total workforce, rising 24.2% from 1,071 (0.6% of the total workforce) employed in 2018Q1 to 1,330 (0.7% of the total Long Beach workforce) employed in 2022Q4.[46] This growth reinforces that these are industries that will likely continue to be important to Long Beach's tech workforce ecosystem in coming years and are worth investing diversity, equity, and inclusion efforts in.

Quantitative Limitations

Limitations faced in the quantitative analysis centered on inaccessibility of certain types of data as well as capacity limitations.

1. Further research is needed on skills data

A recurring theme in stakeholder interviews when asked about barriers to diversity, equity, and inclusion in the workplace was the importance of skillsets, either general technology-based skills or specialized skills for unique technology occupations. Ecosystem partners also said that data on skills held by people in technology occupations would be useful in guiding their training efforts.

2. Population pool mismatches (city of residence versus city of employment)

As included in the footnotes of the quantitative analysis section, available salary data used for this report is based on employees working in as opposed to living in Long Beach, whereas employee demographic data is based on employees living in Long Beach. Because we do not know if all those employed in technology jobs in Long Beach are living in Long Beach, these numbers can provide a limited proxy for average annual wages within each occupation. Ideally, salary and employee demographic data would be compared for technology employees living in Long Beach and separately for technology employees working in Long Beach.

3. Did not analyze educational attainment

Stakeholder interview participants mentioned that data on educational attainment would be useful to DEI efforts, especially differences in educational attainment by salary and occupation. While not included in the scope of this report, such data is available publicly through the Census and should be explored in further research.

[45] Industry- and occupation-based employment are calculated differently. Not all occupations in the aerospace and healthcare/social assistance industries are technology occupations.
[46] Note that these percentages differ significantly from the findings of Hernandez and Steimetz (2021). This may be due to differences in how the aerospace industry is defined and analyzed.

4. Did not complete cross-sectional analysis

This research is limited in that it explores trends in technology worker representation and salary based on race, ethnicity, and gender without accounting for effects of overlapping categories on these trends. For example, a Hispanic male technology worker will be impacted differently by workforce equity issues than a Hispanic female technology worker. Further research should be conducted to study how race, gender, and ethnicity intersect in this context.

5. Commuter data should be gathered

This study seeks to understand who is benefitted by the growth of technology industries in Long Beach. To answer this question, it's important to know whether technology jobs in Long Beach are held by City residents or workers who commute from outside of Long Beach. Information on worker place of residence and place of employment is available through the Census by industry at the ZIP code tabulation area (ZCTA), county, metropolitan statistical area (MSA), and state levels. However, this information is not available by occupation or at the place (city) level. Even if this data was available, place of residence and place of employment data is non-directional and would only tell us the total number of technology workers working and living in the City but not whether jobs in the City are held by City residents or commuters.

Recommendations

Numerous frameworks for justice and equity have been theorized by academics, which can each guide the goals of policymakers, planners, and stakeholder partners in unique directions. Still, the data gathered here from speaking to stakeholders and analyzing diversity and pay gap magnitude reveal common themes about the biggest obstacles to diversity, equity, and inclusion (DEI) in the local technology ecosystem. The groups that are most harmed by the rapid technology growth in the City can be prioritized by local stakeholders dependent upon their DEI priorities.

Private Sector

1. Framework for Equity

As mentioned above, there are many frameworks for equity used by academics and organizations to guide their work. The City of Long Beach believes 'equity' exists "when everyone can reach their highest level of health and potential for a successful life, regardless of their background and identity" (City of Long Beach, 2023). Without a definition for equity, defined strategies, and measurable outcomes, company DEI efforts may be ineffective, or worse, insincere. Corporate stakeholders should define what 'equity' means at their company and define their unique equity needs and performance indicators as a first step to internal staff training.

2. Internal Staff DEI Training

Once a stakeholder has decided on a definition of diversity, equity, and inclusion and specific, measurable needs to be addressed, staff should be trained internally in how to implement company policy towards these goals. As heard in interviews, some offices may need specialized training or more training than others. In other words, training must be localized rather than a blanket effort. Further, companies should hire a DEI coordinator specifically responsible for guiding DEI policy and making sure staff members, not just hiring managers, are trained on company DEI goals.

3. Progress Reports and Transparency

Results of the quantitative portion of the study revealed that resident tech workers of Long Beach who identified as American Indian and Alaska Native, Native Hawaiian and Pacific Islander, Black, and Hispanic received the lowest salaries of any demographic group studied and well below the average salary for a technology worker in general. As mentioned above, DEI policies should include benchmarks for success towards greater representation of underrepresented groups and higher salaries for groups earning disproportionately less. One way to accomplish this would be to conduct regularly updated pay studies that analyze

disparities. Results and corresponding goals should be published online to hold stakeholders accountable and ensure that publicized DEI policy is put into practice.[47]

4. Position Matters

A point made clear both by stakeholder insights and average salary data is that diversity in representation is not enough – position and earnings matter for equity. Dramatic earnings gaps exist between individual occupations. So, while addressing pay gaps based on demographics in general averages as well as within individual occupations, efforts to achieve equity in the technology workforce must target hiring and retention of underrepresented employees in more senior, higher-earning roles. **Ecosystem Partners**, such as education and job training programs and institutions can aid this by using data published by companies on inequity to increase training efforts focused on skills needed for higher-ranking and higher-paying roles.

Public Sector

1. Broaden Technology Focus

Specifically, aerospace and healthcare stand out as two unique and widely recognized technology industries among stakeholders. It is difficult to quantify the current impact of aerospace in relation to other technology industries in Long Beach, especially because job classifications and industry data do not exist at the same geographic scale and cannot be synced. Data demonstrates that aerospace is not the most impactful industry statistically. Still, its growth has gained the attention of community members, public officials, university professors, and economists. Public attention to this industry has the potential to raise broader concern about the growth of other technology industries and technology occupations. Evidently, support must be given to more than just aerospace and startups to grow the City's technology sector, to address diversity, inclusion, and equity in the technology workforce, and to ensure that residents of Long Beach are benefitting from these jobs.

2. Use Data to Target Programs

In pursuit of the big picture goal of increasing rates of female representation in technology, because these rates tend to be relatively high for women in healthcare, healthcare industries represent a unique opportunity. Publicity and programs oriented towards technology occupations within the healthcare industry could then have a positive impact on female representation in tech especially as that industry continues to grow. Nonetheless, for other industries that experience especially low rates of female representation, aerospace for example, programs that partner with gender equity organizations and involving female professionals in outreach programs are equally as important. While women in healthcare is one example, other demographic patterns among technology jobs should be identified, especially as more research is conducted on the topic, to tailor programs that target underpaid and underrepresented groups.

[47] As an example, the City of Long Beach publishes employee demographic data and salaries on their website at https://data.longbeach.gov/explore/dataset/employee-salary

Ecosystem Partners

1. Early (Youth) Education and Training

Publicity received by the aerospace industry can harnessed to increase awareness about aerospace (and other technology) careers, especially among youth early in their education. This timing may be of special importance in an industry such as aerospace because of the unique skills that are required for some positions, such as an engineering role. Further, stakeholders interviewed stressed the need for early education about technology roles and a strong educational foundation for those looking to enter the technology workforce. While certificate programs and higher education opportunities exist, they may be inaccessible without awareness and a strong academic base. **Educational and job training institutions and organizations** should partner early in a student's academic career to successfully support the transition from the classroom to the workforce.

All Stakeholders

1. Connection with Community Members

Connectivity among organizations, educational institutions, local government, and to some extent stakeholders exists. The next steps should be for more stakeholders to get involved and for efforts to be guided by the needs outlined by community partners, quantitative takeaways, and further research conducted on this topic. **Corporate stakeholders** especially should develop relationships with community members to spread information about occupations in technology and let employees be accessible role models.

Conclusion

While supplemental research is needed, these findings have the potential to drive impact beyond City policies and programs. The City of Long Beach, California State University – Long Beach, Long Beach Unified School District, Pacific Gateway Workforce Innovation Network, the Long Beach Economic Partnership, and industry representatives currently collaborate with one another on programs to understand the impacts of economic development from technology growth in the City, train residents and students to enter the technology workforce, and integrate technology resources into public services for community members. Centralized data on the technology workforce can be cited to guide the development of ongoing and future efforts. Further, these findings may hold regional relevance for Los Angeles County and Southern California as key national home bases for many tech and aerospace companies.

Appendix A: Long Beach Zip Codes

ZCTAs within or intersecting the City of Long Beach

FIPS Code	Name
0603790713	ZCTA 90713
0603790731	ZCTA 90731
0603790740	ZCTA 90740
0603790755	ZCTA 90755
0603790802	ZCTA 90802
0603790803	ZCTA 90803
0603790804	ZCTA 90804
0603790805	ZCTA 90805
0603790806	ZCTA 90806
0603790807	ZCTA 90807
0603790808	ZCTA 90808
0603790810	ZCTA 90810
0603790813	ZCTA 90813
0603790814	ZCTA 90814
0603790815	ZCTA 90815
0603790822	ZCTA 90822
0603790831	ZCTA 90831
0603790713	ZCTA 90713

Appendix B: SOC Codes

Technology Occupations

SOC Code (6-Digit)	Occupation
11-3021	Computer and Information Systems Manager
15-1211	Computer Systems Analysts
15-1212	Information Security Analysts
15-1221	Computer and Information Research Scientists
15-1231	Computer Network Support Specialists
15-1232	Computer User Support Specialists
15-1241	Computer Network Architects
15-1242	Database Administrators
15-1243	Database Architects
15-1244	Network and Computer Systems Administrators
15-1251	Computer Programmers
15-1252	Software Developers
15-1253	Software Quality Assurance Analysts and Testers
15-1254	Web Developers
15-1255	Web and Digital Interface Designers
15-1299	Computer Occupations, All Other
15-2031	Operation Research Analysts
17-2011	Aerospace Engineers
17-2031	Bioengineers and Biomedical Engineers
17-2041	Chemical Engineers
17-2061	Computer Hardware Engineers
17-2071	Electrical Engineers
17-2072	Electronics Engineers, Except Computer
17-2112	Industrial Engineers
17-3012	Electrical and Electronics Drafters
17-3021	Aerospace Engineering and Operations Technologists and Technicians
17-3023	Electrical and Electronic Engineering Technologists and Technicians
17-3024	Electro-Mechanical and Mechatronics Technologists and Technicians
17-3026	Industrial Engineering Technologists and Technicians

27-1014	Special Effects Artists and Animators
27-4011	Audio and Visual Technicians
27-4012	Broadcast Technicians
27-4014	Sound Engineering Technicians
27-4032	Film and Video Editors
29-2011	Medical and Clinical Laboratory Technologists
29-2031	Cardiovascular Technologists and Technicians
29-2032	Diagnostic Medical Sonographers
29-3033	Nuclear Medicine Technologists
29-2034	Radiologic Technologists and Technicians
29-2035	Magnetic Resonance Imaging Technologists
29-2055	Surgical Technologists
41-3011	Advertising Sales Agents
49-2011	Computer, Automated Teller, and Office Machine Repairers
49-2022	Telecommunications Equipment Installers and Repairers, Except Line Installers
49-2091	Avionics Technicians
49-2093	Electrical and Electronics Installers and Repairers, Transportation Equipment
49-2094	Electrical and Electronics Installers and Repairers, Commercial and Industrial Equipment
49-2095	Electrical and Electronics Repairers, Powerhouse, Substation, and Relay
49-2096	Electronic Equipment Installers and Repairers, Motor Vehicles
49-2097	Audiovisual Equipment Installers and Repairers

10 Most Common Tech Jobs among Long Beach Residents

SOC Code (6-Digit)	Occupation
11-3021	Computer and Information Systems Manager
15-1211	Computer Systems Analysts
15-1232	Computer User Support Specialists
15-1244	Network and Computer Systems Administrators
15-1252	Software Developers
15-1253	Software Quality Assurance Analysts and Testers
15-1299	Computer Occupations, All Other
17-2071	Electrical Engineers
17-2112	Industrial Engineers
49-2022	Telecommunications Equipment Installers and Repairers, Except Line Installers

10 Highest Earning Tech Jobs among Long Beach Residents

SOC Code (6-Digit)	Occupation
11-3021	Computer and Information Systems Manager
15-1212	Information Security Analysts
15-1221	Computer and Information Research Scientists
15-1241	Computer Network Architects
15-1252	Software Developers
17-2011	Aerospace Engineers
17-2061	Computer Hardware Engineers
17-2071	Electrical Engineers
17-2072	Electronics Engineers, Except Computer
29-2033	Nuclear Medicine Technologists

Aerospace-Specific Technology Occupations

SOC Code (6-Digit)	Occupation
17-2011	Aerospace Engineers
17-3021	Aerospace Engineering and Operations Technologists and Technicians
15-1232	Avionics Technicians

Appendix C: NAICS Codes

NAICS Code	Industry
3364	Aerospace Products and Parts Manufacturing
62	Healthcare and Social Assistance

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