IF YOU BUILD IT, WILL THEY COME?

Exploring the Possibility of an Idaho Engineering and Computer Science Growth Initiative

WICHE
Western Interstate Commission for Higher Education

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Disclaimer
The research presented here includes information derived from SLDS Data from the Idaho State Board of Education (SBOE) and the Idaho State Department of Education (SDE). Any errors are attributable to WICHE.

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EXECUTIVE SUMMARY

Introduction

In 2022, industry leaders voiced concerns to policymakers that Idaho was not producing enough engineering and computer science graduates from its public institutions to meet the needs of Idaho's economy. These leaders expressed interest in launching an engineering and computer science growth initiative similar to a long-time effort in Utah to address these gaps. In response, the Idaho State Board of Education commissioned an analysis from the Western Interstate Commission for Higher Education (WICHE) to explore the issue. Guided by an industry advisory group, the project team reviewed existing research, analyzed publicly available data as well as data from the state's longitudinal data system, modeled the projected supply of graduates, and conducted a range of employer engagement activities to answer two key questions:

1. Is the supply of engineering and computer science graduates from Idaho's public institutions adequate to meet current and projected industry demand?
2. If not, how can the state strategically address the gap between supply and demand?

This analysis was not intended to provide a complete and detailed strategic plan, but rather to assist industry with articulating the gap between supply and demand to the greatest extent possible and identifying high-level, evidence-based approaches to increase credential production. Importantly, these potential approaches are tailored to fit Idaho's context and trends in population growth, demographics, and student flow.

Key Findings

Our analysis concludes the following, based on the best available evidence:

1. **Current Undersupply**: The supply of graduates in engineering and computing disciplines (broadly defined) from the states' public institutions does not appear sufficient to meet existing industry needs.
2. **Future Supply Constraints**: Growing the number of students prepared to enter and succeed in these majors is not as simple as increasing postsecondary capacity. Demographic and educational trends point to at best modest growth in the potential pool of students, meaning any effort to increase graduates in these fields must focus on expanding the educational pipeline of students from K–12 to postsecondary education who are interested in and equipped to succeed in these fields.

A coordinated, industry-led approach to developing a shared vision and action plan to address these nuanced, multifaceted challenges will be an important next step. It is important to recognize that because of the challenges in future demographics and the state's trends in education outcomes, this work will likely be more challenging than Utah's initiative.

Approach

No data source exactly quantifies the hiring demand for recent graduates in Idaho's labor market, nor the available supply of graduates planning to work in Idaho. This report relies instead on a combination of qualitative work, data analysis, and review of existing research to identify proxy metrics for supply and demand where possible and includes discussion of the strengths and limitations of this approach, potential gaps in information, and further questions. WICHE conducted a survey of key employers and industry leaders to gather their perspectives and additional data that is highly relevant to this report. WICHE also received invaluable guidance, counsel, and feedback from a core team of industry advisors drawn from across the state.

Understanding Supply

institutions are used as a proxy metric for the "supply" of new workers available to the state's businesses. The term "computer science" as used in the Utah initiative refers to a wide range of computer-related degrees, thus the term computer science has been adjusted to computer and information science in this report to more accurately reflect the range of degree types discussed. Similarly, both engineering and engineering technology programs were considered at the suggestion of Idaho's industry leaders that advised WICHE on this analysis. For some analyses, the limited number of individuals who enroll in and graduate with degrees in engineering technology make it impractical to present detailed data. Finally, the contributions of the state's private institutions are reflected where appropriate to provide a more complete picture of available supply.

A model of student flow through the education pipeline was used to examine how improvements on certain metrics, such as high school graduation rates, college go-on rates, or progression through postsecondary education would impact the number of graduates produced in the three fields of interest. The results and takeaways from this model are described briefly below and in greater detail in the full report.

Of course, postsecondary graduates are not the only source of supply in the labor market. Employers need to hire across a range of experience levels, some Idaho businesses hire from regional, national, or international candidate pools, and net migration also affects labor supply. However, qualitative research demonstrates robust employer demand for entry-level hires in the fields of interest — typically bachelor's graduates — as well as a strong employer preference for hiring Idaho graduates.[1] Therefore, degree production in engineering and computer and information science fields presents a useful, though imperfect, way to think about workforce supply.

Estimating Demand

The Bureau of Labor Statistics (BLS) offers historical estimates of employment by occupation at the national and the state level, allowing for cross-state comparisons. BLS also produces projections of employment by occupation, but only at the national level. The Idaho Department of Labor (ID DoL) produces state-level projections of employment by occupation, which provide the best available state-level projections of hiring demand by occupation despite certain limitations. For example, the 2020–2030 ID DoL projections do not yet reflect the projected impacts of significant federal policy changes such as the CHIPS and Science Act (CHIPS Act) and the Infrastructure Investment and Jobs Act (IIJA). The project team supplemented the existing ID DoL projections with results from a 2023 employer survey on hiring demand in fields of interest and in-depth interviews with a subset of industry representatives.

Engineering & Engineering Technologies

Degree production and projected job demand in related fields are not a one-to-one match, but comparing the approximate magnitude of the difference between the two does provide some sense of the "gap" that exists between supply and demand. Meanwhile, examining projections based on current trends offers a way to understand whether identified gaps are likely to grow or to shrink if present trends continue.

Engineering and Engineering Technologies Supply

Historical trends in Idaho's engineering bachelor's degree production — the typical entry-level credential of most engineering professions[2] — show growth between 2010 and 2020, primarily driven by substantial growth between 2010 and 2015. Supply modeling shows that if contributing trends persist, Idaho can expect only minimal increases in the number of engineering and engineering technology graduates produced annually by its public institutions. A projected levelling off of the overall number of high school graduates in the state and a negatively trending college go-on rate of Idaho high school graduates are among the primary contributors to this low growth projection.[3]

Meanwhile, existing research shows that just over 60% of engineering bachelor's degree recipients who were Idaho residents at the state's public institutions work in Idaho after graduation, and under 40% of out-of-state students do (including international students, who are over-represented in engineering programs). In engineering technology, 74% of in-state associate degree holders stay in the state and 35% of out-of-state students remain in the state to work.[4] As a result, the number of graduates produced by the state's public institutions may under-represent the available workforce supply.

Importantly, data analysis also revealed that women are significantly less likely to select engineering majors even when controlling for factors like scores on math standardized tests. However, women that do so are more likely to complete their degrees. Strong performance on high school math standardized exams is also positively associated with choosing engineering as a major and completing a degree in the field. As is discussed later, developing and implementing strategies to welcome women into these fields may be productive as the gender disparities hold true even when controlling for math performance, meaning women with strong math results are still much less likely to enter into engineering as a major.

Engineering and Engineering Technologies Demand

Trends in Idaho's engineering job growth show increases over the past decade, at similar rates as surrounding states. Looking forward, there are moderate increases of about 5% nationally between 2021 and 2031 projected for engineering as an occupational field with even more robust growth projected in Idaho — more than 17% between 2020 and 2030. Growth in Idaho's engineering technology occupations is also expected to outpace the national number, growing by more than 13% in the state between 2020 and 2030 compared to 1.4% nationally between 2021 and 2031. According to the ID DoL, engineering can expect to see 984 job openings per year due to turnover and growth between now and 2030, while engineering technology is projected to see 227 annual openings.[5]

However, more recent developments suggest that this may be an underestimate. One engineering industry group estimates that projects funded by the IIJA alone will increase the need for engineers nationally by 82,000 and notes that these increases will affect every state.[6]

> ***"If we were able to fill all our positions, we'd be able to get more revenue in and more clients and we'd then have demand for more engineers… we've been stifled by an inability to find people to do the work, we have more work than we have people to do."***
>
> – Idaho Engineering Employer

The employer survey conducted for this project provides further evidence that the 2020–2030 projections may underestimate demand. Respondents estimated that they are trying to hire nearly 2,000 employees with degrees in engineering and engineering technology within the next 12 months alone, almost double the DoL projected average annual openings. Further, 77% of respondents noted that they are currently struggling to fill jobs that require degrees in engineering and engineering technology fields. While the employer survey sample was not representative of Idaho as a state, the table below illustrates respondents' self-reported number of Idaho-based engineering and computer-related employees compared to state estimates of total employment within these occupations to provide some sense of the coverage offered by the survey.

Employer Survey Respondent Engineering Employees in Idaho Compared to Overall Number of State Engineering Employees.

	STATE TOTAL 2020	STATE TOTAL 2023 (Estimated)	SURVEYED COMPANIES (Estimated)*
Engineering Occupations (17–2000)	10,321	10,892	6,478

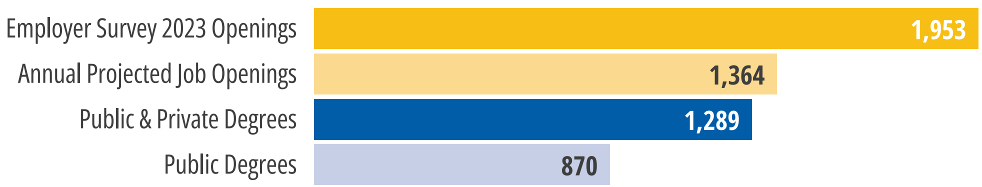
**Survey response options were presented as ranges and these totals assume a midpoint value of the selected range.*

Another key factor to consider is that workforce shortages in the short term may suppress future workforce demand. For example, according to Idaho employers interviewed, the undersupply of engineering candidates is already curtailing business growth opportunities or leading them to develop that business elsewhere. Existing undersupply has already dampened hiring demand, whereas increases in engineer supply could potentially enable business growth and expand hiring demand.

Engineering and Engineering Technologies Gap Analysis

The available quantifications of supply and demand indicate a gap between the number of engineering and engineering technology graduates of all degree types from Idaho public institutions (as depicted by the blue bars in the figure below) and the needs of Idaho's employers (as depicted by the yellow bars in the figure below). While the magnitude of the gap differs depending on the exact specifications used (whether graduates from private institutions are included, if migration is accounted for, etc.) the gap appears significant — particularly considering the likely undercount represented by the demand numbers — and likely to continue over time if present trends continue.

Idaho Institution Annual Engineering & Engineering Technology Degrees Produced (Average of 2018–2020), ID DoL Projected Annual Engineering & Engineering Technologist Job Openings (2020–2030) & WICHE Employer Survey Hiring Demand Estimates (2023)



Sources: Integrated Postsecondary Education Data System, Idaho Department of Labor Occupation Projections (2020–2030), WICHE Employer Survey

Computer & Information Science

Degree production and projected job demand in related fields are not a one-to-one match, but comparing the approximate magnitude of the difference between the two does provide some sense of the "gap" that exists between supply and demand. Meanwhile, examining projections based on current trends offers a way to understand whether identified gaps are likely to grow or to shrink if present trends continue.

Computer and Information Science Supply

The National Center for Education Statistics designates computer and information science degrees as Classification of Instructional Programs (CIP) 11: "Computer and Information Science and Support Services: Instructional programs that focus on the computer and information sciences and prepare individuals for various occupations in information technology and computer operations fields."[7] Similar to engineering, historical trends in computer and information science degree production at the bachelor's level in Idaho — also the typical entry-level credential for many in-demand computer-related professions[8] — show growth between 2010 and 2020, primarily driven by substantial increase between 2010 and 2015. Supply modeling shows that if contributing trends persist, Idaho can expect only minimal increases in the number of computer and information science graduates produced annually by its public institutions.

Research shows that a relatively high percentage of computer and information science public institution graduates stay in Idaho, with over 70% of in-state bachelor's graduates employed in the state after graduation and over 50% of out-of-state graduates.

Additionally, WICHE's pipeline analysis using student-level data finds stark gender gaps in the likelihood of declaring Computer and Information Sciences as a major, as well as completing degrees in this field, even when controlling for math scores and other characteristics. This analysis also showed the importance of K–12 math preparation, with results of standardized high school math tests being strongly associated with entrance into and success in this field in college. This last finding should not be surprising as it is supported by substantial other research as well as the perspectives of industry leaders.

Computer and Information Science Demand

The range of computer occupations continues to evolve, with the current BLS definitions including occupations ranging from computer scientists to web developers to network administrators. Trends in computer-related job growth show a fairly dramatic increase between 2010 and 2021 as computer and information technology related roles became ubiquitous across industries. Idaho's occupational growth trends in a similar way to its neighboring states, though it has continued to lag slightly behind them over the past decade (Washington has long dominated in the overall amount of employment in computer occupations, though Utah's growth trajectory has been the steepest over this period).[9]

> ***"We've not necessarily tried to materially increase our hiring in the state of Idaho… we just found that it was too challenging to find enough candidates locally. So, we diversified our locations in order to fulfill that [need]."***
>
> *– Tech Sector Employer*

In terms of projections, computing occupational fields are projected to increase 14.6% nationally between 2021–31 and 12.2% between 2020–30 in Idaho. The ID DoL estimates that there will be 1,387 annual job openings in the field in Idaho between now and 2030.[10]

Because the projection methodology does not project shifts in industry mix, it may underestimate possible demand. That is, certain industries contract in response to things like macro-economic trends and changing technologies while others expand. While these shifts are difficult to predict, experts from the Idaho Department of Labor reported in a February 23, 2023 interview that there has historically been an increase in computer-related jobs as a range of industries expand their automated components.

As with engineering, the employer survey offers additional evidence that the existing projections for Idaho may underestimate demand. Industry respondents estimated they would like to hire nearly 1,600 employees with computer or information science degrees within the next 12 months, potentially 15% more than already projected. Further, 76% of respondents are currently struggling to fill jobs that require a computer or information science degree. Notably, survey respondents comprised a much smaller segment of the state's overall computing employee population than on the engineering side. Consequently, the computing estimates almost certainly significantly undercount statewide demand.

Employer Survey Respondent Computing Employees in Idaho Compared to Overall Number of State Computing Employees.

	STATE TOTAL 2020	STATE TOTAL 2023 (Estimated)	SURVEYED COMPANIES (Estimated)*
Computer Occupations (15–2000)	15,821	19,588	3,856

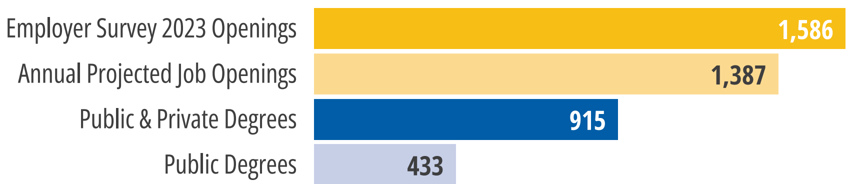
**Survey response options were presented as ranges and these totals assume a midpoint value of the selected range.*

Employer interviews also revealed how workforce shortages can have a downward impact on hiring demand. For example, in past years Idaho establishments have shifted or expanded their businesses outside the state after being unable to fill positions locally. In fact, some technology employers shared that the recent shift to remote work may enable Idaho-based companies to hire out of state to counterbalance local undersupply. Nonetheless, the strong demand for these occupations nationally also means that computer and information science graduates could remain in Idaho and work for employers located virtually anywhere while contributing to Idaho's tax base, reinforcing the benefits of steady graduate production. These types of decisions have the potential to drive demand up or down depending upon the local availability of talent.

Computer and Information Science Gap Analysis

The available quantifications of supply (represented in the blue bars below) and demand (represented by the yellow bars) indicate a gap between the number of computer and information science graduates from Idaho public institutions and the needs of Idaho's employers. Given the strong growth trends in this field, the identified gap appears robust across a range of specifications and appears likely to continue over time if present trends continue.

Idaho Institution Annual Computer and Information Science Degrees (Average of 2018–2020), ID DoL Projected Annual Computing Job Openings (2020–2030) & WICHE Employer Survey Hiring Demand Estimates (2023)



Sources: Integrated Postsecondary Education Data System, Idaho Department of Labor Occupation Projections (2020–2030), WICHE Employer Survey

Student Flow Model

The flow model described above is an important tool to help understand the challenge facing Idaho policymakers, industry leaders, and others committed to this work. The broad takeaway from adjustments to the flow model is that even with substantial improvements in postsecondary completion, few additional degrees would be produced. Improvements to college participation rates, which are obviously a broader state concern, have the potential to drive more students into these fields of interest. A key concern, though, is trying to ensure that those additional students are well-prepared to enter and succeed in the fields of interest.

The results of the flow model are stark. Even with substantial improvements in underlying metrics, like high school graduation rates and postsecondary progression, the state would produce relatively few additional degrees. This effort must be comprehensive and reach new populations of students who have not previously been interested in these fields. Additionally, the data point to the need for engaging students outside of the traditional high school-to-college pipeline.

Next Steps

As noted above, WICHE's does not aim with this report to create a detailed strategic plan for an engineering and computer and information science degree growth initiative. Instead, our intent is to provide a strong, evidence-based framework for potential next steps that is tailored to Idaho's context. The strong, overarching conclusion based on our analysis of the available data is that immediately moving to increase postsecondary capacity in these fields will not greatly increase production. It is important to recognize as a starting point that outcomes of initiatives like the one in Utah are useful guides, but have taken place in a different demographic reality than the one currently faced by Idaho.

The ultimate solution for Idaho will be to develop an Idaho-centered approach. The steps proposed below could form the framework for detailed strategic planning in the future.

Creating a Shared Vision & Coordinated Plan

Generating additional graduates in high-demand fields such as engineering and computer science is a complex, long-term endeavor. The downward demographic trends driving the overall number of high school graduates Idaho is expected to produce paired with the state's declining college-going rates mean the state is facing significant headwinds as they seek to increase supply. While Utah's initiative took place in a growth context (both demographically and economically), Idaho will face a more challenging environment for a similar effort (although the state's economic outlook is very positive). Moreover, addressing the multifaceted challenges of demographic and large-scale educational trends such as the college go-on rate will require the development of equally multifaceted responses.

To drive this effort, the state could facilitate an industry-led partnership between key stakeholders in policy and education to guide the development and ongoing refinement of a shared vision for increasing the number of engineering and computer-related graduates and a set of short- and long-term strategies to achieve this vision. This approach should also situate the effort in Idaho's broader economic context, considering the overall realities of the state's labor market and pressing shortages in other STEM fields such as healthcare.

With substantial attention already focused on college go-on rates, an engineering and computer science growth initiative should complement those efforts with a focus on supporting improvements in K–12 preparation for these fields, as well as driving interest among students.

Additionally, a potential initiative can also work to create and expand other potential student pipelines through enhanced upskilling of current employees, identification and recruitment of individuals who completed substantial credits in these fields but left postsecondary education without a degree, and other strategies focused on adult students.

Identifying Clear Roles & Responsibilities

As partners in this work, industry, policymakers, universities, community colleges, and the K–12 sector should identify how they will individually and collaboratively contribute to achieving the shared vision through the identified short- and long-term strategies. For example, higher education institutions might commit to increasing the number of female students enrolling in and completing engineering and computer and information science programs, partnering with K–12 to improve the math preparedness of high school graduates, and collaborating across the two- and four-year sectors to improve transfer pathways. Alternatively, industry partners might commit to employee upskilling initiatives, provide equipment and internship or project opportunities that meaningfully address challenges identified by educational partners, and provide timely and actionable feedback to educational partners. Given the demographic trends of Idaho's youth population, an important area of focus for all partners should be identifying how to identify, attract, and support non-traditional-aged students through to degree completion.

If there is going to be a sustained initiative, WICHE strongly believes that there will need to be a statewide entity that bears responsibility for coordinating that work. Given the interest of employers and their effectiveness in driving change, it seems appropriate that some type of industry-led body should serve in that role. It is important to note that this recommendation does not imply that such a body would have authority over the other entities noted above, but would collaborate and coordinate within appropriate roles and responsibilities of the different agencies and organizations committed to addressing these issues.

Investing for Impact

In order to make the most of any investment, the partners must identify and prioritize the greatest barriers and most effective solutions to workforce supply. Engineering and computer-related fields encompass a broad range of credentials and specialties that lead to a variety of occupations. The state may consider if a broad or a targeted approach will be most effective for meeting their goals with available funds. As part of this analysis, they should also focus on leveraging Idaho's unique assets in both industry and education for maximum value. Finally, it will be critical to balance immediate employer needs with sustainable growth plans that have the flexibility to account for changing dynamics such as recessions and shifts in automation.

Hopefully, readers of this report will agree with the conclusion that immediately investing in postsecondary capacity improvements should not be the first priority. Obviously, continuing to invest in these programs to make sure that they are turning out high-quality graduates is essential, but it does not appear that postsecondary capacity is the current limiting factor on degree production. Investment must instead first focus on growing the pipeline of students who are prepared to enter and succeed in these fields. Capacity issues can be addressed as those trends begin to change.

Data, Metrics, and Research

While it is standard fare for a report on postsecondary supply and employment demand to feature a recommendation related to data and metrics, that does not make it any less important. As part of the framework, WICHE recommends that industry leaders and other key agencies and organizations coalesce around meaningful metrics for understanding how the initiative that is envisioned is impacting outcomes. It would be easy to focus solely on the number of graduates that are produced annually in each field, and we agree that is an important metric. However, if, for example, the number of students enrolled in public postsecondary institutions in the state declines substantially, but the number of graduates in these fields holds steady, that would be a sign of some success. This report contains numerous different data points and ways of considering supply and demand issues. Certainly not all of the data points will resonate, but they could represent a starting point for consideration. As an initiative unfolds, it is highly doubtful that every approach and policy change will bear fruit, but with a successful monitoring and evaluation approach, it will be possible to continuously refine efforts to improve outcomes.

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INTRODUCTION

With a high-skill, high-tech workforce emerging as a hallmark of a flourishing economy, a steady supply of well-trained graduates in engineering, computer science, and related disciplines will play a critical role in Idaho's future. From building and maintaining the infrastructure needed for the state's fast-growing population, to providing the talent demanded by key industries, engineers, engineering technologists, and computer and information science professionals are a foundational pillar of the state's growth.

These high-paying occupations offer Idahoans family-sustaining wages and contribute to the state's tax base and overall economic vitality. Engineering, engineering technology, and computing occupations all pay well above the average annual salary in the state, with engineering technologists earning 24% more than the average occupation, engineers earning 78% more, and computing occupations a whopping 112% more than the average according to the most recent available data.[11] Moreover, many of these occupations are in high-growth fields, with environmental, industrial, civil, mechanical, electrical, computer hardware, and nuclear engineers, electrical and electronic technicians, and software developers, computer and information systems managers, computer systems analysts, and network and computer system administrators all present on the Idaho "Top Jobs" list.[12] Yet the impact of these occupations on the state goes far beyond these direct contributions.

Average Annual Wages in Idaho Occupations

All Occupations
$60,580

Engineering Occupations
$108,133

Computing Occupations
$128,391

Engineering Technologist Occupations
$74,821

Source: WICHE analysis of Idaho DoL data.

Idaho's key industries as identified by the state's Department of Commerce all rely on these professions, in particular advanced manufacturing, aerospace, food production, shared services, and energy.[13] Idaho companies of all sizes — from large employers like Micron Technology and Idaho National Laboratory (INL) to local small businesses — rely on the high-tech workforce to maintain their operations and to spur growth and innovation. According to interviews WICHE conducted with multiple employers between January and April 2023, many of the state's fastest growing companies have been founded, launched, and staffed by graduates of the state's engineering and computer science programs, bringing new industries and opportunities to the state. Therefore, a healthy pipeline of engineering and computer and information science graduates seems to play a pivotal role in the continued growth of Idaho's economy.

Yet in recent years, industry leaders have begun to express concerns that they cannot find enough talent in these critical fields, impacting their companies' growth and innovation. These leaders expressed interest in launching an engineering and computer science growth initiative similar to a long-time effort in Utah to address these gaps. A recent analysis of Utah's initiative found that the number of engineering and computer science graduates from Utah public institutions more than doubled between 2000 and 2020, as did engineering and computer science employment over the same period. The report's authors also found that in 2020, Utah's engineering and computer science workforce sustained and supported 238,419 jobs, $19.1 billion in earnings, and $25.2 billion in gross domestic product for the state.[14]

In response to these industry concerns, the Idaho State Board of Education commissioned an analysis from the Western Interstate Commission for Higher Education (WICHE) to explore the issue. Guided by an industry advisory group, the project team reviewed existing research, analyzed publicly available data, modeled the projected supply of graduates using Idaho data, and conducted a range of employer engagement activities to answer two key questions:

1. Is the supply of engineering and computer science graduates from Idaho's public institutions adequate to meet current and projected industry demand?.
2. If not, how can the state strategically address the gap between supply and demand?.

This analysis was not intended to provide a complete and detailed strategic plan, but rather to assist industry with articulating the gap between supply and demand to the greatest extent possible and identifying high-level, evidence-based approaches to increase credential production.

METHODOLOGY

Understanding Supply

Graduates in engineering, engineering technology, and computer-related fields from Idaho postsecondary institutions are used as a proxy metric for the "supply" of new workers available to the state's businesses. To analyze this population WICHE used publicly available data from the Integrated Postsecondary Educational Data System (IPEDS) as well as data from the Idaho State Board of Education (more detail on the State Board of Education data can be found in the Appendix).

After consultation with the Industry Advisory Team and a literature review, WICHE opted to include three codes from the Classifications of Instructional Programs (CIP) — developed by the National Center for Educational Statistics to offer a standardized way to categorize postsecondary academic programs by field — in the analysis.

- **CIP 11 – COMPUTER AND INFORMATION SCIENCES AND SUPPORT SERVICES** Instructional programs that focus on the computer and information sciences and prepare individuals for various occupations in information technology and computer operations fields.[15]
- **CIP 14 – ENGINEERING** Instructional programs that prepare individuals to apply mathematical and scientific principles to the solution of practical problems.[16]
- **CIP 15 – ENGINEERING TECHNOLOGIES/TECHNICIANS** Instructional programs that prepare individuals to apply basic engineering principles and technical skills in support of engineering and related projects or to prepare for engineering-related fields.[17]

A note on terminology, the term "computer science" as used in the Utah initiative refers to the full range included in CIP 11 (a wide range of computer-related degrees) thus the term computer science has been replaced with computer and information science to more accurately reflect the degree types discussed. In addition, while this report focuses on graduates of public institutions, the contributions of the state's private institutions are reflected where appropriate to provide additional information on available supply.

The analysis primarily focuses on the credential type most typical for entry-level employment in its related field, however, additional information on postsecondary degree types critical to industry such as masters and doctoral degrees are included as well. After receiving substantial feedback from employers on the topic of non-degree credentials such as certificates, it became clear that there is not consensus among Idaho employers on any type of certificate that was critical for employment in these fields, thus, they are not a primary focus of this analysis.

Of course, recent postsecondary graduates are not the only source of supply in the labor market. Employers need to hire across a range of experience levels and some Idaho businesses hire from regional, national, or international candidate pools and net-migration also affects labor supply. However, qualitative research demonstrates robust employer demand for entry-level hires in the fields of interest — typically bachelor's graduates — as well as a strong employer preference for hiring Idaho graduates.[18] Therefore, degree production in engineering and computer-related fields presents a useful, though imperfect, way to think about workforce supply.

To better understand the pipeline supplying graduates of these two fields, WICHE employed a range of quantitative and qualitative approaches. This work includes a complex student flow model developed by the National Center for Higher Education Management Systems (NCHEMS) that examines how the number of graduates in these fields may change in the future based on current trends and state demographics.

This model is based on numerous different data points from the education pipeline with a focus on the three fields of interest: engineering, engineering technologies, and computer science and information services.

At a high level, the model shows what happens to degree production when you adjust any one of a number of "levers" related to the education pipeline. This is not designed to be a tool for making perfect projections about future degree production, but more of a tool to show how changes in important metrics are likely to impact overall outcomes.

The model will help policymakers, industry leaders, and others to see where it might be possible to get the best "bang for the buck" in terms of investment.

The model is built by analyzing a combination of publicly available data from the U.S. Department of Education's Integrated Postsecondary Data System (IPEDS), U.S. Census Data, state high school graduation rates, and student-level data provided by the Idaho State Board of Education. Each of these data sources is used to build up a model of the education pipeline.

Within the model, we are able to then adjust key metrics, including

- High-school graduation rates
- College go-on rates
- Number of out-of-state students attending college in Idaho
- Overall participation rate of Idaho residents in postsecondary education (which helps account for adult students)
- Progression rates within particular degree programs

With each adjustment, the model then calculates the change in degrees produced, with a focus on the three fields of interest. As an example, Idaho institutions annually produced 737 engineering degrees on average from 2019–21. Based solely on shifts in the population and assuming the status quo in all metrics, by the 2029–30 school year, the state would produce a total of 37 additional bachelor's degrees in Engineering (this is not an increase of 37 per year, but 37 total over the time frame). As will be discussed in greater detail below, this would not fill the expected gaps, and changes in some metrics would be expected to produce greater gains than others.

One metric that the model does not adjust for is the percentage of students who elect to go into the fields of interest. As will be discussed below, this is likely an important piece to consider as well. Separate data analyses below examine the percentage of students ever choosing a field of interest, but it is difficult to say if these numbers are good, bad, or indifferent without appropriate comparisons and additional research.

It is important to emphasize again that the model is not intended to be an exact projection model, but to help guide thinking and approaches to addressing the issues raised by industry and key state employers. It is an essential tool for situating the issue within Idaho's population and demographic context.

Estimating Demand

There is no one perfect data source that cleanly lays out the precise number of new engineers and computer science graduates that Idaho will need in the future. Instead, WICHE has examined a range of measures, trends, and projections, and paired that with first-hand information from Idaho employers who are looking to hire these graduates.

Historical employment trends

The Bureau of Labor Statistics (BLS) offers historical estimates of employment by occupation at the national and the state level, allowing for cross-state comparisons. BLS also produces projections of employment by occupation, but only at the national level.

Occupational projections

The Idaho Department of Labor (ID DoL) produces state-level projections of employment by occupation, which provide the best available state-level projections of hiring demand by occupation despite certain limitations. For example, the 2020–2030 ID DoL projections do not yet reflect the projected impacts of significant federal policy changes such as the CHIPS and Science Act (CHIPS Act) and the Infrastructure Investment and Jobs Ac (IIJA).

Employer survey & interviews

The project team supplemented the existing ID DoL projections with results from a 2023 employer survey on hiring demand in fields of interest and in-depth interviews with a subset of key industry representatives.

Gap Analysis

Degree production and projected job demand in related fields are not a one-to-one match, but comparing the approximate magnitude of the difference between the two does provide some sense of the "gap" that exists between supply and demand. Meanwhile, examining projections based on current trends offers a way to understand whether identified gaps are likely to grow or to shrink if present trends continue. In the sections that follow WICHE has attempted to combine the available evidence to assess the gap in degree production but recognizing that many different factors may affect that gap for all three fields of interest.

SUPPLY OVERVIEW

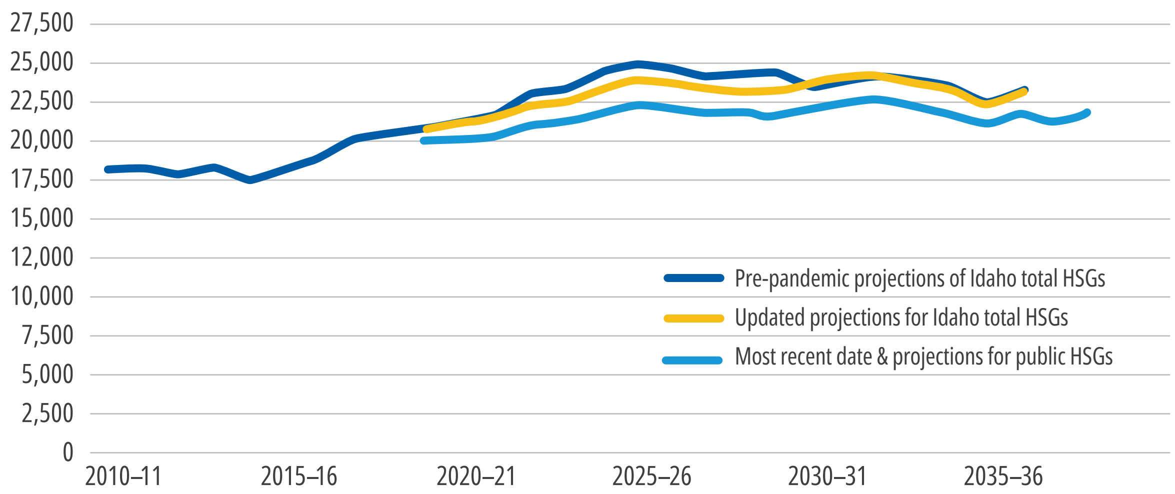
General Student Trends

Nationally, the number of students enrolled in postsecondary education is projected to grow by nine percent by 2031.[19] That growth would be welcome across the country as the last decade has seen steady declines in the number of students enrolled. Idaho has seen substantial drops in its college-going rate in recent years. The percentage of high school graduates enrolling in a postsecondary institution within three years of graduation has declined five percentage points, from 63% to 58% from the graduating class of 2015 to the class of 2019 (the most recent year for which data are available).[20] This mirrors national trends, which have also shown a declining number of high school graduates enrolling in postsecondary institutions.[21]

While these metrics relate to rates, the raw number of potential future graduates is also a key concern when considering approaches to increasing the number of future graduates in particular fields of study. A useful starting point for this piece of the puzzle is projections about the size of Idaho's future high school graduating classes.

The state's future high school graduating classes are expected to grow through the middle of the decade, followed by a period of modest decline, ending in 2037 at roughly the same number of high school graduates as the state produces today. This is shown in Figure 1.

Figure 1. Projected Idaho high school graduates



Source: WICHE, Knocking at the College Door

These trends help set the context for Idaho's intended effort to grow the number of graduates in the three fields of interest. The solid dark line represents projections made by WICHE in 2020 using data that predates the COVID-19 pandemic. The dotted lines represent updated projections with more recent state data. While the new information indicates a slightly lower peak in the total number of graduates in the middle of the decade (represented by the dark dots), the longer-term numbers are relatively consistent with previous projections. Idaho is still expected to see a relatively flat number of high school graduates through the remainder of the projected period.

While Utah is often cited as the model for an initiative such as this, it is absolutely essential to recognize that Utah's effort started in a vastly different context than what Idaho faces today. As Utah launched its work, the state was in a period of growing high school graduating classes, increasing postsecondary enrollment, and a booming state economy.[22]

While Idaho's economic growth continues to be strong, the trends in the other two areas are quite different from those Utah faced. As can be seen in Figure 1 above, Idaho is expected to soon reach a peak in the number of high school graduates it produces, followed by years of relatively constant production. Coupled with the state's college go-on trends, this necessitates different thinking and different policy approaches. While in Utah, the effort benefited from natural growth in potential student populations, meaning that the major interventions could focus on increasing postsecondary capacity, in Idaho, as the data will show, interventions likely will have to focus on growing the pipeline of potential students as a precursor to increasing postsecondary capacity to handle influxes of students in these majors.

Essentially, this initiative must develop a laser focus on being more efficient with a smaller number of students. As the analysis on the following pages hopefully makes clear, Idaho's pathway to an increased number of graduates in Engineering, Engineering Technology, and Computer and Information Science requires a concerted effort across the pipeline, from interesting more K–12 students in these fields at younger ages, to improving math preparation in K–12, to increasing the percentage of students who are likely to succeed that select one of these fields, to supporting them after they declare a major all the way through to graduation. Simply put, based on the data and analysis that follow, if the state invests resources in increasing postsecondary capacity in these fields without prior efforts to grow the pipeline of incoming students, it is unlikely that the number of graduates would meaningfully increase.

To get to that conclusion, we walk through analysis of the current pipeline, and blend that with the underlying trends described at the outset of this section.

Cohort Analysis Background

To shed further light on issues of supply, WICHE has analyzed student-level data provided by the Idaho State Board of Education and the State Department of Education to identify factors that are associated with students choosing to major in one of these fields and succeeding once they do so. This analysis also examines how many students with these characteristics of success are opting for and succeeding in different educational pathways. The aim is that this analysis can help sharpen the focus of policy and financial interventions to boost the number of graduates working in Idaho.

For this work, WICHE has examined two discrete cohorts of students — those entering public postsecondary institutions in the state for the first time in the 2013–14 school year and those doing so for the first time in the 2018–19 school year. Descriptive data for the two cohorts are useful for comparing differences over time and across majors of interest — in this case computer and information science, engineering, and engineering technologies. WICHE selected these cohorts intentionally, with the earlier cohort being chosen to provide enough time for program completion and the more recent cohort selected to provide more current information while still allowing some time to observe progress through the postsecondary system.

The data WICHE received from the Idaho State Board of Education runs through the 2021–22 school year.

Cohort Demographic information

In the following sections, descriptive demographic data are presented for the two cohorts. [23] As can be seen in Table 1, both cohorts feature more females than males, consistent with other demographic data reported by the Idaho State Board of Education.

The data show a decreasing overall cohort size of first-time enrollees in postsecondary education from the 2013–14 to 2018–19 cohorts. Additionally, both cohorts show a slightly larger population of females than males.

Similar to Idaho's overall population, the race/ethnicity of the cohorts is predominantly white, as can be seen in Table 2.

Table 1. Gender distribution of cohorts

	2013–14	2018–19
Females	53.0%	54.6%
Males	44.8%	45.1%
Unknown/Unreported	2.2%	< 1%
Total Students	**21,894**	**18,883**

Table 2. Race/ethnicity of cohorts

	2013–14	2018–19
Black/African American	1.8%	1.9%
Asian	1.6%	2.4%
NHOPI	< 1%	< 1%
AI/AN	1.1%	< 1%
White	79.8%	79.4%
Multiracial	1.6%	2.0%
Hispanic	11.4%	11.5%
Unknown/Unreported	2.5%	1.6%
Total Students*	**18,881**	**17,926**

**Note: The number of students reported in this table differ across variables due to missing data for some students.*

Standardized Exam Math Results

WICHE also received information on student results on standardized tests. Two exams were considered —– the Idaho Standards Achievement Test (ISAT) and the SAT (the meaning for the acronym of this national exam was dropped years ago but originally stood for "Scholastic Aptitude Test"). Distribution of the results is described in Tables 3 and 4 (page 26). Our focus is on students' math results and the relationship between those and student outcomes in computer and information science and engineering (which is discussed in greater detail in later sections). These results are only presented for the 2018–19 cohort and not available for all students. While multiple measures of ISAT math performance are available, WICHE focuses on the math composite results. The results include disaggregation by gender, because, as will be seen throughout this report, there is a substantial gender gap in the number of students that go into the fields of interest.

Table 3. ISAT results distribution, 2018–19 cohort

LEVEL	% OF ALL STUDENTS	% OF MALES	% OF FEMALES
1 – Does not meet standards	25.6%	26.1%	25.3%
2 – Nearly meets standards	30.0%	28.7%	30.9%
3 – Meets standards	27.2%	26.2%	27.9%
4 – Exceeds standards	17.2%	18.9%	15.9%

Students take the ISAT for math in grade 10. The four levels are described by the State Department of Education as follows: level 4 shows that the student exceeds grade level achievement standards; level 3 represents meeting grade level achievement standards; level 2 indicates that the student has nearly met the grade level achievement standards; and level 1 suggests that the student has not met those standards.[24]

Distribution on the math portion of the SAT is somewhat similar, with the majority of students grouped into the middle bands.

Table 4. SAT scores, 2018–19 cohort

LEVEL	% OF ALL STUDENTS	% OF OF MALES	% OF OF FEMALES
< 301	< 1%	< 1%	< 1%
301–400	9.0%	8.2%	9.6%
401–500	29.3%	26.6%	31.4%
501–600	41.5%	41.5)	42.0%
601–700	15.4%	18.1%	13.3%
701–800	4.4%	5.9%	3.1%

ISAT results were available for about 37% of students and SAT results were available for about 34% of the 2018–19 cohort with substantial overlap meaning most students who took any exam took both. With only about a third of students having math scores, caution is warranted before drawing firm conclusions about math results in the subsequent sections. There are statistically significant differences between the populations of students who do have results and those that don't, but the results, as will be shown later, are important and suggestive in helping to guide potential policy decisions. This is an important vein of analysis with substantial research showing strong connections between math preparation and student success in fields like engineering and computer science, although this relationship can also be tied to students' perceptions of their own self-efficacy in math.[25]

The gender differences in distribution on both tests are relatively consistent and statistically significant. More males tend to score in the highest bands, but, as will be discussed in greater detail below, this modest difference does not come close to explaining the substantial gender gap in the students who choose these three fields of interest.

Geographic

WICHE is also able to examine geographic information for a subset of students in each cohort. Using generally accepted definitions, the distribution of students in the two cohorts varies in their location, as can be seen in Table 5.

Table 5. Geographic distribution of cohorts

LOCALE	2013–14	2018–19
City	26.0%	26.4%
Suburb	29.7%	26.7%
Town	22.7%	24.3%
Rural	21.6%	22.7%
Total Students	**8,503**	**9,737**

As can be seen in the Table 5, in both cohorts, the majority of students live in cities and suburbs, with over 55% of postsecondary students coming from schools in those locales in the 2013–14 cohort and over 53% doing so in the 2018–19 cohort. With concerns about inequalities across regions of the state in math preparation, this distribution will be examined in greater detail below for considering impacts to the supply pipeline for future engineering and computer and information science graduates.

Degree Completion Results

In the two cohorts analyzed, a large number of students completed postsecondary credentials. The information in Table 6 shows the distribution of completions in all fields as well as the percentage of students who were still enrolled and the number who no longer appear in the dataset. This suggests that they may have stopped out, although this should not be taken as a detailed analysis of overall completion rates due to various data considerations.

Table 6. Degree distribution by cohort

DEGREE LEVEL	2013–14	2018–19
Associates	6.2%	5.4%
Bachelor's	22.9%	17.7%
Master's	6.4%	6.1%
Doctorate	< 1%	< 1%
Still Enrolled	< 1%	8.4%
No Longer Enrolled	63.6%	62.3%
Total Students	**21,894**	**18,883**

As would be expected, the data for 2013–14 show more credential completions and fewer students still enrolled. Of those who completed degrees or are still enrolled, more than 80% of degree completers in the 2013–14 cohort earned bachelor's or higher degrees, while just under 17% of degree completers earned associates degrees. For the 2018–19 cohort, the numbers are closer to 60% completing bachelor's or higher, with a quarter of that population still enrolled and about 14% earning associates degrees. A large percentage of both cohorts is no longer enrolled.

ENGINEERING

Engineering Supply

Historical trends in Idaho's engineering bachelor's degree production — the typical entry-level credential of most engineering professions[26] — show growth between 2010 and 2020, primarily driven by substantial growth between 2010 and 2015.

Supply modeling shows that if contributing trends persist, Idaho can expect only minimal increases in the number of engineering graduates produced annually by its public institutions. A projected levelling off of the overall number of high school graduates in the state and a negatively trending college go-on rate of Idaho high school graduates are among the primary contributors to this low growth projection.[27]

Meanwhile, existing research shows that just over 60% of engineering bachelor's degree recipients who were Idaho residents at the state's public institutions are found in the state's unemployment insurance data after graduation, suggesting that a large portion of graduates from Idaho institutions may be leaving the state.[28] Under 40% of out-of-state students are found in working in jobs covered by the state's unemployment insurance data (including international students, who are over-represented in engineering programs).[29] As a result, the total number of graduates produced by the state's public institutions may overstate the available workforce supply due to outmigration, though there are not available data for the in-migration of graduates in these fields from other states.

Importantly, data analysis for the project also revealed that women are significantly less likely to select engineering majors, although those who do so are more likely to complete their degrees.

Engineering Technology

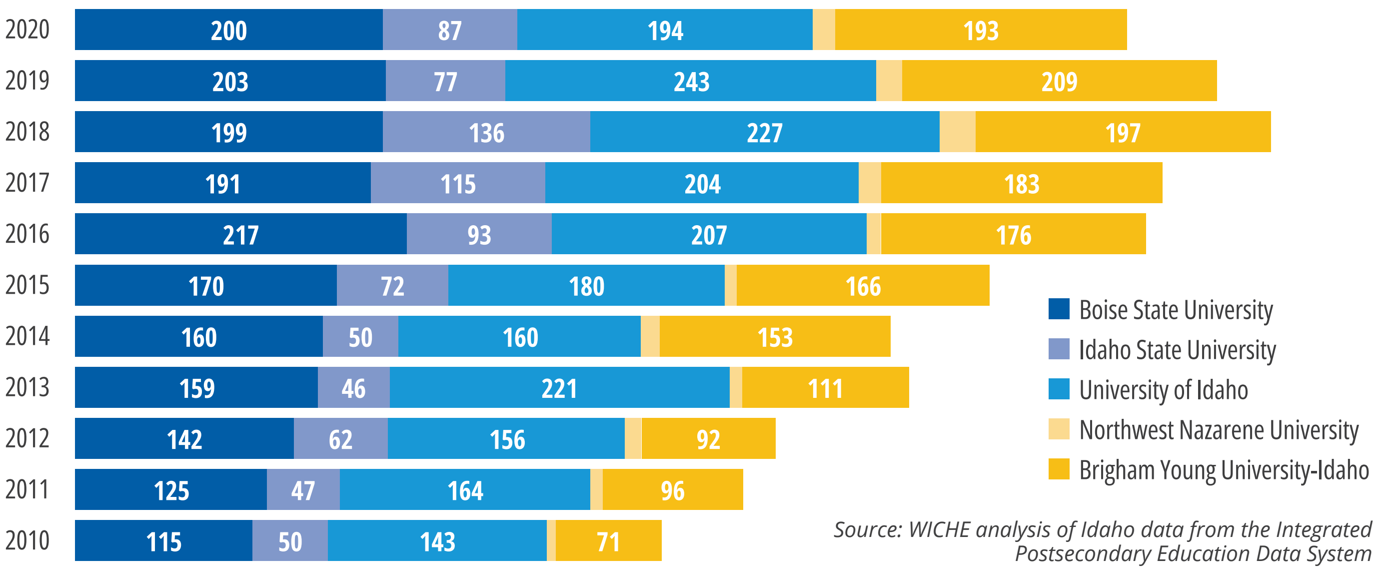
Engineering technology programs have historically been offered at the sub-baccalaureate level, including associate degree and certificate options. Between 2018 and 2020, Idaho produced 166 associate degrees in engineering technology per year; in 2020, the highest percentage came from Idaho State University (40%) followed by the College of Western Idaho (22%), the College of Southern Idaho (17%), North Idaho College (6%), and Lewis-Clark State College (4%). The remaining 10% of the annual associate degrees were from Brigham Young University-Idaho (BYU-Idaho). Currently the state's public institutions only produce a handful of graduates in bachelor's degree programs in engineering technology — 15 per year statewide between 2018 and 2020.

While BYU-Idaho does graduate a significant number of students in CIP 15, they are largely in subcategories of the designation that may more naturally fit into descriptive categories outside of engineering. For example, their main bachelor's degree offering in Engineering Technology is in CIP 15.1202 — Computer/Computer Systems Technology/Technician (from which they produced an average of 123 bachelor's degrees per year between 2018 and 2020).

Trends in Degree Production

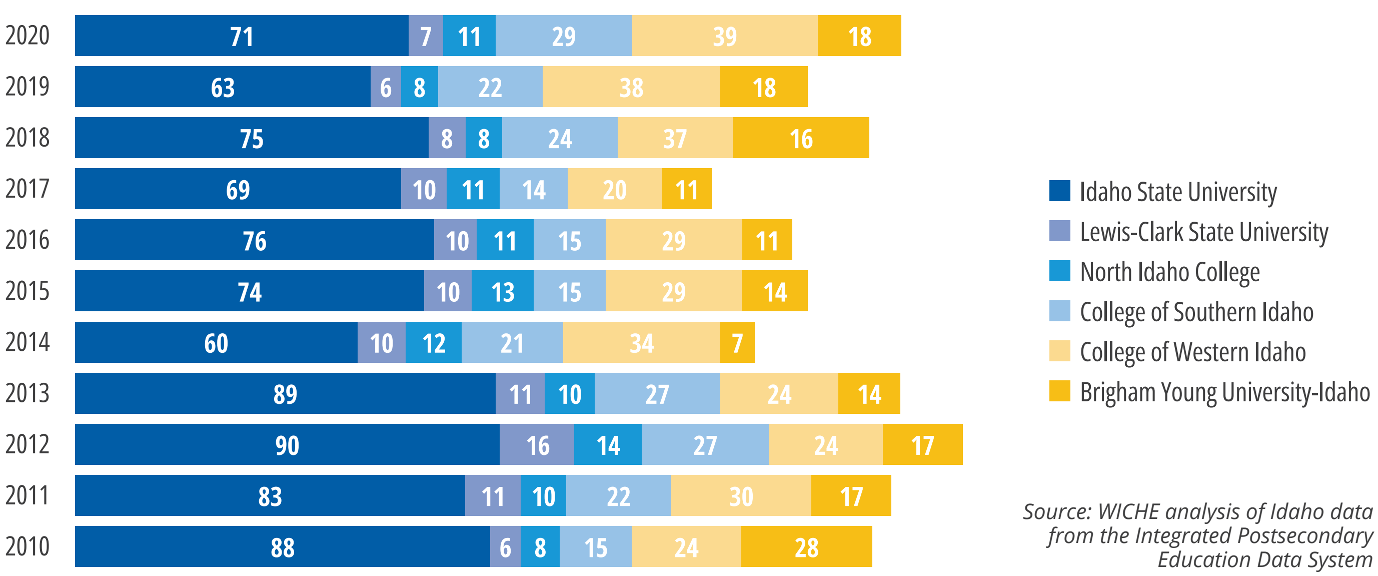
We begin the supply analysis with summary data on completions from all Idaho institutions. As can be seen in Figure 2, according to federally collected data, Idaho's institutions grew the number of Engineering graduates the latter part of the 2010s, but that growth has tapered off, which would be consistent with the observed decline in the number of students declaring one of these fields as their major. Figure 3 shows completions of associates degrees in engineering technology have been more volatile and in 2020 (the most recent available year of data), eclipsed 2010 numbers.

Figure 2. Annual bachelor's degree completions in engineering from Idaho institutions



Source: WICHE analysis of Idaho data from the Integrated Postsecondary Education Data System

Figure 3. Annual associate degree completions in engineering technology from Idaho institutions



Source: WICHE analysis of Idaho data from the Integrated Postsecondary Education Data System

The growth over time for bachelor's degrees in engineering is particularly noteworthy, but further and continuing analysis is warranted to determine how much all institutions (including BYU-Idaho) contribute graduates to the workforce and whether graduates are employed in the state. As noted earlier, previous research by the Idaho State Board of Education shows that engineering graduates in particular tend to have a lower-than-average rate of being found in state employment data.[30]

Cohort Analysis: Engineering and Engineering Technologies

Using the data from the two cohorts of students, WICHE analyzed pathways, progression, and successful student outcomes in the different majors of interest. This section presents those results, starting with descriptive data about the number and characteristics of students who opt into these majors, then similar data about those students who complete degrees in these fields.

This analysis builds toward a more complex model that estimates the association between different student characteristics, including performance on math standardized tests and student demographics, and pursuing and completing a degree in these fields. The model is not meant to provide causal conclusions, but to try to illustrate the types of students who are succeeding in these fields as a tool to assess the potential pathways for greatly expanding the number of graduates.

In this vein, this analysis is complementary to the model showing how improvements in different areas of the education pipeline are likely to impact the potential future number of graduates in different ways (please see the section below on the student flow model).

Descriptive Data – Engineering and Engineering Technologies Supply

As a first step in this analysis, Table 7 shows the percentage of students who declare a major within CIP code 14 or 15 at any point in the time frame covered by the data, as a percentage of all students that ever declared a major.

Among the 2013–14 student cohort, of all the students who declared a major, 7.5% were engineering majors at some point, which decreased to 6.0% for the 2018–19 cohort. For the engineering technologies major those numbers were 1.5% for the 2013–14 cohort and 1.3% for the 2018–19 cohort.

Table 7. Percentage of students declaring engineering and engineering technologies as a major

MAJORS	2013–14	2018–19
CIP 14 (Engineering)	7.5%	6.0%
CIP 15 (Engineering Technologies)	1.5%	1.3%
Total Students Declaring a Major	**18,929**	**16,839**

While it is not fully appropriate to draw trends from two points in time, the decline in the overall number of students declaring a major is supported by other data points and the drop in the percentage of students entering these fields is sobering. The decline in the percentage of students who ever declared engineering, when compounded with the declining overall numbers of students, represents a drop of 400 students between the 2013–14 cohort and the 2018–19 cohort. While not all of these enrollees may have graduated, it potentially illustrates the reasons for the end of the growth in degree production illustrated above.

Next, the analysis turns to examining some of the potential gaps between how likely different populations are to enter these fields. As a starting point, Tables 8 and 9 show the percentage of males and females that ever declare a major of engineering or engineering technology.

These data show what is well-known to faculty and leadership at institutions of higher education and consistent with volumes of research about gender disparities in engineering fields. This gender gap is persistent throughout the data points examined in this report and suggests that identifying ways to attract more females into the field may be an important approach. The results are statistically significant and substantively large. Discussion will return to questions around the gender gap in discussing the associations between performance on math standardized tests and success in these fields, but the gap remains persistent after taking other factors into account.

Table 8. Percentage of students declaring engineering as a major by gender

MAJORS	2013–14	2018–19
Female	2.1%	2.0%
Male	13.9%	11.0%
Total Students Declaring Major	**18,929**	**16,839**

Table 9. Percentage of students declaring engineering technologies as a major by gender

MAJORS	2013–14	2018–19
Female	< 1%	< 1%
Male	2.7%	2.6%
Total Students Declaring Major	**18,929**	**16,839**

Disparities by race and ethnicity were also raised as a potential issue in discussions with employers as well as staff from postsecondary institutions. Here, the data are less clear, partly due to limited information on race and ethnicity for some individuals. The data in the table below shows the percentages of students ever declaring engineering as a major.

Table 10. Percentage of students ever declaring engineering as a major by race/ethnicity

RACE/ETHNICITY	2013–14	2018–19
Black/African American	4.5%	4.0%
Asian	16.1%	10.7%
NHOPI	***	***
AI/AN	4.4%	4.0%
White	6.3%	5.9%
Multiracial	9.9%	6.9%
Hispanic	4.8%	4.5%

****Redacted due to small cell sizes.*

There are numerous interesting points from this examination. Overall, the data are clearly consistent with the decline in the number of students declaring engineering as a major. While there are statistically significant differences in the distribution across races, also of note are the sharp declines in the percentage of Asian and multiracial students who declared engineering as a major. Although the number of Asian students who declared any major grew by more than 130 students between the two cohorts, the number of those students who declared this major increased by only a single student.

Due to small numbers of graduates, a separate analysis of students declaring engineering technology as their major disaggregated by race/ethnicity is not included.

Research shows that students' math knowledge is highly predictive of selection of engineering (and ultimate success), with some caveats that this can be moderated by improvements in self-perception of math abilities and strong goals.[31] Table 11 shows the percentage of students scoring at each level of the ISAT who ever declared engineering as a major, while the subsequent table showing the same results by band of results on the math portion of the SAT.

As would be expected, for both exams there is a clear and consistent pattern of students with higher math scores being associated with a higher likelihood of ever declaring engineering as a major. Referring back to the previous data points on gender, it is also a worthwhile question to consider whether the gender gap in declaration of engineering as a major is partially explained by differences in performance on math exams by gender.

This data point shows that the gender gap persists even among students with equivalent math performance. It shows that of students from the 2018–19 cohort, only about seven percent of females with the highest math scores on the ISAT ever declared engineering as a major, while just under 26% of males with similar scores did. Looking at the spread for students who scored over 600 on the math portion of the SAT, just under eight percent of those females ever declared engineering as a major compared to almost 24% of males. For females, high math scores appear to have less of an association with declaration of engineering as a major.

The smaller number of students in engineering technologies precludes a detailed analysis of the relationship between math and major declaration, though the results do not suggest as strong of a relationship between performance on math standardized tests, nor are they statistically significant

Table 11. ISAT scores and declaration of engineering as a major

ISAT COMPOSITE LEVEL	% OF STUDENTS DECLARING ENGINEERING
1	1.3%
2	3.3%
3	6.1%
4	16.0%

Table 12. SAT scores and declaration of engineering as a major

SAT SCORE RANGE	% OF STUDENTS DECLARING ENGINEERING
< 301	0%
301–400	< 1%
401–500	1.9%
501–600	5.4%
601–700	12.9%
701–800	28.1%

Table 13. Percentage of students with high math scores declaring as engineers

EXAM	% OF MALES DECLARING ENGINEERING	% OF FEMALES DECLARING ENGINEERING
ISAT Level 4	25.7%	6.8%
SAT Math > 600	23.8%	7.7%

Throughout the course of the project, discussions with employers and others raised questions about the role of Idaho's geography in producing engineers. In particular, respondents wondered whether those from more rural areas may be less likely to enter into these fields. The data suggest there may be some truth to this, with statistically significant differences in the percentage of students from each location that ever declare engineering as their major. The numbers for both cohorts are presented in Table 14.

Table 14. Percentage of students from each locale ever declaring engineering as a major

COHORT YEAR	CITY	SUBURB	TOWN	RURAL
2013–14	9.2%	5.1%	5.6%	5.6%
2018–19	8.1%	6.3%	4.9%	5.8%

The location information comes from students' high school records, and does not cover the entire cohorts, but the results are suggestive of a modest difference with students from urban areas more likely than those from rural areas to declare engineering as a major. These results are statistically significant.

With smaller numbers of students opting into engineering technologies, the results differ. For the 2013–14 cohort, there are no statistically significant differences, but for the 2018–19 cohort, there are differences, with students from rural areas more likely to pursue that pathway. The results are shown in Table 15.

Table 15. Percentage of students from each locale ever declaring engineering technologies as a major

COHORT YEAR	CITY	SUBURB	TOWN	RURAL
2013–14	1.2%	0.9%	1.0%	0.8%
2018–19	.9%	.9%	1.7%	2.6%

Student Characteristics and Graduation

The data above shows how different student characteristics are associated with declaring one of the two broad engineering categories as a student major. This section focuses on the association between those same student characteristics and student success — defined as completing a degree — of those who ever declared one of these two fields as a major. Because the cell sizes shrink considerably when only using a subset of students (in this case, those that ever declared engineering or engineering technologies as a major), some of the analyses are not as fully disaggregated as above.

Table 16. Degree completion rates for students that ever declared engineering as a major

COHORT YEAR	GRADUATED	GRADUATED IN ENGINEERING
2013–14	45.6%	68.3%
2018–19	27.9%	75.9%

Table 17. Degree completion rates for students that ever declared engineering technologies as a major

COHORT YEAR	GRADUATED	GRADUATED IN ENG. TECH
2013–14	36.0%	68.8%
2018–19	19.2%	78.4%

Overall, approximately 29% of students who ever declare any major in the two cohorts ultimately end up completing a degree. The data in the tables below show that the success rate for those who ever declare engineering is higher, and about the same for engineering technologies. As one would expect, the percentage of those completing a degree in the 2018–19 cohort is lower, which is likely mainly due to there being fewer years for those students to complete their studies.

These tables show the percentage of students who declared the noted major who graduated. The third column shows the percentage of those graduates who completed their degree in the field of interest.

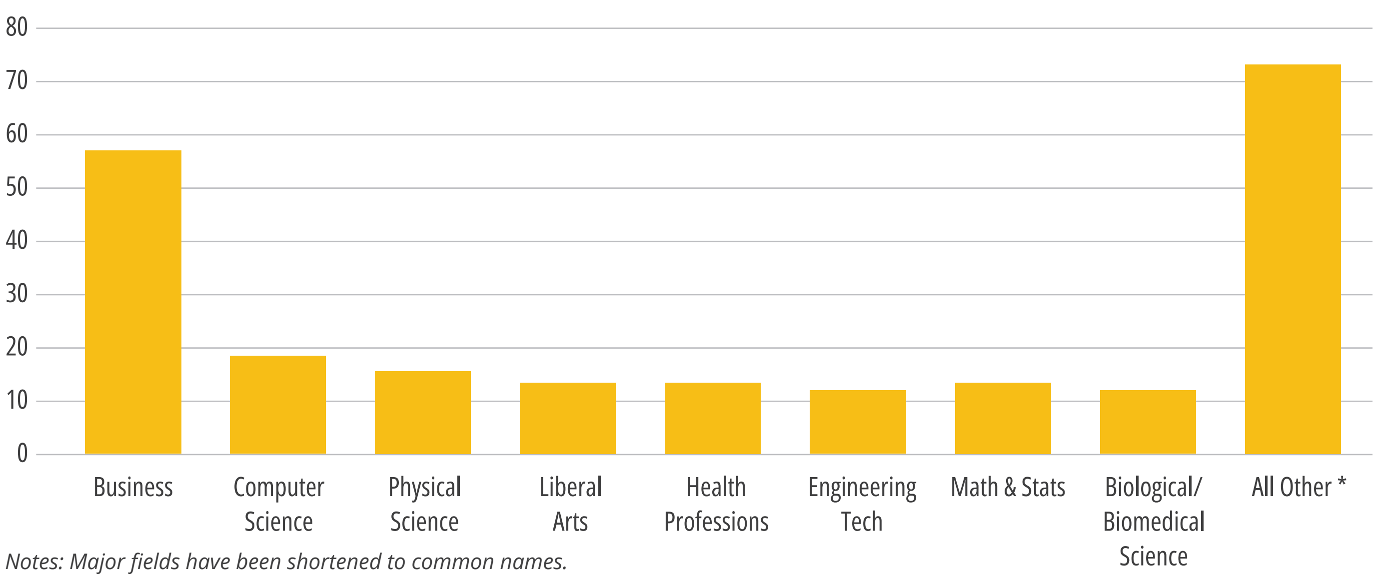
This shows that of those who graduated and at any point in their academic career declared engineering (CIP 14) as a major, in the 2013–14 cohort, about 68% graduated in engineering, while 76% of those same students from the 2018–19 cohort did so. Without broader analysis, it is difficult to determine whether this represents a material change between the cohorts or whether the shorter time horizon explains the difference. It could be that those who left the major will take longer to graduate, so over time, both the percentage of students from that cohort who graduate will increase and the number graduating in other fields will increase, driving down the percentage who graduate in engineering.

It is also difficult to know whether this number is good, bad, or indifferent without comparators from other years, and possibly other states and institutions. Even cross-state applicability and generalizability is questionable due to differing state contexts.

However, this type of pipeline metric would be essential to monitor and understand as this broader initiative continues to move forward. The interested parties should pay close attention to the pipeline and how it may change.

One key question from this analysis is what other fields these students are graduating in. Figures 4 and 5 show the most popular alternative majors for this population.

Figure 4. Majors of graduates who completed degrees in other fields after declaring as an engineering major, 2013–14 cohort



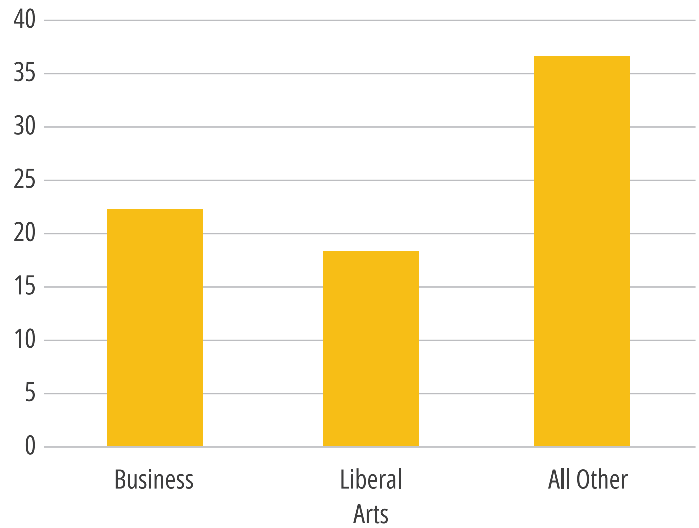
Notes: Major fields have been shortened to common names.

**The "all other" category includes numerous majors, but none with a graduate count above nine individuals.*

This shows that business was by far the most popular alternative major for those that ever declared engineering as a major. It also suggests that further analysis is warranted to help analyze why students are leaving the major and whether policy or practice decisions might lead to greater completions. Although business majors are important to the economy, converting graduates from that major to engineering may not cause as much concern as it would if most of the students who switched majors moved to education or nursing-related fields, given the state's workforce shortages in those areas.

Similar data for the 2018–19 cohort shows fewer majors, which is not surprising given that a smaller number of students from that cohort graduated in other fields. The most prevalent other fields were business and liberal arts.

Figure 5. Majors of graduates who completed degrees in other fields after declaring as an engineering major, 2018–19 cohort



Notes: Major fields have been shortened to common names.

The "all other" category includes numerous majors, but none with a graduate count above nine individuals.

Now we turn to examining whether different student characteristics are associated with differences in the rates at which students who ever declare engineering as a major graduate in engineering. Looking at differences by gender, there are very slight, but not statistically significant differences, with both females and males who ever declare engineering completing in engineering at relatively similar rates (although those women are more likely to graduate overall).

The smaller sample sizes for engineering technology do not support disaggregated analysis.

Math scores again are only available for a subset of the 2018–19 cohort, but are suggestive of a strong relationship. With small sample sizes, it is not possible to draw firm conclusions, but among those students who ever declared engineering as a major and ultimately graduated, those who, for example scored in the highest levels of the ISAT and SAT were more likely to graduate in engineering. Again, these results are only suggestive due to the limited coverage of math exam results, but are worth further consideration as this initiative continues.

Examining data by location again shows suggestive, but not statistically significant, differences with rural students who declare engineering as a major being just slightly less likely to graduate in engineering compared to peers from other locales.

Probability model

From here, we examine the student characteristics that are associated with completing a degree in engineering and engineering technology. Through a model that incorporates multiple characteristics, we are able to isolate, for example, the association between gender and completion while controlling for a student's high school location and math scores. It is important to note that this is not a causal analysis. The results discussed below do not prove that any particular student characteristic causes increased or decreased success rates but are suggestive of important relationships that should be considered as part of this initiative.

As would be expected based on the summary statistics provided above, as well as other pre-existing research, the factors associated with the biggest difference in the probability of graduating with an engineering degree are being male and scoring well on standardized tests. The model used, called a logistic regression, shows whether the likelihood of the outcome of interest — in this case, graduation with a degree in engineering — increases or decreases with a change in one variable while controlling for others.[32]

Females, even when controlling for race/ethnicity, location of high school, and math performance are about 22 times less likely to graduate with an engineering degree than males. This result is statistically significant, and, to say the least, substantively large. Again, it is worth emphasizing that this is when we also controlled for math results, so this strong relationship holds when math results are equivalent.

The math results also show strong statistical significance and pointed in the direction that would be expected. Students achieving a rating of three on the ISAT were about three times less likely to graduate in engineering than those who achieved the highest rating (again, the results were statistically significant). Students achieving a rating of two were about 10 times less likely to graduate (also statistically significant.)

The limited availability of data on math exam results greatly decreases the number of observations, making it difficult to assess in particular, the relationship between race/ethnicity and graduation in engineering while controlling for location and previous math performance.

The limited data available for math results shrank the number of observations which likely contributed to the lack of statistically significant results for location and race/ethnicity. We repeated the model without the math results, which is not ideal, because it is clearly an important factor. But the model can still show important areas for consideration.

In this second model, being female is again negatively associated with graduating in engineering. The results also show a statistically significant difference, with students who came from cities just about twice as likely to graduate in engineering as those from rural areas. Additionally, students with a multiracial background were about 2.3 times more likely than white students to graduate in engineering, while Hispanic students were about half as likely as white students to do so. All of these results were statistically significant.

In summary, these results confirm what is already suspected. It is clear that there is a strong negative association between being female and completing a degree in engineering, even when controlling for math performance. Additionally, it appears possible that there are important differences worth considering related to race/ethnicity. As Idaho's employers and higher education institutions begin considering how best to boost the number of engineers, addressing gender gaps appears to be a high priority.

Also, it is clear from these results, as well as the knowledge and expertise of institutional faculty and staff, that math skills are particularly important.

Student Flow Model

The final component of the supply analysis is a model that allows us to examine how many degrees the state is expected to produce in the coming years based on current and recent trends around college go-on rates, progression in postsecondary education, and other factors. This is particularly helpful for identifying where significant changes to the pipeline of students will have the greatest impact on the number of graduates over time. This model should not be viewed as a "crystal ball" that perfectly predicts what will happen in the future based on different inputs (like increased high school graduation rates). Instead, it should be viewed as a tool that gives industry experts, policymakers, and other interested parties a sense of which metrics and data points are particularly important if the state aims to substantially increase degree production in these fields.

Current Trends Continue

If current trends in high school graduation rates, college-going rates (both of directly out of high school for in-state and out-of-state students as well as first-time college participation of 20–44-year-olds), progression year-over-year in postsecondary, and credential completion continue through 2029–2030 the state can expect their degree production in fields of interest to hold nearly flat with an increase of less than one percent in both engineering and engineering technology.

Table 18. Current and projected additional undergraduate engineering awards by credential type

	CURRENT UNDERGRADUATE AWARDS (2019–21 PEDS AVG.)		PROJECTED ADDITIONAL AWARDS (2021–22 THROUGH 2029–2030)	
	ENGINEERING	ENGINEERING TECH	ENGINEERING	ENGINEERING TECH
Certificates	21	137	1	1
Associates	29	166	0	2
Bachelor's	737	202	37	2

The data allows for this projection to be broken down by institutional sector as well — with the "Public Research" category encompassing Boise State University, Idaho State University, and the University of Idaho.

Table 19. Current and projected additional undergraduate engineering awards by institutional sector

	CURRENT UNDERGRADUATE AWARDS BY PROGRAM (2019–21 PEDS AVG.)		PROJECTED ADDITIONAL AWARDS BY PROGRAM (2021–2022 THROUGH 2029–2030)	
	ENGINEERING	ENGINEERING TECH	ENGINEERING	ENGINEERING TECH
Public Research	543	115	36	1
Public Masters and Bachelors	4	11	0	2
Public Two-Year & Less Than Two-Year	25	175	0	2
Private	215	204	1	2

Increasing the High School Graduation Rate

Beginning with the model's first lever, high school graduation rates, we can explore the impact of an increase to the state's overall high school graduation rate on credential production in our fields of interest. If Idaho were to increase their overall high school graduation rate from its current 80% to just under 91% — an average of the highest state high school graduation rates in the country — the model projects modest degree gains over time at about seven additional bachelor's degrees in engineering per year and less than one additional associates degree per year in engineering technology. This is not surprising, given the relatively strong current high school graduation rate, there is simply limited room to grow.

Table 20. Projected additional undergraduate engineering awards with an increase in high school graduation rate

	PROJECTED ADDITIONAL AWARDS BY PROGRAM – CURRENT TRENDS (2021–22 THROUGH 2029–2030)		PROJECTED ADDITIONAL AWARDS BY PROGRAM – WITH HS GRAD RATE AT AVERAGE OF BEST-PERFORMING STATES (2021–22 THROUGH 2029–2030)	
	ENGINEERING	ENGINEERING TECH	ENGINEERING	ENGINEERING TECH
Certificates	1	1	2	2
Associate	0	2	0	2
Bachelor's	37	2	52	3

Increasing the College-going Rate

One of the most critical areas to examine is how changes to Idaho's college-going trends might impact future degree production. Between 2017 and 2020, the state saw a declining "go-on" rate, the percentage of graduating Idaho high school seniors who enroll directly in college the following fall, decreasing by over 10 percentage points during this period.[33] As the table below demonstrates, increasing college go-on rates for students directly out of high school has a more dramatic impact on degree production. If Idaho were to achieve a go-on rate of 47%, which is the national average as well as a rate the state exceeded as recently as 2018, the model suggests that could lead to 80 additional bachelor's degrees in engineering over the course of the projections. This would more than double the 37 additional bachelor's degrees expected with the current go-on rate. If the state were to approach a more aspirational goal — such as the nearly 58% seen in state's with the highest go-on rates — that number more than triples, with 118 additional degrees projected.

Table 21. Projected additional undergraduate Engineering awards due to increased go-on rates

	PROJECTED ADDITIONAL AWARDS BY PROGRAM – CURRENT TRENDS (2021–22 THROUGH 2029–2030)		PROJECTED ADDITIONAL AWARDS GO-ON RATES AT NATIONAL AVG. (2021–22 THROUGH 2029–2030)		PROJECTED ADDITIONAL AWARDS GO-ON RATES AT TOP-PERFORMING AVG. (2021–22 THROUGH 2029–2030)	
	ENG.	ENG. TECH	ENG.	ENG. TECH	ENG.	ENG. TECH
Certificates	1	1	3	3	4	5
Associate	0	2	1	4	1	6
Bachelor's	37	2	80	5	118	8

While different methods of calculating the go-on rate can offer different perspectives — for example using a three year after-high school timeframe to better capture students who take time off for a gap year or a Church mission — it is clear that increases in the go-on rate are an important piece of the puzzle.

Increasing Out-of-State Students

Findings from the State Board of Education have also revealed some substantial increases in out-of-state students opting to attend college in Idaho in recent years — including a 21% jump in enrollment at Idaho universities from fall 2019 to 2022.[34] While there is speculation this was driven by pandemic-related trends, if out-of-state enrollment continued to grow at a rapid pace, we can see this also leads to a small uptick in engineering degree production.

Table 22. Projected additional engineering undergraduate awards with increased out-of-state directly out of high school (DOHS) college-going numbers

	PROJECTED ADDITIONAL AWARDS CURRENT TRENDS (2021–22 THROUGH 2029–2030)		PROJECTED ADDITIONAL AWARDS – OUT OF STATE DOHS COLLEGE-GOING INCREASED 10% (2021–22 THROUGH 2029–2030)		PROJECTED ADDITIONAL AWARDS – OUT OF STATE DOHS COLLEGE-GOING INCREASED 20% (2021–22 THROUGH 2029–2030)	
	ENG.	ENG. TECH	ENG.	ENG. TECH	ENG.	ENG. TECH
Certificates	1	1	2	2	2	2
Associate	0	2	0	2	0	2
Bachelor's	37	2	44	4	51	6

Increasing College Participation of 20–44-year-olds

Another way to explore this question is to look at the first-time college participation rate of the state's 20–44-year-old population. Currently, Idaho's participation rate for this population is 1.55%, however, the national average is just over 2% and the best-performing states sit above 3%. Attracting more adult students into the educational pipeline leads to even larger projected increases in degree production — at the top end of the range leading to nearly 30 additional bachelor's degrees in engineering per year over the projections period, more than a six-fold increase over current trends.

Table 23. Projected additional undergraduate engineering awards with an increase in first-time (FT) college participation rates of 20–44 year-olds

	PROJECTED ADDITIONAL AWARDS – CURRENT TRENDS (2021–22 THROUGH 2029–2030)		PROJECTED ADDITIONAL AWARDS – FT PARTICIPATION RATE AT NATIONAL AVG. (2021–22 THROUGH 2029–2030)		PROJECTED ADDITIONAL AWARDS – FT PARTICIPATION RATE AT BEST-PERFORMING AVG. (2021–22 THROUGH 2029–2030)	
	ENG.	ENG. TECH	ENG.	ENG. TECH	ENG.	ENG. TECH
Certificates	1	1	4	4	9	9
Associate	0	2	1	4	1	9
Bachelor's	37	2	93	3	229	6

Improving Postsecondary Progression Rates

Another scenario the model can explore is what a change in progression rates from year-to-year in our fields of interest might look like. For example, a 10-percentage point increase in progression rates (first-to-second year, second-to-third year, and third-to-fourth year) in engineering programs would generate more than three times the number of degrees with no change (about 12 new bachelor's degrees in engineering per year between 2021 and 2029). A 10-percentage point increase in progression rates is a dramatic improvement — research shows one intensive program increased retention rates in STEM fields between nine to 15 percentage points — necessitating a significant investment from the institution and including robust student support services.[35] A 10-percentage point increase in engineering and engineering technology progression rates across all institutions and each year-to-year transition would be an aspirational goal.

Table 24. Projected additional engineering undergraduate awards with an increase in year-to-year progression rates

	PROJECTED ADDITIONAL AWARDS BY PROGRAM – CURRENT TRENDS (2021–22 THROUGH 2029–2030)		PROJECTED ADDITIONAL AWARDS BY PROGRAM – 10-PERCENTAGE-POINT INCREASE IN PROGRESSION RATES (2021–22 THROUGH 2029–2030)	
	ENGINEERING	ENGINEERING TECH	ENGINEERING	ENGINEERING TECH
Certificates	1	1	5	8
Associate	0	2	1	8
Bachelor's	37	2	128	2

Student Flow Model Conclusions

Of course, no model can perfectly capture all the needed inputs nor perfectly predict outcomes. Rather, their true value lies in exploring the patterns and trends that could emerge in different scenarios by making adjustments to the inputs based on estimates of possible — if aspirational — future directions drawn from existing data and research findings.

The model levers possible with the available data show us that impacting college participation will be a key factor in increasing degree production for engineering at the bachelor's level, while important questions such as breakdowns by gender and major choice remain unanswered.

Engineering Demand

Key Findings

Taken together, historical trends that show growth in engineering employment over the last decade, projections that predict continued occupational growth, and recent qualitative data that suggest hiring demand for engineers is already exceeding these growth projections demonstrate a robust labor market for graduates with degrees in engineering fields.

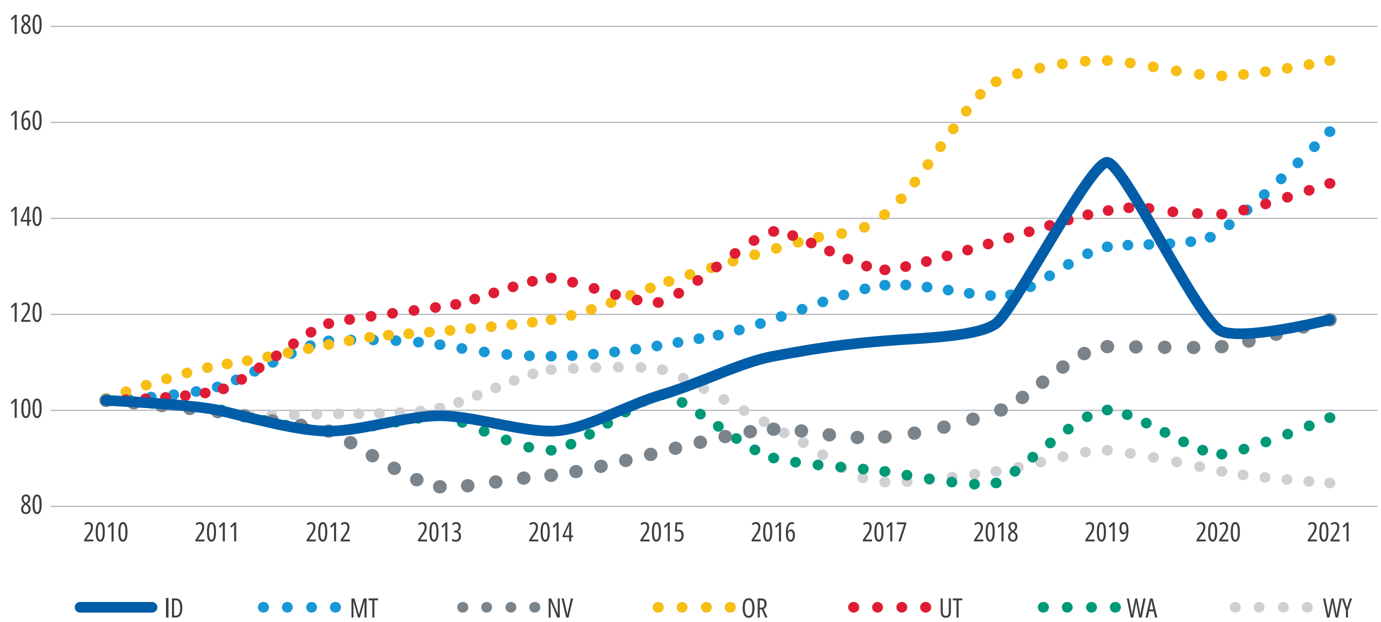
A key question for additional study will be the relationship between engineering and engineering technology fields in terms of employer demand and higher education degree production.

Historical Data

From 2010 to 2021, employment in engineering occupations in Idaho grew at a comparatively moderate pace, with BLS estimating 7,450 Idaho engineers in 2010 and that number rising to 8,710 by 2021. Among Idaho's surrounding states, Oregon saw the most dramatic growth in engineering employment during this time period, followed by Utah and Montana, while Nevada more closely matched Idaho's own growth trajectory.

However, there are some important differences in the overall number of engineers estimated to be working in each state. In the northwest, Washington employs significantly more engineers than any of Idaho's other neighbors, followed by Oregon and Utah.[36]

Figure 6. Engineering occupational employment growth overtime in Idaho and surrounding states

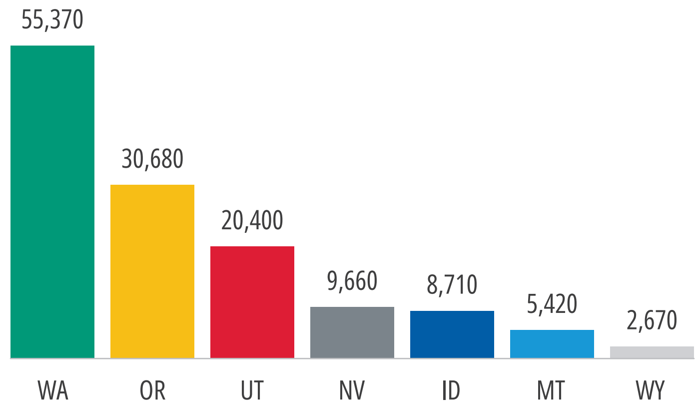


Note: *Data are indexed where 100 = Number of Jobs in 2010*

Source: Bureau of Labor Statistics, Occupational Employment Statistics (OES) Survey

The combination of ongoing regional growth and large engineering labor markets in neighboring states suggests that Idaho's engineering graduates likely have — and will continue to have — competing employment opportunities in surrounding states. This is further confirmed by a 2017 study on the inter-state movement of licensed professional engineers educated in Idaho, which showed that while a preponderance remain in the state, the most common alternative destination for engineering graduates was Washington.[37]

Figure 7. Engineering occupational employment in Idaho and surrounding states (2021)



Source: Bureau of Labor Statistics, Occupational Employment Statistics (OES) Survey

Projections

Looking forward, there is moderate growth projected for engineering as an occupational field nationally, with an increase of about 5% between 2021 and 2031. Meanwhile in Idaho, the state Department of Labor projects more dramatic growth, with the occupation growing 17% between 2020 and 2030. The Idaho Department of Labor projects that there will be 984 annual job openings in engineering due to turnover and growth each year between now and 2030.[38]

However, due to the timing of the state-level projections, the impacts of relevant policy developments such as the federal Infrastructure Investment and Jobs Act (IIJA) and CHIPS and Science Act are not yet reflected. One engineering industry group estimates that infrastructure projects funded by the IIJA alone will increase the need for engineers nationally by 82,000 and notes that these increases will affect every state given the distribution of funding.[39] Meanwhile, the CHIPS and Science Act has spurred growth in Idaho's semiconductor industry, most notably Micron's planned expansion, including the construction of a new manufacturing fab in Boise projected to create 2,000 jobs — including a subset in engineering technology fields.[40]

Therefore, it is likely that the 2020 projections underestimate the total number of new jobs in engineering that will be available in Idaho in the coming years.

> ***"If we can't hire them here than we will grow in other areas. We will go where the graduates are. We have [multiple] other offices [across the country]."***
>
> – Idaho Engineering Employer

Another crucial point is that the projected annual job openings only describe what employers are projected to need — they do not say anything about the availability of workforce to fill these openings.[41] Employer interviews revealed that workforce shortages in the short term have already contributed to suppressed workforce demand. One engineering firm described turning down projects and ultimately growth opportunities for their firm because of a lack of qualified engineers available to do the work. They also noted that this can then lead to overwork and burnout for existing employees — further exacerbating supply issues. Another Idaho employer, with offices across the country, shared that they would like to hire locally, but would hire outside the state if they couldn't find the candidates they needed.

While it is not possible to directly quantify these impacts, these comments suggest that an increase in the supply of engineers could potentially enable business growth and expand hiring demand beyond current projections, alternatively, a continued undersupply could have a dampening effect on demand.

> ***"If we were able to fill all our positions, we'd be able to get more revenue in and more clients and we'd then have demand for more engineers… we've been stifled by an inability to find people to do the work, we have more work than we have people to do."***
>
> – Idaho Engineering Employer

Engineering Technology

The linkage between engineering technology educational programs and occupations is not as direct as the link between many engineering degrees and occupations. For example, you'd likely hire someone with a bachelor's degree in civil engineering to fill a civil engineer role. However, our qualitative analysis suggested that employers in Idaho often approach technician roles with more flexibility, hiring from a variety of STEM-related degree fields and providing on-the-job training for needed skillsets. While the employer survey discussed below revealed robust demand for bachelor's degrees in engineering technology fields, as noted in the supply section, the state does not currently produce a large number of bachelor's in engineering technology fields.

Employer Survey

The employer survey conducted for this project provides further evidence that the 2020–2030 state projections may underestimate demand. While the employer survey sample was not representative of Idaho as a state, Table 25 illustrates respondents' self-reported number of Idaho-based engineering employees compared to state estimates of total employment within engineering occupations to provide some sense of the coverage offered by the survey.

Table 25. Employer survey respondent engineering employees in Idaho vs. total of state engineering employees

	STATE TOTAL 2020	STATE TOTAL 2023 (ESTIMATED)	SURVEYED COMPANIES (ESTIMATED)*
Engineering Occupations (17–2000)	10,321	10,892	6,478

**Survey response options were presented as ranges and these totals assume a midpoint value of the selected range.*

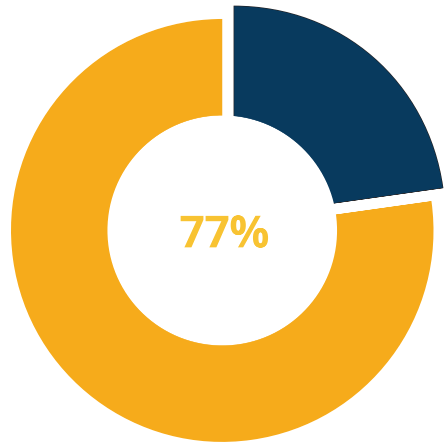
Among employers looking to hire workers in engineering roles, approximately two-thirds were looking for applicants with a bachelor's degree in an engineering or engineering technology field. However, it is important to note a subset of employers had a significant need for more advanced degree types, with nearly 20% of respondents looking for applicants with a masters' degree in engineering, and three percent seeking to hire candidates with doctoral degrees.

Respondents estimated that they are trying to hire nearly 2,000 employees with degrees in engineering and engineering technology fields within the next 12 months alone, almost double the DoL projected average annual openings. This number grows to 4,377 over the next five years, and up to 5,325 over the next 10 (even though some employers were not able to speculate beyond the five-year time horizon).

Nearly 80% of respondents indicated that they are struggling to fill jobs requiring engineering degrees.

Another key theme from the survey — as well as employer interviews — was the quality of Idaho graduates. The survey results demonstrated a strong employer preference for hiring from Idaho institutions, with 92% of responding companies agreeing that "'Hiring graduates from Idaho colleges and universities is important to us." and nearly 80% responding that Idaho universities are not producing enough graduates for their hiring needs.

Figure 8. Percent of survey respondents currently struggling to fill jobs that require a postsecondary engineering degree



Engineering Gap Analysis

The available quantifications of supply and demand indicate a gap between the number of engineering and engineering technology graduates from Idaho public institutions and the needs of Idaho's employers. The magnitude of the gap differs depending on the exact specifications used.

Considerations:

- **Type of Degree**: There is demand for a range of degree types — from associates to doctoral degrees — among Idaho's employers, although the majority of the demand appears to be at the bachelor's level. More detailed analyses exploring employers' demand for specific degree types could be a potential next step. Moreover, in engineering different specializations prepare graduates for different occupations with limited substitutability. The state may wish to focus on particular areas of importance to the state and its industries. For this initial analysis, all engineering degree types have been aggregated into a broad "engineering" category.
- **Institutional Sector**: The focus of this work is public institutions and their degree production, however, private institutions — in particular BYU-Idaho — also play a key role in producing graduates. Considering how to include the impact of private institutions (and what percentage of their graduates remain in Idaho) is another question for future study.

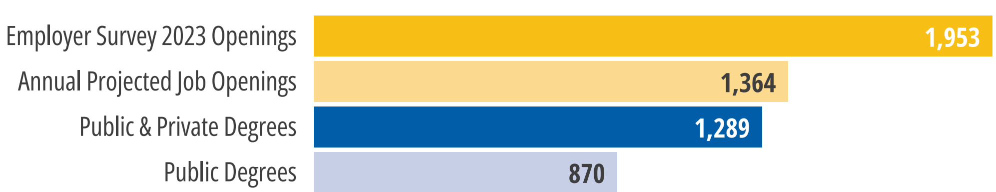
> ***"Idaho has had a fantastic record of producing graduates that can work shoulder to shoulder with engineering graduates from anywhere in the country — Purdue, Yale, Kansas State, Penn State, all the best engineering schools — we produce really, really good engineers which is unusual for a small, rural state"***
>
> – Idaho Engineering Employer

- **Migration**: Past research demonstrates that Idaho will lose some percentage of recent engineering graduates to jobs in other states. Therefore, not all of the graduate "supply" will end up in the state's labor market. Nonetheless, qualitative work did reveal that some engineers educated in Idaho opted to come back as mid-career professionals. Though these numbers cannot be quantified with available data sources, it is important to keep these in- and out-flows in mind when considering approaches to increasing supply. With previous research showing engineering graduates are among the most likely to leave the state, industry should focus on retaining a greater percentage of recent graduates in the state.
- **Time Horizon**: Projections by nature become less reliable the farther they stretch from baseline data. As a result, short-term projections have the greatest likelihood of accuracy. For this reason, numerical gaps are only presented for a 12-month period. The available data suggest that the gap between supply and demand will widen over time as Idaho (without intervention) produces only a very modest additional number of engineering graduates year- over-year and employer hiring demand rises to 4,377 job openings for candidates with a degree in engineering/engineering technology by 2028 (as indicated in the employer survey). Yet the demand-suppressing effects of workforce shortages that can lead employers to limit growth or relocate as described in interviews might ultimately drive down the overall amount of hiring demand. It's important to note that while the "gap" between supply and demand would lessen in this scenario, Idaho's economy would still be losing out on potential growth.

Summary

The available numbers (see the figure below) and the robust employer demand expressed in survey responses and interviews suggest that Idaho's labor market would benefit from a significant increase in the number of engineering and engineering technology graduates. However, supply modeling shows that the pipeline of students prepared to enter and succeed in Idaho's programs is not large enough to drive the increases Idaho employers are looking for. Taken together, these results suggest an investment in Idaho's student pipeline is needed.

Figure 9. Idaho degree production for engineering and engineering tech compared to projected job openings and employer survey job demand



Sources: Integrated Postsecondary Education Data System, Idaho Department of Labor Occupation Projections (2020–2030), WICHE Employer Survey

COMPUTER & INFORMATION SCIENCE

Computer & Information Science Supply

The National Center for Education Statistics (NCES) classifies computing degrees as "Computer and Information Science and Support Services: Instructional programs that focus on the computer and information sciences and prepare individuals for various occupations in information technology and computer operations fields."[42] Similar to engineering, historical trends in computer-related degree production at the bachelor's level in Idaho — also the typical entry-level credential for many in-demand computer-related professions[43] — show growth between 2010 and 2020. Supply modeling shows that if contributing trends persist, Idaho can expect only minimal increases in the number of computer-related graduates produced annually by its public institutions.

Research shows that a relatively high percentage of computer-related public institution graduates stay in Idaho, with over 70% of in-state bachelor's graduates employed in the state after graduation and over 50% of out-of-state graduates.[44] At the associates level, an impressive 78% of non-resident students end up in Idaho's workforce after graduation, a percentage point higher than the 77% of resident students who are found in the state's workforce.[45]

Cohort Analysis – Computer Science

This analysis follows a similar path as the previous one for engineering and engineering technologies. Using student-level data from the two cohorts (2013–14 and 2018–19 first-time postsecondary students) we present descriptive data about the number and characteristics of students who enter this major and go on to complete a degree in the field. For convenience, the full name of the field is shortened to "computer science" throughout this section.

We also conclude this section with a more advanced model that controls for student characteristics to examine relationships that may be useful in charting a path forward for this initiative.

Alternative Credentials & Skills-Based Hiring

Employers throughout the technology sector expressed a strong preference for skills over specific degree types. Many noted that they consider a candidate's portfolio of work ahead of their academic credentials.

While this might suggest employers are flocking to hire graduates of bootcamps or other short-term credential offerings, qualitative work suggested that this is not the case in Idaho.

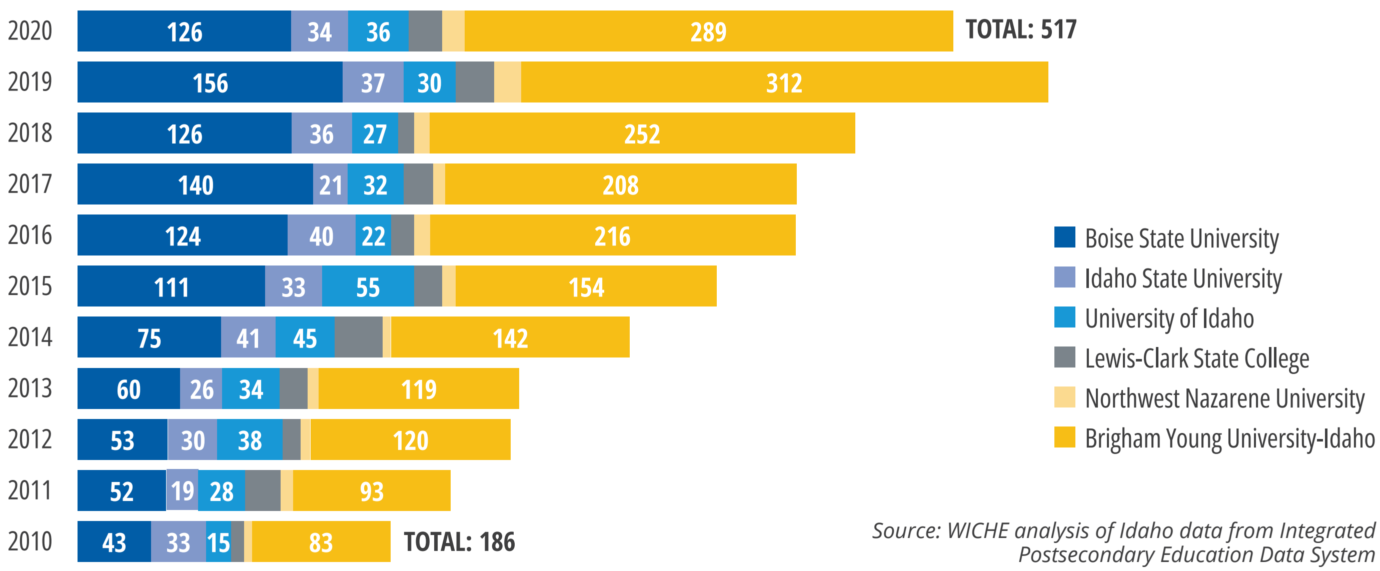
Overwhelmingly, survey respondents and interviewees in the tech sector noted that their most successful candidates came from either traditional academic pathways (such as a bachelor's degree in computer science) or from backgrounds with robust on the job training — such as cybersecurity experience gained in the military. Several employers shared that candidates from shorter-term training providers like bootcamps did not bring the desired skill level.

Therefore, despite the focus on skills-based hiring in the tech sector, degrees in computer and information science do seem to continue to offer a reasonable proxy of supply (so long as they continue to offer high-level skills training and relevant curricula).

Summary Statistics

As a first step in this analysis, we show the state trends in degree production for Computer Science. Similar to the analysis above, WICHE also examined the number of degrees produced over the past 10 years at Idaho institutions. Those results are presented in the below.

Figure 10. Annual degree completions in computer science



Source: WICHE analysis of Idaho data from Integrated Postsecondary Education Data System

At first glance, the numbers show impressive growth, nearly tripling from 2010 to 2019. However, much of that growth comes from private institutions (particularly BYU-Idaho). While that could be an important source of degree production, it is not clear what percentage of those graduates are located in Idaho and how many may be located in other states completing degrees via distance education.

There was substantial growth in the public sector from 2010 through 2015, but at that point, the growth for public institutions essentially levels off. While the private sector could be an important sector to consider, it is generally beyond the scope of this report.

Next, we begin to use the student-level data from Idaho public institutions to better understand the pipeline for computer science. The first step in this analysis shows the percentage of students who declare computer science as a major.

For the 2013–14 cohort, of all the students who ever reached the point of declaring a major, four percent declared Computer Science (CIP 11) at some point in their academic career. This grew to nearly five percent in the 2018–19 cohort, representing an increase of 40 total students (due in part to the shrinking overall size of the 2018–19 cohort compared to 2013–14.)

Table 26. Students declaring computer science as a major

COHORT	STUDENTS DECLARING ANY MAJOR	PERCENT EVER DECLARING COMPUTER SCIENCE
2013–14	18,929	4.0%
2018–19	16,839	4.8%

Next, the analysis examines the relationships between different student characteristics and declaring Computer Science as a major, with results reported in Table 27.

Table 27. Percentage of students declaring computer science as a major by gender

GENDER	2013–14	2018–19
Female	1.1%	1.6%
Male	7.4%	8.6%

Similar to Engineering, there is evidence of a large gender gap in the percentage of students who ever declare Computer Science as a major, perhaps pointing towards similar potential policy and practice interventions. These differences are statistically significant.

As noted earlier, there is a very modest, but statistically significant difference in performance on math standardized exams by gender. But similar to the analysis above, that difference is nowhere near large enough to account for the gender disparities in declaring for Computer Science. Table 28 shows the same data point — percentage of students declaring Computer Science as a major — limited to those students who achieved high levels on those exams.

Table 28. Percentage of high-scoring students declaring computer science as a major by gender

EXAM & SCORE	MALE STUDENTS DECLARING CIP 11	FEMALE STUDENTS DECLARING CIP 11
ISAT Composite Highest Level	15.4%	2.6%
SAT Math Above 600	15.2%	3.6%

This analysis shows a similar story as engineering, with students achieving high results on standardized math tests showing a greater likelihood of ever declaring Computer Science as a major. Females with high math scores still show a substantially lower likelihood of ever declaring this major compared to Males. These differences are statistically significant.

Turning to Race/Ethnicity, we examine the same information for the percentage of students of different backgrounds who ever declared Computer Science as a major.

Table 29. Percentage of students declaring computer science as a major by race/ethnicity

RACE/ETHNICITY	2013–14 COHORT % DECLARING CIP 11	2018–19 COHORT % DECLARING CIP 11
Black/African American	4.5%	3.6%
Asian	5.6%	10.7%
NHOPI	***	***
AI/AN	3.3%	6.7%
White	4.0%	4.6%
Multiracial	5.5%	4.2%
Hispanic	4.1%	4.0%
Unknown	5.2%	3.7%

****Redacted due to small cell sizes.*

The interesting points from this examination are the relatively homogenous distribution among the 2013–14 cohort, with substantial increases in the percentage of Asian and American Indian/Alaska Native students declaring this major in 2018–19. The increases in students from these racial backgrounds accounts for the majority of the growth in total numbers between the two cohorts. The differences among groups in the 2013–14 cohort are not statistically significant, but that changes for the 2018–19 cohort.

Following the same approach as with engineering, we now examine any differences by a student's location while in high school to assess whether there are important differences to consider for Idaho's rural communities.

Table 30. Percentage of students declaring computer science as a major by high school location

COHORT	CITY	SUBURB	TOWN	RURAL
2013–14	4.5%	4.0%	3.6%	4.4%
2018–19	6.4%	5.3%	4.8%	5.3%

Again, there are noteworthy differences between the 2013–14 and 2018–19 cohorts. The distribution from the earlier cohort is not statistically significant, but it is for the latter group of students. The primary difference is the sharp increase in the percentage of students from high schools located in cities who declare this major.

With that as an overview of the relationships between students' characteristics and likelihood of declaring computer science as a major, we now turn to likelihood of completing a degree in the field. As noted earlier, overall about 29% of those students who declare any major end up completing a degree. Table 31 shows how many students who ever declared computer science as a major ended up graduating. Then of those graduates, it shows the percentage who graduated in computer science.

Although the total numbers differ, generally speaking it appears that those who at one point declare Computer Science as a major and graduate in something else tend towards Business and Liberal Arts degrees, similar to those majoring in engineering.

Table 31. Percentage of computer science majors that graduate and that do so in the field

COHORT	GRADUATED IN ANY MAJOR	GRADUATED IN COMPUTER SCIENCE
2013–14	33.4%	68.9%
2018–19	23.0%	67.3%

Turning to the question of whether different student characteristics are associated with persistence in computer science, for the 2013–14 cohort, there is a marginally statistically significant difference, with about 58% of females who ever declare it as a major completing in the field, compared to about 71% for males. For the 2018–19 cohort, there is no statistically significant difference, with about 63% of females who declare computer science as a major completing within the field, compared to 69% for males.

Looking at the relationship between math scores and persistence to completion within the major, there is not a strong relationship, mainly due to the small sample size. Similarly, the results for the relationship between location of a student's high school and persistence within the field is mixed and not statistically significant.

Probability Model

WICHE analyzed a probability model that looks at the association between graduating with a degree in computer science and various student characteristics, including gender, race/ethnicity, and location. We also, similar to the engineering analysis, use one model with math results and one without due to the limited data available. This approach allows us to control for these characteristics to try to isolate the important relationships with the hope of guiding policy and practice as Idaho considers a broader initiative.[46]

The results are similar to those for engineering. Being female, when controlling for location, race/ethnicity, and math scores, is associated with a ten-fold decrease in the likelihood of completing a computer science degree. Math results (ISAT composite achievement ranking) are less linear, but individuals scoring below a "four" associated with substantially lower odds of completing a degree in this field as well. Asian students are associated with substantially greater odds of completing a Computer Science degree (more than 10 times) than white students while controlling for the other factors. The relationships with other races/ethnicities is not statistically significant.

In the second model, when we drop the controls for math results (which again warrants substantial caution in interpreting the results), the statistically significant relationships do not change.

Student Flow Model

As in engineering, the final component of the supply analysis for computer and information science is projecting the number of degrees the state can expect to produce in the coming years.

Current Trends Continues

If current trends in high school graduation rates, college-going rates (both of directly out of high school for in-state and out-of-state students as well as first-time college participation of 20–44-year-olds), progression year-over-year in postsecondary, and credential completion continue through 2029–2030 the state can expect their degree production in the field of interest to hold nearly flat with an increase of less than 1% in computer and information science.

Table 32. Current and projected additional undergraduate computer & information science awards

	CURRENT UNDERGRADUATE AWARDS (2019–21 IPEDS AVG.)	PROJECTED ADDITIONAL AWARDS (2021–22 THROUGH 2029–2030)
	COMPUTER SCIENCE	COMPUTER SCIENCE
Certificates	146	4
Associates	234	7
Bachelor's	518	11

The data allows for this projection to be broken down by institutional sector as well — with the "Public Research" category encompassing Boise State University, Idaho State University, and the University of Idaho.

Table 33. Current and projected additional undergraduate computer & information science awards by institutional sector

	CURRENT UNDERGRADUATE AWARDS BY PROGRAM (2019–21 IPEDS AVG.)	PROJECTED ADDITIONAL AWARDS BY PROGRAM (2021–2022 THROUGH 2029–2030)
	COMPUTER & INFORMATION SCIENCE	COMPUTER & INFORMATION SCIENCE
Public Research	224	6
Public Masters and Bachelors	35	2
Public Two-Year & Less Than Two-Year	281	9
Private	360	5

Increasing the High School Graduation Rate

Beginning with the model's first lever, high school graduation rates, we can explore the impact of an increase to the state's overall high school graduation rate on credential production in computer and information science. If Idaho were to increase their overall high school graduation rate to that of an average of the highest state high school graduation rates in the country, the model projects only a handful of gains,. The model projects only 18 additional bachelor's degrees by 2029–2030 with an improved high school graduation rate, or said differently, less than one more degree per year than current trends produce.

Table 34. Projected additional undergraduate computer and information science awards with an increase in high school graduation rate

	PROJECTED ADDITIONAL AWARDS BY PROGRAM – CURRENT TRENDS (2021–22 THROUGH 2029–2030)	PROJECTED ADDITIONAL AWARDS BY PROGRAM – WITH HS GRAD RATE AT AVERAGE OF BEST-PERFORMING STATES (2021–22 THROUGH 2029–2030)
	COMPUTER & INFORMATION SCIENCE	COMPUTER & INFORMATION SCIENCE
Certificates	4	6
Associates	7	11
Bachelor's	11	18

Increasing the College-Going Rate

As with all of higher education in Idaho, college-going rates are projected to have an impact on computer and information science degree production. If Idaho were to achieve the national average go-on rate of 47% for in-state students directly out of high school, the model suggests that could lead to 29 additional bachelor's degrees in computer and information science over the course of the projections. If the state were to approach a more aspirational goal — such as the nearly 58% seen in state's with the highest go-on rates — that original number more than quadruples, with 45 additional degrees projected.

Table 35. Projected additional undergraduate computer and information science awards with increases in the college-going rate of direct out of high school (DHOS) students in Idaho

	PROJECTED ADDITIONAL AWARDS – CURRENT TRENDS (2021–22 THROUGH 2029–2030)	PROJECTED ADDITIONAL AWARDS – DOHS COLLEGE-GOING RATE AT NATL. AVG. (2021–22 THROUGH 2029–2030)	PROJECTED ADDITIONAL AWARDS – DOHS COLLEGE-GOING RATE AT BEST-PERFORMING AVG. (2021–22 THROUGH 2029–2030)
	COMPUTER & INFORMATION SCIENCE	COMPUTER & INFORMATION SCIENCE	COMPUTER & INFORMATION SCIENCE
Certificates	4	10	15
Associate	7	18	27
Bachelor's	11	29	45

Increasing Out-of-State Students

Looking at the impacts of increasing the number of out-of-state students enrolling directly out of high school, we can see that this is projected to double the number of additional bachelor's degrees, but has less of an impact on associates degrees and certificates (similar to the findings in engineering and engineering technology).

Table 36. Projected additional computer & information science undergraduate awards with increased out-of-state directly out of high school (DOHS) college-going numbers

	PROJECTED ADDITIONAL AWARDS – CURRENT TRENDS (2021–22 THROUGH 2029–2030)	PROJECTED ADDITIONAL AWARDS – OUT-OF-STATE DOHS COLLEGE-GOING INCREASED 10% (2021–22 THROUGH 2029–2030)	PROJECTED ADDITIONAL AWARDS – OUT-OF-STATE DOHS COLLEGE-GOING INCREASED 20% (2021–22 THROUGH 2029–2030)
	COMPUTER & INFORMATION SCIENCE	COMPUTER & INFORMATION SCIENCE	COMPUTER & INFORMATION SCIENCE
Certificates	4	4	4
Associate	7	8	9
Bachelor's	11	18	25

Increasing College Participation of 20–44-year-olds

Increasing the rate of first-time college participation of the state's 20–44-year-old population to national and high-performing state averages has a particularly strong impact on the projected production of computer and information science bachelor's degrees, which rise to 52 additional degrees produced over the projection period.

Table 37. Projected additional undergraduate computer & information science awards with an increase in first-time (FT) college participation rates of 20–44-year-olds.

	PROJECTED ADDITIONAL AWARDS – CURRENT TRENDS (2021–22 THROUGH 2029–2030)	PROJECTED ADDITIONAL AWARDS – FT PARTICIPATION RATE AT NATIONAL AVG. (2021–22 THROUGH 2029–2030)	PROJECTED ADDITIONAL AWARDS – FT PARTICIPATION RATE AT BEST-PERFORMING AVG. (2021–22 THROUGH 2029–2030)
	COMPUTER & INFORMATION SCIENCE	COMPUTER & INFORMATION SCIENCE	COMPUTER & INFORMATION SCIENCE
Certificates	4	9	20
Associate	7	15	34
Bachelor's	11	23	52

Improving Postsecondary Progression Rates

As with engineering, improving progression year-over-year in postsecondary does increase the number of additional degrees produced more significantly than increasing the high school graduation rate, but less so than increasing college participation.

Table 38. Projected additional undergraduate computer & information science awards with a 10% increase in retention rates

	PROJECTED ADDITIONAL AWARDS – CURRENT TRENDS (2021–22 THROUGH 2029–2030)	PROJECTED ADDITIONAL AWARDS – 10-PERCENTAGE-POINT INCREASE IN RETENTION RATES (2021–22 THROUGH 2029–2030)
	COMPUTER & INFORMATION SCIENCE	COMPUTER & INFORMATION SCIENCE
Certificates	4	21
Associates	7	32
Bachelor's	11	30

Student Flow Model Conclusions

Similar to engineering, the model levers possible with the available data show us that impacting college participation will be a key factor in increasing degree production at the bachelor's level in computer and information science, while important questions such as breakdowns by gender and major choice remain unanswered.

Computer & Information Science Demand

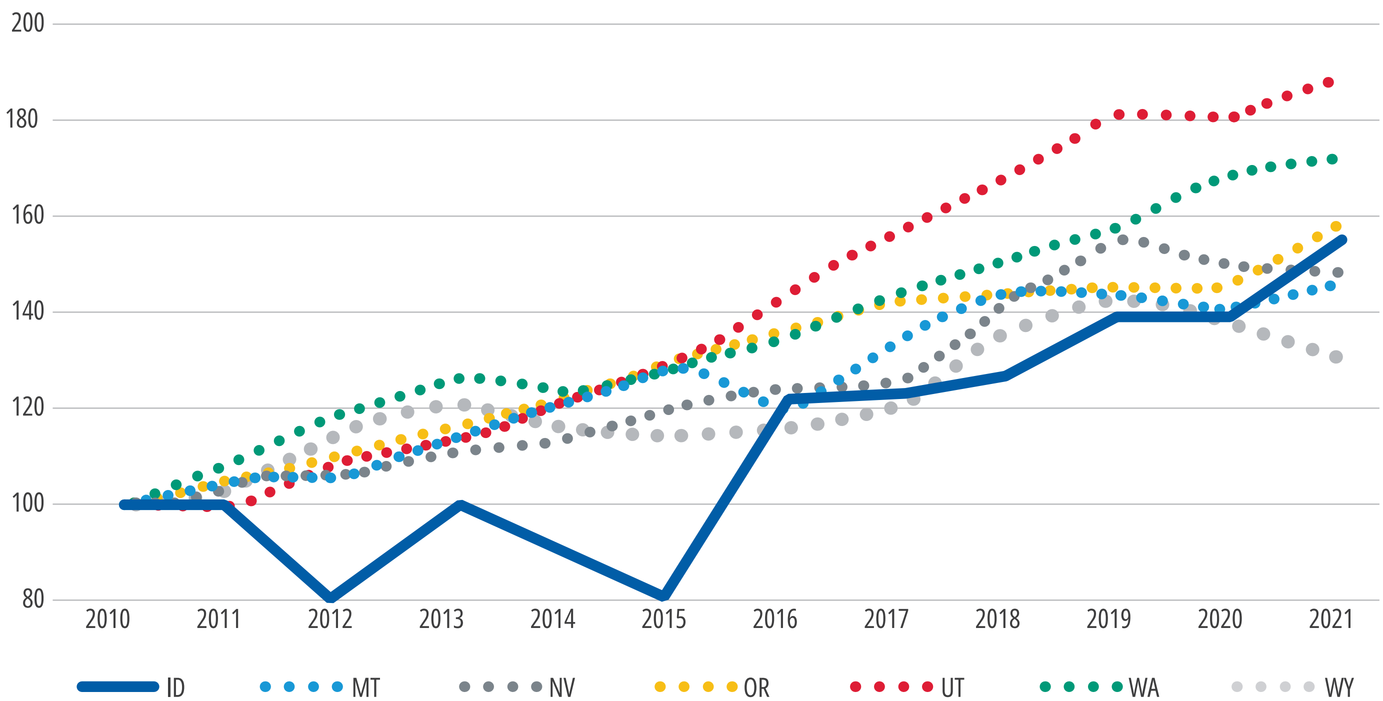
Key Findings

Historical trends that show growth in computing employment over the last decade, projections that predict continued occupational growth, and recent qualitative data that suggest hiring demand is already exceeding these growth projections demonstrate a robust labor market for graduates with degrees in computer-related fields.

Historical Data

From 2010 to 2021, employment in computing occupations in Idaho grew substantially, with BLS estimating 12,050 Idahoans were employed in computer occupations in 2010 and 18,750 by 2021. This growth trend was present across the Northwest, with Utah leading the way in terms of growth trajectory.

Figure 11. Computer Science employment growth in Idaho and surrounding states



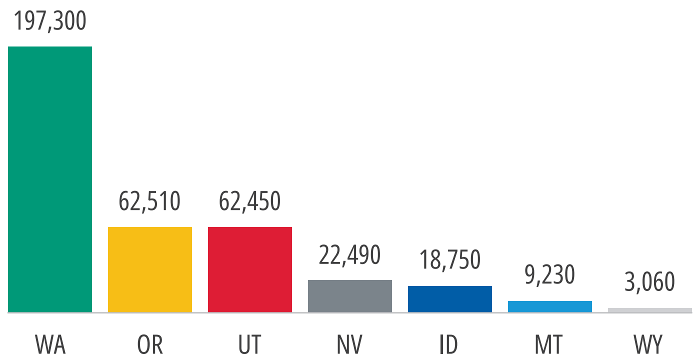
Note: *Data are indexed where 100 = Number of Jobs in 2010*

Source: Bureau of Labor Statistics, Occupational Employment Statistics (OES) Survey

As with engineering, the total number of employees in computing occupations varies widely in the region, with Washington employing the greatest number by a large margin. Overall, employment in computer occupations is substantially higher than in engineering occupations over the same time frame, with computer occupations employing roughly double the number of estimated workers in engineering.

The combination of ongoing regional growth and large labor markets in neighboring states suggests that Idaho's graduates in computer-related fields will likely have competing employment opportunities in surrounding states.

Figure 12. Computer occupational employment in Idaho and surrounding states (2021)



Source: Bureau of Labor Statistics, Occupational Employment Statistics (OES) Survey

Importantly, computer occupations are among the occupational types that have undergone some of the greatest changes over the past few decades. New job types have emerged that didn't exist a decade ago, while others have become obsolete. This is one argument for continuing to look at computer occupations in a broad sense, as a targeted focus on more detailed occupation types might end up being difficult to track over time as occupational classifications shift.

Nonetheless, the field does incorporate a variety of occupational types with quite a range in key attributes such as skillsets required, educational qualifications needed, and median salaries. There may be specific areas of focus for the state, such as software development or cybersecurity, as well as potentially emerging areas related to the development and use of technologies loosely known as artificial intelligence (AI), that warrant special attention.

Projections

Computer-related occupations are projected to grow considerably in both Idaho and across the United States in the coming years, increasing by more than 12% between 2020 and 2030 in Idaho and by nearly 15% between 2021 and 2031 nationally (this is compared to a 5% growth rate for all occupations). According to the ID DoL's 2020–2030 projections, the state can expect to see 1,387 annual openings due to turnover and growth in computer-related occupations each year till 2030.[47]

Remote Work

Another factor that increases the difficulty in accurately projecting the number of available jobs in coming years is the rise in remote work — which is especially common in computer-related occupations. As businesses have the option of hiring from anywhere, employer interviews revealed a few key points:

- Some Idaho-based technology companies will hire locally, if talent is available but they will hire remote workers if not.
- An increasingly remote tech workforce offers opportunities for Idaho's graduates to work for companies either within or outside of the state — while still contributing to the state's tax base.

It is also important to understand that shifts in industry mix are not reflected in the projections' methodology. For example, as advances in computing led to the automation of clerical work the number of clerical jobs declined, but the number of jobs in information technology grew — meaning that jobs shifted from one industry to another over time.[48] Future shifts towards automation could certainly change the projected growth trajectory of computer occupations. Though past trends suggest that these shifts in industry mix might lead to more jobs in computer-related occupations, rapidly evolving technologies such as artificial intelligence add a layer of uncertainty.

The projections also do not reflect national trends in 2022 and early 2023 which have featured some large-scale layoffs at major technology companies. However, early evidence suggests that, in many cases, those laid off were able to find alternative employment within their occupational field. This highlights the distinction between occupations and industries. It is possible that industries — such as the tech sector — may expand and contract without a corresponding impact on occupations, as other industries like healthcare, retail, and finance continue to expand their hiring demand for computer-related occupations such as software engineers and developers.[49]

Employer interviews also suggested an extremely strong demand for mid-career computer science professionals — particularly among Idaho's burgeoning start-up sector. Some interviewees felt that the layoffs from large multi-national corporations might even offer opportunities to hire for traditionally difficult-to-fill roles. Further, multiple smaller, earlier stage tech startups noted that while they typically hire later career talent in their initial phases, they plan to hire more entry-level (just out of school) talent as they expand and have more capacity to train less experienced staff. Therefore, expanded availability of mid-career tech talent could possibly support growth and have a positive impact on future demand in certain scenarios.

Alternatively, rising interest rates which increase the cost of borrowing — a posited contributor to the tech sector layoffs — will likely also negatively impact the growth and hiring demand of Idaho's technology-focused businesses. For example, one technology company noted a recent hiring freeze.

Large-scale, macro-economic trends such as a cooling economy or possible recession would also negatively impact the demand for workers in this occupational field, and this possibility cannot be ignored. However, while not predictive, existing research on Utah's engineering and computer science growth initiative from 2000–2020 shows that the 2008 recession resulted in a short-term flattening of available jobs in the two fields, which then rebounded in subsequent years.[50]

Employer Survey

The employer survey was focused on employers in the engineering and technology sectors, meaning those for whom a large percentage of their workforce is made up of employees with credentials in engineering and computer and information science fields. However, as discussed in preceding sections of the report, computer occupations span a wide variety of industries with employers in all sectors increasingly needing talent with computer-related skills. It is likely the lower share (relative to engineering) of computing employees reached by the survey in comparison to state totals reflects the difficulty in reaching the many different types of employers who employ those in computer occupations. Nonetheless, the survey was able to capture valuable feedback from a robust number of employers with computer-related hiring demand.

Table 39. Survey respondent computer-related employees vs. overall number of Idaho computer-related employees

	STATE TOTAL 2020	STATE TOTAL 2023 (ESTIMATED)	SURVEYED COMPANIES (ESTIMATED)*
Computer Occupations (15–1200)	15,821	19,588	3,856

**Survey response options were presented as ranges and these totals assume a midpoint value of the selected range.*

Among employers looking to hire candidates with degrees in computer-related fields, nine percent were looking for associates degrees, 72% bachelor's degrees, nine percent for masters degrees, and seven percent for doctoral degrees. Similar to engineering, this suggests that a focus on bachelor's degrees would most align with employers' overall needs — though some companies do have specialized needs for candidates with advanced degrees as well as at the associates level.

Computer & Information Science Gap Analysis

The available quantifications of supply and demand indicate a gap between the number of computer-related graduates from Idaho public institutions and the needs of Idaho's employers. The magnitude of the gap differs depending on the exact specifications used and will remain sensitive to the evolving nature of the field.

Considerations

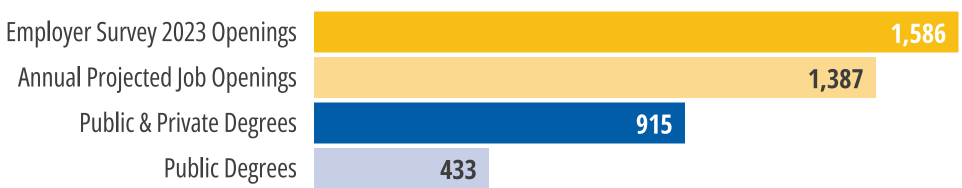
- **Relationship Between Degrees & Skills-based Hiring**: Because of employers' strong preference for demonstrable skills over specific degree types, a key factor in maintaining demand for Idaho's computer and information science graduates will be ensuring that programs offer strong preparation in foundational skills and industry-relevant curricula.
- **Institutional Sector**: The focus of this work is public institutions and their degree production, however, private institutions — in particular BYU-Idaho — also play a key role in producing graduates. Considering how to include the impact of private institutions is another question for future study.
- **Migration**: The evolving nature of remote work, especially given recent trends of large-scale layoffs from major technology companies, has an uncertain directional impact on Idaho's demand for tech workers. Yet Idaho's strong history of retaining both in- and out-of-state graduates of computer and information science programs in their workforce suggests increasing the local supply of tech talent could have advantages for both Idaho's employers and the state's tax base.

- **Time Horizon**: Projections by nature become less reliable the farther they stretch from baseline data. As a result, short-term projections have the greatest likelihood of accuracy. For this reason, numerical gaps are only presented for a 12-month period. The available data suggest that the gap between supply and demand will widen over time as Idaho (without intervention) produces only a very modest additional number of computer and information science graduates year-over-year and employer hiring demand rises to 2,216 job openings for candidates with degrees in computer and information science by 2028 (as indicated in the employer survey). Yet the demand-suppressing effects of workforce shortages that can lead employers to limit growth or relocate as described in interviews might ultimately drive down the overall amount of hiring demand. It's important to note that while the "gap" between supply and demand would lessen in this scenario, Idaho's economy would still be losing out on potential growth.

Summary

The available numbers (see Figure 13) and the robust employer demand expressed in survey responses and interviews suggest that Idaho's labor market would benefit from a significant increase in the number of computer and information science graduates. However, supply modeling shows that the pipeline of students prepared to enter and succeed in Idaho's programs is not large enough to drive the increases Idaho employers are looking for. Taken together, these results suggest an investment in Idaho's student pipeline is needed.

Figure 13. Idaho degree production for computer and information science compared to projected job openings and employer demand



Sources: Integrated Postsecondary Education Data System, Idaho Department of Labor Occupation Projections (2020–2030), WICHE Employer Survey

NEXT STEPS

Although this document is not intended to be a traditional strategic plan, it can be thought of as a framework for how the state might move forward on an initiative to increase production and retention of engineering, engineering technologies, and computer science. Although there is not a single clear data point or analysis that fully proves the state is facing shortfalls in these fields, WICHE's conclusion, based on a range of available evidence, is that there is a strong need to increase the number of skilled, educated, and trained workers in these fields. Failure to meet this demand may not show up as an immediate crisis, but instead would be evident in missed opportunities for economic growth and increases in the number of sustainable, well-paying jobs. :

The other central conclusion, hopefully made abundantly clear from the data analysis presented throughout this report, is that Idaho faces a completely different context and demographic situation compared to Utah in 2000. Capacity constraints in postsecondary education are not currently the limiting factor in the production of graduates in these fields. This is not to say that those programs may or may not need investment to stay current and ensure high-quality programs (a question that is beyond the scope of this report). Instead, the substantial focus of any initiative must be on changing the underlying factors of the pipeline first. As more students select into these fields, capacity may become a bigger issue, but currently, that is not as big a problem as declining college go-on rates and the relatively low number of students that are prepared to enter and succeed in these fields.

The rest of this section identifies potential next steps to develop a growth initiative that is driven by data and evidence and led by industry experts.

Creating a Shared Vision & Coordinated Plan

The available evidence is compelling that Idaho would benefit from a growing pipeline of well-trained engineers, engineering technicians, and computer and information science professionals. Idaho's public institutions have a strong record of producing successful graduates in these occupations, yet the overall number of graduates has not kept pace with industry demand in Idaho's growing economy.

Generating additional graduates in these high-demand fields is a complex, long-term endeavor. The downward demographic trends driving the overall number of high school graduates Idaho is expected to produce paired with the state's declining college go-on rates mean the state is facing significant headwinds as it seeks to increase supply. While Utah's successful growth initiative took place in a high-growth context (both demographically and economically), Idaho will face a more challenging environment for a similar effort. Moreover, addressing the multifaceted challenges of demographic and large-scale educational trends such as the college go-on rate will require the development of equally multifaceted responses.

Single sector or piecemeal efforts will be inadequate to address this challenge, so the state must develop a shared vision for growth in these fields, ensuring that all that relevant partners from industry, policy, and education are at the table. As the ultimate beneficiary and subject matter expert, industry is well-positioned to take the lead in guiding this work.

Three key questions to answer in establishing this vision will be:

- What entity will lead this effort?
- What is the overarching goal?
- What is the scope of the effort?
  - What fields will it encompass?
  - What degree and/or credential types will be included?
  - Will the focus be on public institutions or all institutions in the state?
  - How will it address issues outside of the education pipeline, such as retention of graduates in Idaho?

Once a shared vision for the state's engineering and computer and information science workforce pipeline is established, the focus must be on actionable steps to take the vision from theory to reality. ¬The initiative partners must identify the combination of short- and long-term strategies they will pursue as part of a coordinated plan to achieve their goal, and the metrics they will track along the way to determine successes and necessary course corrections.

Key questions to answer as a coordinated action plan is crafted will be:

- What long-term actions must be taken to achieve the vision?
- What short-term actions must be taken to achieve the vision?
- What metrics will need to be tracked to determine success? (more discussion presented below)
  - Do these data currently exist and if so, are they being collected?
- Who will be responsible for monitoring progress and making decisions along the way?

This approach should also situate the effort in Idaho's broader economic context, considering the overall realities of the state's labor market and pressing shortages in other STEM fields such as healthcare.

Identifying Clear Roles & Responsibilities

As partners in this work, industry, policymakers, universities, community colleges, and the K–12 sector should identify how they will individually and collaboratively contribute to achieving the shared vision through the identified short- and long-term strategies.

A critical element will be the statewide framing and approach. Each group of partners must come to the effort prepared to contribute to the development and execution of the statewide vision, exploring how they are best positioned to leverage their unique resources to contribute to the overall goal. Rather than individual plans and targets, each partner should have clear responsibilities mapped out that will collectively lead to the achievement of the statewide goal(s).

For example — given the results of the supply analysis — postsecondary institutions (both two- and four-year institutions) may wish to initially focus on building their pipeline of potential students. In many cases this may include building on and investing in ongoing efforts in these areas.

- Partnering with K–12 to improve the math preparedness of high school graduates and generating more interest in these fields.
- Collaborating across the two- and four-year sectors to improve transfer pathways, and
- Engaging non-traditional students such as those who have never attended postsecondary, those who attended and stopped out (especially with substantial credits in fields of interest), or those looking to shift careers or upskill within the field.

Another important element will be identifying the current and needed capacity of existing higher education programs in the fields of interest. Specifically, the state will want to review available data and collect needed data to identify the gaps between current capacity and the capacity needed to achieve the goal(s) set by the visioning process. A sample capacity assessment rubric is included in Table 40.

Table 40. Sample capacity assessment rubric

ELEMENT	CONSIDERATIONS	IDEAL CAPACITY	CURRENT CAPACITY	INVESTMENT
Faculty	• What type of faculty are needed? • What resources (labs, etc.) will they need to be successful? • Are there opportunities to share high-cost faculty positions across institutions?	• What are ideal student-faculty ratios for offering high-quality programs in the fields of interest? • How many faculty, by type, would be needed to offer the number of credit hours required by the target number of students?	• How many faculty are currently employed in the fields of interest and how many credit hours can they teach?	• What level of investment would be needed to go from current to ideal capacity? • Which investments would produce maximum impact in a constrained funding environment?
Students	• What types of additional student supports (ex. advising, tutoring, etc.) are needed to support successful entry into and progression through these programs? • What resources can be shared at the state level ?	• What evidence-based supports would a student in the fields of interest ideally have access to?	• How many of these support services are currently offered? • Where are there gaps in terms of availability and capacity of current services?	• What level of investment would be needed to go from current to ideal capacity? • Which investments would produce maximum impact in a constrained funding environment?
Space & Equipment	• What facilities (classroom space, labs, etc.) are needed to offer these programs at a high level of quality? • How can institutions work together to jointly leverage assets?	• What space and facilities would these programs have in an ideal scenario?	• What space and equipment resources does the institution currently have?	• What level of investment would be needed to go from current to ideal capacity? • Which investments would produce maximum impact in a constrained funding environment?

Meanwhile, industry partners might commit to employee upskilling initiatives, provide equipment and internship or project opportunities that meaningfully address challenges identified by educational partners, and provide timely and actionable feedback to educational partners.

Given the demographic trends of Idaho's youth population, an important area of focus for all partners should be identifying how to identify, attract, and support non-traditional-aged students through to degree completion. There are numerous potential audiences for this approach, including employees at existing firms that have interest in advancing their careers through additional education, students who have stopped out of these programs with a substantial number of credits, and other working Idaho residents who are in related fields. This outreach should be paired with effective policies and practices, including employee tuition assistance, strong prior learning assessment, and other approaches that serve adult students.

Investing for Impact

In order to make the most of any investment, the partners must identify and prioritize the greatest barriers and most effective solutions to increasing workforce supply. Engineering and computer-related fields encompass a broad range of credentials and specialties that lead to a variety of occupations. The collective effort may consider if a broad or a targeted approach will be most effective for meeting their goals with available funds. As part of this analysis, they should also focus on leveraging Idaho's unique assets in both industry and education for maximum value. Finally, it will be critical to balance immediate employer needs with sustainable growth plans that have the flexibility to account for changing dynamics such as recessions and shifts in automation.

While this report does not attempt to place a dollar figure on a level of state investment that is appropriate (due in part to the need to effectively set the stage for exactly how such an initiative will produce growth), it is likely that this will lead, if successful, to needs for additional state resources.

But it is also clear that such an initiative will require investment and contributions from industry. Contributing time and thought to leading such an initiative is only the first step. Additionally, it may require industry investment to aggressively support additional employee education and training opportunities and to help address the large percentage of engineering graduates that appear to be leaving the state.

It is important to recognize that this work will not take place in a vacuum, with substantial state-wide attention and effort focused on improving college go-on rates, addressing worker shortages in healthcare, education, and other fields, and major recent policy changes such as the new funding available for the Idaho Launch program. Ensuring that the vision and plan for this initiative functions within this broader context can help make investments of all parties more effective and efficient rather than redundant or duplicative.

Data, Metrics, and Research

Most reports that lay out how an initiative like this could be successful include a section on improving data and metrics and carrying out additional research. While this is a common approach, that does not make it any less important. A thorough and detailed data analysis shifted WICHE's initial expectations for charting out how this initiative might best proceed. Initially, our thought was that the Utah work seemed very effective and essentially following that model would serve Idaho well. As has been clearly laid out, though, the different state contexts suggest that Idaho must follow a different approach to reach the same goal.

As part of this framework, WICHE recommends that industry leaders and other key agencies and organizations coalesce around meaningful metrics for understanding how the initiative that is envisioned is impacting outcomes. Essentially, the initiative should develop a set of key metrics that it hopes to shift through policy and practice. These will likely include readily available administrative data, such as enrollments and completions in these programs, but also more complex analyses including retention in state of recent graduates, medium-term migration and employment patterns of recent graduates, student interest in these fields, and more. It would be easy to focus solely on the number of graduates in each field that are produced annually, and we agree that is an important metric. But if, for example, the number of students enrolled in public postsecondary institutions in the state declines substantially, but the number of graduates in these fields holds steady, that would be a sign of some success. This report contains numerous different data points and ways of considering supply and demand issues. Certainly not all of the data points will resonate, but they could represent a starting point for consideration. As an initiative unfolds, it is highly doubtful that every approach and policy change will bear fruit, but with a successful monitoring and evaluation approach, it will be possible to continuously refine efforts to improve outcomes.

Additionally, it is highly likely that the initiative will benefit from a strong research and evaluation plan. As new policies, programs, or approaches are tried, it is essential that some form of evaluation takes place to assess their effectiveness and potentially lead to improvement. It is also likely that the work would benefit from research on certain topics. As one example, better understanding the clear gender gaps is essential. It may be that as professions, engineering and computer science never end up with equal numbers of males and females, but the data clearly show that there are a large number of females who would likely succeed, but are choosing different paths.

Additionally, it should be clear from this report that qualitative data from surveys and interviews are essential to gaining a full perspective of not just what is happening, but why.

Ultimately, this will be a difficult and complex undertaking, but there is strong evidence that it is highly needed for Idaho. Effective use of data and research will help ensure success, efficient use of investment, and better overall outcomes for Idaho and its students.

The state is blessed with a strong data system and an insightful research team at the State Board of Education. Certainly, there are always competing priorities and limits on staff capacity, but the state has plenty of existing infrastructure to provide an effective data infrastructure to support this work.

ACKNOWLEDGEMENTS

Industry Advisory Team

This initiative was guided by a core advisory team of industry representatives. These leaders in Idaho's engineering and technology sectors generously dedicated their time and expertise to inform the project, offering extensive feedback on the scope and design and making critical connections with their colleagues across Idaho in support of employer engagement efforts. The team met six times between November 2022 and April 2023, in addition to providing feedback on survey design, interview and survey outreach, and the preliminary findings.

Industry Advisory Team Members

- Elli Brown, Director, State and Local Government Affairs, Idaho National Laboratory
- Tim Haener, Chairman and Corporate Risk Manager, J-U-B Engineers & Industry Advisory Board Member, University of Idaho College of Engineering
- Jim Gasaway, Industry Advisory Board Chair, Boise State University Department of Computer Science
- Jay Larsen, President, Idaho Technology Council
- Tom Loutzenheiser, Industry Advisor Board Chair, Boise State University College of Engineering
- Dee Mooney, Executive Director, Micron Foundation
- Alan Prouty, Vice President, Environmental & Regulatory Affairs, J.R. Simplot & Industry Advisory Board Chair, Idaho State University College of Science & Engineering
- Ryne Stoker, Chief Executive Officer, President, and Principal Engineer, GeoTek and Industry Advisory Board Chair, University of Idaho College of Engineering

Report Contributors

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Employers

Employers across Idaho made time in their busy schedules to offer their feedback on the issues raised in this report. We deeply appreciate the time they took to reflect on the importance of an engineering and computer and information science trained workforce to their companies' success. Their perspectives constitute a critical piece of this analysis and their ongoing engagement will be key to continued progress.

TECHNICAL APPENDIX

Student Data Analyzed

Public Education Pipeline Model

This the rationale and overall scope of the data WICHE requested for the analysis in the foregoing report. WICHE proposed to develop and provide a projection model for degree production in key majors for engineering and computer and information science by Idaho public postsecondary institutions. This work also shows key leakage points and identifies important metrics for future monitoring and evaluation of efforts to increase production.

This model can only estimate supply from public education sources. In its reporting, WICHE identifies to what extent Idaho K–12 and public postsecondary students contribute to overall degree production for engineering and computer and information science, and what other sources supplement this in Idaho. The parameters of the projections (i.e. the number of years into the future the model covers) were determined by the available data.

To produce this analysis, WICHE proposed using aggregated data to create a cohort-based flow model, and using individual-level data across cohorts of high school graduates and postsecondary enrollees and credential completers to build a model of the pipeline for producing graduates in engineering and computer science.

The research questions included:

1. Based on current and recent historical trends, how many credentials in engineering and computer science are Idaho's public institutions expected to produce?
2. At what point in their enrollment progression do students entering postsecondary enter into major programs of interest?
3. At what point(s) in enrollment progression, and to what extent/volume, do students transition out of engineering and computer science majors, or from other majors into these?
4. What factors are associated with postsecondary students entering into these majors?
5. What factors are associated with credential completion in these majors and programs? Of switching program or stopping out?
6. What factors are associated with student success for first time and transfer students?
7. What factors are associated with employment in Idaho?
8. At what rate do students who stop out return, and when they do, are they successful? (this was anticipated for the earlier cohort initially proposed, which was not included due to data limitations)

9. How has "leakage" changed over time? Key analysis points:
    1. What pct. Of high school graduates enter postsecondary within 3 Years?
    2. What pct. of CIP-entrants complete 25% of credits necessary for graduation within X years? 50%? 75%? 100%? (Compare 2013–14, and 2018–19 entering cohorts)
    3. What pct. of CIP graduates are employed in the universe of businesses covered by Idaho unemployment insurance within 1, 5, and 10 years?

Description of Students Covered

This appendix highlights some high-level information about the students included for the analysis in the report, for context, and is not an exhaustive data dictionary or the like. Important things to keep in mind about the resulting dataset(s) compiled from the data received from the Idaho OSBE:

- Results may be affected, although presumably marginally, by errors or anomalies in the data provided to WICHE. As well, these results may 'over-simplify' or mask some complexity and nuance that are inherent to postsecondary enrollment and completion student behavior and data patterns. Further research, planning and tracking should include deliberate data preparation and review, to account for and represent more myriad and nuanced patterns than were intended for this 'snapshot' of results.
- The results in this appendix generally summarize the highest observed postsecondary awards among the covered students, and do not specifically tabulate students who earned multiple of the same 'highest award' (e.g., two Bachelor's). Further research, planning and tracking should consider the incidence of multiple awards, including among computer and information science and engineering graduates. And the results in this appendix focus on the completion and degree outcomes of the students, and for the most part, not their enrollment patterns.

Cohort Flow Model Aggregated Data: Student Counts, FTE and Graduates, by Categories

This approach builds from WICHE's existing work on High School graduates and is based on aggregated student data, that has been compiled to the state-level by WICHE from publicly available sources supplemented by student-level data requested here. The model is based on enrollment and graduation data from K–12 in Idaho and enrollment and completion data from Idaho's public postsecondary institutions.

This results in a product similar to WICHE's Knocking at the College Door, projecting the number of graduates in CIP codes of interest.

Aggregated Data Request

WICHE requested public school K–12 enrollment counts (October census headcounts), by grade, and the number of high school graduates, for school years 2020–21 and 2021–22. Note: State-level counts were requested, at a minimum; the data and timeline did not support detailed analysis within state (e.g., by education region or school district), but this level of analysis might be relevant for further analysis, for identifying regional differences in potential school populations.

WICHE also requested counts of degree-seeking postsecondary students, by declared major (CIP), and enrollment and awards completed for Idaho public postsecondary institutions (Assoc, Bach, Masters, and PhD) by CIP Code for academic years 2016–17 through 2021–22 (fall 2022–23 data were not available for this report).

For postsecondary enrollment, WICHE also requested that four-year students be categorized into groupings representing <20%, 40%, 60%, 80%, and >100% of progress towards the number of credits necessary for degrees, for each academic year, by CIP (in categories of <33%, 66%, and >100% progress towards the number of credits necessary for two-year/Associate's degree students).

For graduate degrees/students, WICHE requested that students be grouped into numbers initially enrolled, at intermediate progression points evident in the data, and number who completed by award type and CIP. These data were requested for academic years 2016–17 through 2021–22. For all of the aggregated information, WICHE requested disaggregation by race/ethnicity, gender, and income flag (economic disadvantage status), but analysis by these categorizations was ultimately not part of the analysis due to data limitations and low cell counts.

Ultimately, only six categorizations were available in the data for the cohort flow model: academic year 2016–17 to 2021–22, at 2-year or 4-year institution, whether student was directly from high school or other enrollment status. Thus, details such as student sex, race/ethnicity or transfer status were not able to be modeled from the available data.

Note: *For brevity, not all details are presented in the tables below. Also provided were full-time equivalent and percent of progress towards credits required for degree.*

Head counts by Related Major and Years Enrolled, 2016–17 to 2021–22

a. Idaho Public Postsecondary Four-Year Institutions

MAJOR	ID PUBLIC HIGH SCHOOL GRADUATES ENROLLED IN YEAR AFTER GRADUATION ("IMMEDIATE COLLEGE-GOING")						OTHER					TOTAL	HIGH SCHOOL GRADUATES % TOTAL OF YEAR ONE STUDENTS
	ACADEMIC YEAR	ONE	TWO	THREE	FOUR	FOUR +	ONE	TWO	THREE	FOUR	FOUR +		
Computer and Information Sciences and Support Services	2016–17	229	158	121	101	170	239	201	180	144	363	1,906	49%
	2017–18	192	171	130	111	205	265	177	153	131	333	1,868	42%
	2018–19	225	137	142	119	227	237	206	143	107	321	1,864	49%
	2019–20	170	160	115	131	230	197	189	155	115	295	1,757	46%
	2020–21	202	131	134	102	266	217	165	140	124	276	1,757	48%
	2021–22	208	157	128	125	260	294	157	133	113	269	1,844	41%
Engineering	2016–17	354	271	252	194	280	529	551	581	403	936	4,351	40%
	2017–18	308	261	246	234	327	529	428	402	390	848	3,973	37%
	2018–19	316	209	222	212	377	426	410	348	280	802	3,602	43%
	2019–20	291	243	194	206	398	424	307	319	276	669	3,327	41%
	2020–21	287	209	191	181	399	374	333	243	275	597	3,089	43%
	2021–22	318	189	200	180	394	380	285	266	212	533	2,957	46%
Engineering/ Engineering-Related Technologies/ Technicians	2016–17	40	36	19	18	27	51	48	43	29	99	410	44%
	2017–18	51	37	33	11	34	42	52	33	28	85	406	55%
	2018–19	48	40	27	27	33	55	43	35	19	95	422	47%
	2019–20	67	28	27	14	52	62	37	26	26	84	423	52%
	2020–21	58	51	20	26	53	66	50	32	20	75	451	47%
	2021–22	35	41	31	16	48	63	53	34	19	68	408	36%

b. Idaho Public Postsecondary Two-Year Institutions

MAJOR	ID PUBLIC HIGH SCHOOL GRADUATES ENROLLED IN YEAR AFTER GRADUATION ("IMMEDIATE COLLEGE-GOING")					OTHER				TOTAL	HIGH SCHOOL GRADUATES % TOTAL OF YEAR ONE STUDENTS
	ACADEMIC YEAR	ONE	TWO	THREE	THREE +	ONE	TWO	THREE	THREE +		
Computer and Information Sciences and Support Services	2016–17	100	65	29	43	114	69	33	108	561	47%
	2017–18	95	74	55	72	121	79	37	109	642	44%
	2018–19	124	55	48	103	115	64	45	114	668	52%
	2019–20	144	106	52	162	106	74	50	116	810	58%
	2020–21	115	70	59	156	84	68	51	84	687	58%
	2021–22	137	90	70	201	102	60	45	86	791	57%
Engineering	2016–17	21	12	10	8	37	25	8	23	144	36%
	2017–18	19	12	5	15	30	18	9	25	133	39%
	2018–19	50	21	14	24	39	26	11	25	210	56%
	2019–20	73	34	16	55	72	31	16	37	334	50%
	2020–21	49	42	29	53	43	37	20	30	303	53%
	2021–22	62	31	32	47	46	29	25	34	306	57%
Engineering/ Engineering-Related Technologies/ Technicians	2016–17	34	30	10	22	54	25	21	52	248	39%
	2017–18	32	26	17	27	57	32	15	62	268	36%
	2018–19	26	20	17	34	44	32	22	59	254	37%
	2019–20	29	23	17	56	38	34	18	64	279	43%
	2020–21	17	16	20	33	25	24	18	35	188	40%
	2021–22	37	14	15	27	34	17	13	24	181	52%

Progression Model Individual Level Data: High School Graduate, Other First-Time College Students and Degree Completer Cohorts

This model complements the pipeline projections by identifying points in the Idaho public postsecondary credential pipeline (particularly for associates and bachelor degrees) where there is “leakage”. This model uses recent and historical data to identify student characteristics associated with:

- Entrance into majors related to engineering and computer science
- Retention in those fields of study/programs
- Completion of those credentials from those programs
- Subsequent employment in Idaho

This modelling relies on student-level datasets of three cohorts. Overall, there were over 94,000 individuals represented in the data from Idaho OSBE.

Idaho Public High School Graduates for the Progression Modeling

A primary focus of the progression analysis in this report relates to Idaho public high school graduates of the Classes of 2012–13 and 2017–18, and their postsecondary enrollment and completion (Note: WICHE initially requested a third, earlier cohort year, but there were limitations in the data prior to 2013–14, particularly K–12 data).

	TOTAL	NOT COLLEGE-GOING		WENT TO COLLEGE WITHIN ACADEMIC YEAR			WENT AT LATER POINT	
2012–13	16,731	4,688	28%	9,254	(AY 2013–14)	55%	2,789	17%
2017–18	18,926	7,116	38%	9,668	(AY 2018–19)	51%	2,142	11%

While they were not the primary focus of the analysis presented in the report, there were additionally almost 14,000 Idaho public high school graduates available to analyze from graduating classes 2004–05 to 2021–22, who were in the sample because they either enrolled in college or university for the first (known) time in the 2013–14 or 2018–19 academic years (related to Cohort 2 on page 73) or received a postsecondary credential in 2016–17 or 2021–22 (related to Cohort 3 on page 73).

Notes: *Distribution of Idaho public high school graduates from years other than 2012–13 and 2017-18 is not tabulated, because they were incidentally included in the drawn cohorts and do not describe comprehensive patterns for those other graduating class years. ‘Received a (related) credential’ within nine years for 2012–13 high school graduates, within four years for 2017–18 high school graduates. City-to-rural schema in use by the National Center for Education Statistics for representing the geographic nature of schools’ populations. ‘Related field’ and ‘Credential’ were CIP 11, 14, or 15, as throughout this report*

- Idaho public high school graduates from regions four and six were the most under-represented among the high school graduates who completed an engineering or computer science/information services credential, in this sample; high school graduates from region three were over-represented.

- High school graduates from schools categorized as ‘city’ or ‘suburb’
- Male high school graduates were less likely (62%) than females (73%) to enroll in postsecondary at any point covered by the sample, but were significantly over-represented among those who ever majored in (male: 88%) or completed an engineering or computer science/information services credential (male: 81%).

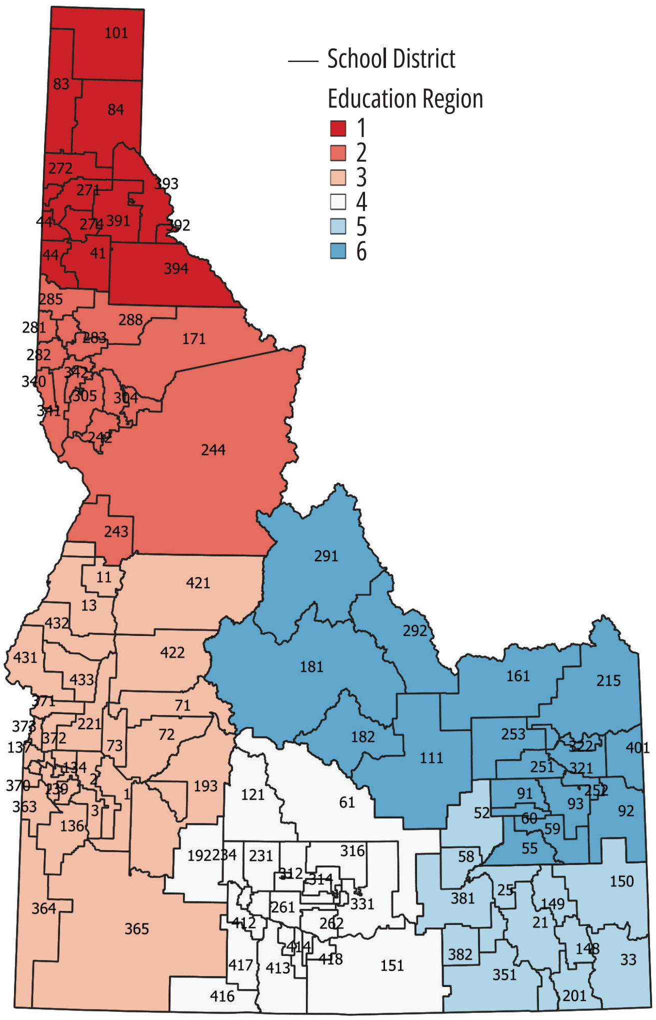
Distribution of the 2012-13 and 2017-18 Public High School Graduates (Selected Characteristics)

By Education Region

			FIELDS OF INTEREST	
	PERCENT OF TOTAL	ENROLLED POST-SECONDARY (AT ANY POINT)	MAJORED (IN ONE OR MORE TERMS)	RECEIVED CREDENTIAL
One	11%	11%	12%	11%
Two	5%	5%	5%	5%
Three	44%	44%	43%	54%
Four	12%	12%	10%	9%
Five	9%	9%	9%	7%
Six	16%	16%	19%	12%
Virtual	0%	0%	0%	0%
Total	35,567	23,897	1,117	661

By Locale/Urbanicity

			COMP. SCI. OR ENGINEERING	
	PERCENT OF TOTAL	ENROLLED POST-SECONDARY (AT ANY TIME)	MAJORED IN A RELATED FIELD (EVER)	RECEIVED A RELATED CREDENTIAL
City	24%	25%	30%	34%
Suburb	26%	27%	26%	29%
Town	25%	24%	22%	18%
Rural	22%	21%	20%	17%
Virtual	3%	2%	2%	2%
Total	35,657	23,897	1,117	661



Map source: https://boardofed.idaho.gov/resources/map-of-education-regions-in-idaho/.

Postsecondary Entrants for the Progression Modeling

The second set of student cohorts for the progression modeling were those first-year (undergrad or graduate) or first year as transfer students in Idaho public institutions in 2018–19 (Summer term 2018 to Spring term 2019) and 2013–14 (Summer term 2013 to Spring term 2014).

These cohorts encompass the Idaho public high school graduates from Cohort 1, who enrolled in postsecondary within the first academic year after their high school graduation, as well as other students who entered the covered postsecondary institutions in that year:

		FIRST-TIME STUDENTS OTHER THAN IMMEDIATE COLLEGE-GOING IDAHO PUBLIC HIGH SCHOOL GRADUATES		IDAHO PUBLIC HIGH SCHOOL GRADUATES		
FIRST ENROLLED	TOTAL	STUDENTS WITH TERM-LEVEL DETAIL	LESS DETAIL (FOR CREDENTIAL AWARDS)	IMMEDIATE COLLEGE-GOING	OTHER GRADUATING CLASS	ID HSGs % OF ENROLLED POST-SECONDARY STUDENTS
AY 2013–2014	31,002	19,577		9,254	2,171	37%
AY 2018–2019	26,520	14,047	24,506	9,668	2,805	47%
Other Year	24,506					
Total Post-Sec. Students	82,028					

Notes: *Students categorized as First-time enrollees in AY 2013–14 or 2018–19 are those which were part of the defined cohorts for which term-level detail was received. A portion of additional students appear to have first enrolled in either of these two years, as indicated in the less detailed data about students who received a postsecondary credential in 2016–17 or 2021–22, which also included students who first enrolled in any year beginning 2001–02 ('Other Year').*

Related to the focus of this report:

- 30% of the entering students in 2013–14, and 38% in 2018–19, were Idaho public high school graduates who enrolled within the year after their high school graduation.
- 38% of the entering postsecondary students in 2013–14 and 2018–19 who ever declared a major in engineering or computer science/information services were graduates of Idaho public schools. The enrollment data indicates that the share of entering postsecondary students who ever declared a major in engineering or computer science/information services and were Idaho high school graduates increased from 29% in 2013–14 to 48% in 2018–19 (albeit this was in the context of fewer students who declared these majors, 2,236 and 1,825, respectively).
- 42% of the entering postsecondary students from 2013–14 and 2018–19 who received a credential in engineering or computer science/information services were graduates of Idaho public schools. Among the 2013–14 entering postsecondary students who had received a credential in engineering or computer science/information services (875), 47% were Idaho public high school graduates. (The data only cover credentials/degrees awarded through 2021–22, too few years elapsed to report completion outcomes for 2018–19 entering students). Postsecondary Graduates in 2016–17 and 2021–22

- The third set of cohorts for progression analysis were students who were awarded a postsecondary credential in 2016–17 or 2021–22 (any major, to allow some comparison of how non-engineering/computer science completers enter into the workforce).
- These data about credentials awarded in two academic years provide a snapshot of annual engineering or computer science/information services graduate production by Idaho public postsecondary institutions:

Postsecondary Graduates in 2016–17 and 2021–22

The third set of cohorts for progression analysis were students who were awarded a postsecondary credential in 2016–17 or 2021–22 (any major, to allow some comparison of how non-engineering/computer science completers enter into the workforce).

These data about credentials awarded in two academic years provide a snapshot of annual engineering or computer science/information services graduate production by Idaho public postsecondary institutions:

	2016–17				2021–22			
	ASSOCIATE'S	BACHELOR'S	MASTER'S	DOCTOR'S	ASSOCIATE'S	BACHELOR'S	MASTER'S	DOCTOR'S
COMPUTER AND INFORMATION SCIENCES AND SUPPORT SERVICES								
Idaho High School Graduate	35	62	0	0	97	103	4	0
Other Postsecondary Entrant	81	136	26	3	48	121	19	10
Total	116	198	26	3	145	224	23	10
ENGINEERING								
Idaho High School Graduate	14	139	5	0	13	25%	30%	34%
Other Postsecondary Entrant	9	27%	26%	29%	26%	27%	26%	29%
Total	23	24%	22%	18%	25%	24%	22%	18%
ENGINEERING/ENGINEERING-RELATED TECHNOLOGIES/TECHNICIANS								
Idaho High School Graduate	14	139	5	0	71	6	33	0
Other Postsecondary Entrant	9	361	122	9	20	215	94	30
Total	123	31	5	9	33	400	127	30
OTHER FIELD OF STUDY								
Idaho High School Graduate	1,078	1,927	106	–	1,976	2,710	369	5
Other Postsecondary Entrant	1,702	3,705	1388	79	1275	3649	1603	78
Total	2,780	5,632	1,494	79	3,251	6,359	1,972	83

In 2016–17, about 80% of credentials for computer/information sciences and support services or engineering and related technologies/technicians among previous Idaho public high school graduates in one of the target fields were to white non-Hispanic students, 12% were to students of another race or ethnicity (8% were unknown race or ethnicity). The proportions in 2021–22 were 77% white non-Hispanic, 18% other race or ethnicity and 5% unknown.

Employer Survey

Survey Administration and Response Follow Up

The survey was delivered in partnership with the Idaho Technology Council (ITC), with respondents solicited from the ITC membership, membership of the industry advisory boards of the state university's engineering and computer science programs, the Idaho chapter of American Council of Engineering Companies, and individual recommendations from the project's industry advisory team. The survey was distributed to 684 companies.

Email invitations to the survey were distributed by the Idaho Technology Council beginning January 5. The survey remained open for responses through March 15, 2023 while follow-up was conducted to get responses from as many and diverse respondents as possible. By March 15, 2023, surveys were initiated by 116 respondents, 44 of which were largely incomplete or were responses from more than one respondent from the same company, resulting in 72 unduplicated and mostly complete responses, which are tabulated below.

Results

Shown below are basic distributions of the responses received.

NOTE: *The tables show results among those who answered; numbers may vary based on survey completeness.*

Survey Introduction

Your cooperation with this 5 minute survey will help us estimate the magnitude of Idaho businesses' needs for employees with engineering and computer science postsecondary education. We will use the responses collected to supplement existing occupational demand estimates so that the state has up-to-date information about current and anticipated demand as they consider engineering and computer science education investments and programming.

Your responses will be kept secure and confidential and company names will not be shown in connection with any specific results.

If you need to consult records or another individual for the requested information, you can suspend and resume this survey form using the link provided.

1. **Company name**: Check here ☐ if you do not want your company name shown in the published list of responding companies.

2. **In what Idaho county is your company located?**: If you have employees in more than one location in Idaho, please indicate the county of the location where the majority of Idaho employees are employed.

COUNTY	NUMBER	PERCENT
Ada County	42	59%
Ada County, and other locations	6	8%
Bannock County	2	3%
Boise County	1	1%
Bonner County	1	1%
Bonneville County	2	3%
Canyon County	2	3%
Caribou County	1	1%
Gooding County	1	1%
Idaho County	1	1%
Kootenai County	1	1%
Latah County	5	7%
Nez Perce County	1	1%
Washington County (and Ada County)	1	1%
Multiple locations, including outside of Idaho	4	6%
TOTAL	**71**	**100%**

3. **Industry sector**: Please choose from these nationally standardized sectors. If your firm spans more than one industry sector, please select 'Other' and specify below

NAICS CODE	DESCRIPTION	ADDITIONAL INFORMATION (NOT PROVIDED BY ALL RESPONDENTS)	NUMBER	PERCENT
54	Professional, Scientific, and Technical Services	Analog Encryption for Storage and Communication. Department of Defense. Embedded Systems Design/Sales of Product. Engineering. Engineering and Construction. Geotechnical Engineering. Legal Technology. Structural Engineering Consultation. Technology Services, Solutions and Global Internet.	33	46%
33	Manufacturing	Aerospace. Mining and Manufacturing.	12	17%
51	Information	Data Analytics and Visualization. Software as a Service.	8	11%
45	Retail Trade	Also Wholesale, Transportation and Aviation Sectors.	3	4%
52	Finance and Insurance		2	4%
61	Educational Services		2	4%
62	Health Care and Social Assistance		2	3%
22	Utilities		1	1%
92	Public Administration		1	1%
81	Other Services, except Public Administration	IT and Related Technology.	1	1%
11	Agriculture, Forestry, Fishing and Hunting	Lumber.	1	1%
11	Other	Architecture and Engineering Consulting. Industrial, Mining, Food, Wood and Dairy, in combination. Legal. Utilities, Manufacturing, Professional Scientific and Technical Services, in combination.	4	6%
	Total		71	100%

4. **How many employees (total, engineering, and computer/IT) do you have assigned to your Idaho operations and do any percentage of these employees work remotely from outside of Idaho?** Please approximate as necessary. Include full-time, part-time, contract, and seasonal employees. If you are responding on behalf of more than one site doing business in Idaho, include employees across these multiple sites.

   Please use your best estimation of the "Engineering" and "Computer and Information Technology" employee categories. If you hire technicians in either category, please include them in your count. Software engineers should be counted under Engineering Employees. Examples of Computer and Information Technology Employees include but are not limited to: website developers, IT project managers, IT product owners, and tech support personnel.

	0	1–5	6–10	11–20	21–30	31–40	41–50	51–75	76–100	101–250	251–500	500+	CANNOT ESTIMATE, NOT APPLICABLE	EST. EMPLOYEES ACROSS RESPONDING COMPANIES*
Total Employees		7	6	5	7	5	3	1	2	11	7	16	1	13,434
Computer and Information Technology Employees	10	34	2	6	2	1	1	1	2	3	2	4	3	3,856
Engineering Employees	4	18	4	7	6	4	3	6	4	5	2	7	1	6,478

*** NOTE:** *Rather than asking for precise estimates, respondents were provided ranges in which to indicate their hiring demand. This table presents responses by range category. WICHE computed the estimated employees across responding companies from the mid value of the range. For example, for the range "41–50," low = 41, mid = 45, and high = 50.*

5. **Now, please anticipate the TOP 3 major fields of study you will most need among engineering and computer/IT employees to fulfill your hiring needs over the next year and up to 10 years into the future.** Include full-time, part-time, contract, and seasonal employees, and consider your need for employees to fill new positions as well as to replace turnover, retirements, etc. If you are responding on behalf of more than one site doing business in Idaho, include employees across these multiple sites.

			NUMBER OF RESPONSES			
	CIP Code	**Program Title**	**#1**	**#3**	**#2**	**Chose as a Top 3 Major**
Computer and Information Sciences and Support Services	11.07	Computer Science	9	3	1	13
	30.08	Mathematics and Computer Science	2	5	1	8
	11.0103	Information Technology	1	2	4	7
	11.09	Computer Systems Networking and Telecommunications	1	2	4	7
	15.1202	Computer Technology/Computer Systems Technology	3	1	2	6
	11	Computer And Information Sciences And Support Services	3	1	1	5
	11.0801	Web Page, Digital/Multimedia and Information Resources Design	0	1	3	4
	11.04	Information Science/Studies	1	1		2
	11.1001	Network and System Administration/Administrator	0	1	1	2
	11.0104	Informatics	1			1
	11.0804	Modeling, Virtual Environments and Simulation	0	1		1
	Number of Companies with Computer and Information Sciences and Support Services as One of the Top Hiriing Majors		**21**	**18**	**17**	**21**
Engineering	14.0801	Civil Engineering, General	16	4		20
	14.19	Mechanical Engineering	1	6	7	14
	15.0805	Mechanical Engineering/Mechanical Technology/Technician	5	6	2	13
	15.1304	Civil Drafting and Civil Engineering CAD/CADD	2	5	5	12
	14.47	Electrical and Computer Engineering	5	3	2	10
	15.0303	Electrical, Electronic and Communications Engineering Technology/Technician	0	5	3	8
	14.01	Engineering, General	2	3	1	6

	CIP Code	Program Title	NUMBER OF RESPONSES #1	#3	#2	Chose as a Top 3 Major
Engineering	14.0805	Water Resources Engineering	0	4	2	6
	14.10	Electrical, Electronics and Communications Engineering	3	1	2	6
	14.99	Engineering, Other	3	1	2	6
	15.0613	Manufacturing Engineering Technology/Technician	2	1	3	6
	14.07	Chemical Engineering	1	2	2	5
	14.0901	Computer Engineering, General	4			4
	14.13	Engineering Science	1	1	2	4
	14.1801	Materials Engineering	0	1	3	4
	14.14	Environmental/Environmental Health Engineering	1		1	2
	14.27	Systems Engineering	0		2	2
	14.21	Mining and Mineral Engineering	0	1		1
	14.23	Nuclear Engineering	1			1
	Number of Companies with Engineering as One of the Top Hiring Majors		**47**	**44**	**3**	
		Unsure, cannot estimate*	1	1		

*** NOTE:** *One of the respondents, who could not classify the field of study, indicated demand for 'Intern' positions with a professional, scientific, and technical services establishment. The other respondent could not estimate demand but responded to other parts of the survey.*

6. **Please estimate for the #1, #2, and #3 education majors selected above: The preferred degree level for your firm's employees with that education major. Your recent ability to find employees with this education.**

NOTE: *The total number of responses for a given degree level may exceed the number of respondents, because companies could provide this information for up to three 'top' majors and therefore a given survey response may be reflected in up to three cells.*

6. **Please estimate for the #1, #2, and #3 education majors selected above: The preferred degree level for your firm's employees with that education major. Your recent ability to find employees with this education.**

NOTE: *The total number of responses for a given degree level may exceed the number of respondents, because companies could provide this information for up to three 'top' majors and therefore a given survey response may be reflected in up to three cells.*

			Preferred Degree Level (Number of Responses)				Recent Ability to Find Employees (Number of Responses)		
	CIP Code	Program Title	Associate	Bachelor	Master or Higher*	Something Else or NA	Generally Able to Fill	Somewhat challenging to fill	Very challenging or unable to fill
Computer and Information Sciences and Support Services	11	Computer And Information Sciences And Support Services		3	2	1		3	
	11.0103	Information Technology	1	6			1	1	3
	11.0104	Informatics		1					1
	11.04	Information Science/Studies		2				1	
	11.07	Computer Science	1	10	1	1		7	2
	11.0801	Web Page, Digital/Multimedia and Information Resources Design		4			2	1	
	11.0804	Modeling, Virtual Environments and Simulation		1					
	11.09	Computer Systems Networking and Telecommunications	2	5				1	1
	11.1001	Network and System Administration/Administrator		2			1		
	15.1202	Computer Technology/Computer Systems Technology	1	3	2	1	1	2	1
	30.08	Mathematics and Computer Science		4	4			2	2

*** NOTE:** *Three respondents indicated that a Doctoral degree was the preferred degree level for employees with Computer Technology/Computer Systems Technology, Electrical and Computer Engineering, and Engineering (Other) degrees. And three indicated a Doctoral degree was preferred for employees with a Mathematics and Computer Science major.*

	CIP Code	Program Title	PREFERRED DEGREE LEVEL (NUMBER OF RESPONSES)				RECENT ABILITY TO FIND EMPLOYEES (NUMBER OF RESPONSES)		
			Associate	Bachelor	Master or Higher*	Something Else or NA	Generally Able to Fill	Somewhat challenging to fill	Very challenging or unable to fill
Engineering	14.01	Engineering, General	1	4	1			1	3
	14.07	Chemical Engineering		5			1		2
	14.0801	Civil Engineering, General		12	8		2	6	7
	14.0805	Water Resources Engineering		3	3				4
	14.0901	Computer Engineering, General		4		1	1	2	
	14.10	Electrical, Electronics and Communications Engineering		4	2		1	4	
	14.13	Engineering Science	1	3				3	
	14.14	Environmental/Environmental Health Engineering		1	1				
	14.1801	Materials Engineering			4			2	
	14.19	Mechanical Engineering		10	4		5	3	1
	14.21	Mining and Mineral Engineering		1				1	
	14.23	Nuclear Engineering			1			1	
	14.27	Systems Engineering	1	1				2	
	14.47	Electrical and Computer Engineering	2	4	5		1	1	2
	14.99	Engineering, Other		3	3			1	3
	15.0303	Electrical, Electronic and Communications Engineering Technology/Technician		6		2	2	4	
	15.0613	Manufacturing Engineering Technology/Technician	1	5				2	
	15.0805	Mechanical Engineering/Mechanical Technology/Technician	2	10		1	3	4	1
	15.1304	Civil Drafting and Civil Engineering CAD/CADD	5	4	2	1		3	5
		Unsure, cannot estimate top majors		2					1

7. **About how many employees with that education do you expect to hire in the next 12 months, between now and 5 years from now, and between now and 10 years from now (approximate as necessary).**

NOTE: *Rather than asking for precision estimates, respondents were provided ranges in which to indicate their hiring demand: 0, 1–5, 6–10, 11–20, 21–30, 31–40, 41–50, 51–75, 76–100, 101–250, 251–500, and more than 500. For feasibility, this table summarizes responses by broader categories. WICHE computed the estimated Jobs from the mid value of the range. For example, for the range "'1–50," low =41, mid = 45, and high = 50. Also, the total number of responses for a given program may exceed the number of respondents, because companies could provide this information for up to three 'top' majors and therefore a given survey response may be reflected in up to three cells.*

a. In the next 12 months

			PROJECTED NUMBER OF EMPLOYEES			PERCENT OF ESTIMATED JOBS			
	CIP Code	Program Title	1–50	51–100	100 or more	Associate	Bachelor	Master or PhD	ESTIMATED JOBS
Computer and Information Sciences and Support Services	11.0103	Information Technology	6		1	1%	99%		541
	11.09	Computer Systems Networking and Telecommunications	5		1	94%	6%		533
	11.07	Computer Science	12	1		1%	79%	7%	202
	30.08	Mathematics and Computer Science	6	1			92%	8%	118
	11.0801	Web Page, Digital/Multimedia and Information Resources Design	3	1			100%		97
	11	Computer And Information Sciences And Support Services	5				51%	49%	37
	15.1202	Computer Technology/Computer Systems Technology	6			9%	40%	9%	35
	11.0804	Modeling, Virtual Environments and Simulation	1				100%		8
	11.1001	Network and System Administration/Administrator	2				100%		6
	11.04	Information Science/Studies	2				100%		6
	11.0104	Informatics	1				100%		3
	COMPUTER AND INFORMATION SERVICES AND SUPPORT SERVICES								**1,586**

			Projected Number of Employees			Percent of Estimated Jobs			
	CIP Code	Program Title	1–50	51–100	100 or more	Associate	Bachelor	Master or PhD	ESTIMATED JOBS
Engineering	15.0303	Electrical, Electronic and Communications Engineering Technology/Technician	7		1		98%		396
	15.0613	Manufacturing Engineering Technology/Technician	4	1	1	1%	99%		280
	15.0805	Mechanical Engineering/Mechanical Technology/Technician	11		1	2%	97%		260
	14.0801	Civil Engineering, General	19	1			75%	25%	210
	14.47	Electrical and Computer Engineering	8		1	88%	8%	4%	209
	14.1801	Materials Engineering	3	1				100%	119
	14.10	Electrical, Electronics and Communications Engineering	5	1			95%	5%	115
	14.19	Mechanical Engineering	14				84%	16%	74
	15.1304	Civil Drafting and Civil Engineering CAD/CADD	11			24%	58%	12%	50
	14.23	Nuclear Engineering	1					100%	45
	14.01	Engineering, General	6			20%	73%	8%	40
	14.0901	Computer Engineering, General	3				74%		31
	14.27	Systems Engineering	2			11%	89%		28
	14.0805	Water Resources Engineering	5				22%	78%	27
	14.99	Engineering, Other	6				61%	39%	23
	14.07	Chemical Engineering	5				100%		20
	14.13	Engineering Science	4			18%	82%		17
	14.14	Environmental/Environmental Health Engineering	2				50%	50%	6
	14.21	Mining and Mineral Engineering	1				100%		3
	ENGINEERING								**1,953**
		Unsure, cannot estimate	1				100%		3

b. Between now and 5 years from now, and between now and 10 years from now:

			5 YEARS FROM NOW NUMBER RESPONDING BY RANGE AND TOTAL ESTIMATED				10 YEARS FROM NOW* NUMBER RESPONDING BY RANGE AND TOTAL ESTIMATED			
	CIP Code	**Program Title**	**1–50**	**51–100**	**100 or more**	**Estimated Jobs**	**1–50**	**51–100**	**100 or more**	**Estimated Jobs**
Computer and Information Sciences and Support Services	11.0103	Information Technology	5	1	1	643	5		2	762
	11.09	Computer Systems Networking and Telecommunications	4	1	1	640	3	2	1	720
	11.07	Computer Science	10	1	1	475	7	1	3	1188
	30.08	Mathematics and Computer Science	6	1		110	4	1	1	319
	11.0801	Web Page, Digital/Multimedia and Information Resources Design	3			19	3			38
	11	Computer And Information Sciences And Support Services	5			151	2	2	1	374
	15.1202	Computer Technology/Computer Systems Technology	6			89	4			120
	11.0804	Modeling, Virtual Environments and Simulation	1			45			1	175
	11.1001	Network and System Administration/Administrator	2			11	1			3
	11.04	Information Science/Studies	2			18	2			23
	11.0104	Informatics	1			15				0
	COMPUTER AND INFORMATION SERVICES AND SUPPORT SERVICES					**2,216**				**3,722**

*** NOTE:** *WICHE heard that it is difficult to estimate demand at 5 years and particularly 10 years out, and a diminished number of responses are reflected in the longer timeframes. The estimate demand was distributed similarly across degree levels as at 12 months, so for feasibility, it is not repeated in this table.*

			5 YEARS FROM NOW NUMBER RESPONDING BY RANGE AND TOTAL ESTIMATED				10 YEARS FROM NOW* NUMBER RESPONDING BY RANGE AND TOTAL ESTIMATED			
	CIP Code	**Program Title**	**1–50**	**51–100**	**100 or more**	**Estimated Jobs**	**1–50**	**51–100**	**100 or more**	**Estimated Jobs**
Engineering	15.0303	Electrical, Electronic and Communications Engineering Technology/Technician	7		1	413	7		1	445
	15.0613	Manufacturing Engineering Technology/Technician	4		1	545	3	1	1	598
	15.0805	Mechanical Engineering/Mechanical Technology/Technician	11	1		202	9	2		232
	14.0801	Civil Engineering, General	19		1	579	13	4	1	916
	14.47	Electrical and Computer Engineering	9		1	594	6	1	1	651
	14.1801	Materials Engineering	2	1	1	582	2		1	512
	14.10	Electrical, Electronics and Communications Engineering	4	1	1	502	3	1	2	795
	14.19	Mechanical Engineering	13	1		165	11	1		234
	15.1304	Civil Drafting and Civil Engineering CAD/CADD	11			109	10			130
	14.23	Nuclear Engineering		1		88				0
	14.01	Engineering, General	5		1	244	5			103
	14.0901	Computer Engineering, General	4			86	1	1	1	266
	14.27	Systems Engineering	1			3	1			8
	14.0805	Water Resources Engineering	5			72	4	1		129
	14.99	Engineering, Other	6			81	4			98
	14.07	Chemical Engineering	5			52	4	1		117
	14.13	Engineering Science	4			44	3			68
	14.14	Environmental/Environmental Health Engineering	1			8	1			8
	14.21	Mining and Mineral Engineering	1			8	1			15
	Engineering					**4,377**				**5,325**
	14.21	Unsure, cannot estimate	2			6	2			11

8. **Any additional information about your anticipated engineering and/or computer/ information technology hiring needs you would like to share.**

Respondents with (primarily) Computer and Information Sciences and Support Services demand:

- Data Management, Data Integration, Data Security
- Had multiple job openings for 2 years now and unable to fill. Lack of interested candidates and lack of qualified candidates.
- Hire people for non-technical positions in customer success with some background in software (ex. bootcamp) or OTJ in cybersecurity (ex. from National Guard experience) that they can over time train up.
- We need all types of knowledge workers.
- Most of our positions are required to work on-site at one of the National Labs or in Washington DC which can make hiring more challenging.
- Need to include analytics, business intelligence and artificial intelligence/machine learning.
- The above are approximate numbers for our Idaho-based business unit. My personal hiring needs skew more strongly towards highly educated research professionals (small number of PhDs or Masters with demonstrable research experience)
- The most important skill is not math and the process, it is all of that in addition to creativity, critical thinking, and communication. We need people who are coachable.
- We are struggling to hire in the Idaho market. Most new hires are either in other states or outside the country. We've been investing in establishing development centers in other cities to find talent.
- We have found that we have to settle for people outside of Idaho and people without degrees, but with the right experience, in order to fill our job openings.
- We hire mainly from out of state. We actively recruit outside of Idaho.
- We're finding that computer programming, UI/UX, product management, and other 'build software application' positions are generally very hard to find in Idaho and much easier to find in other areas so we hire remote. We also find that local code schools are generally preparing employees better for real world needs better than the universities in this sector.
- We've hired many persons remotely to expand our options and diversity. Even locally living persons prefer to work remote so we are comfortable with remote workers.

Respondents with (primarily) Engineering demand

- Any type of engineer, plus another specialty do not wish to disclose; demand would really increase if a big project they're working on happens; would really shift these numbers
- CAD technicians are more difficult to locate/hire than engineers.

- I'm a Boise State Alumni and I will NOT hire anyone without a direct referral from that college. I'm personally utterly embarrassed by the lack of basic embedded systems knowledge from our local university. The level of industry targeted knowledge is beyond lack luster. Every - single - one of my interviews with a BSU alumni that has applied through LinkedIn or any other medium that wasn't directly selected by me has turned into me educating the interviewee rather than them answering the most basic of questions. i.e. "show me a circuit that will allow a microcontroller to read the resistance of a potentiometer". Seriously BSU, please update your program. I'm tired of recommending employers as well as students go elsewhere - in fact - anywhere else (CWI, U of I, etc.).
- More advanced analytic background is critically important going forward.
- These numbers cover anticipated hiring for three current locations, but are not inclusive of all our technical hiring. As an engineering and environmental firm, all our hires outside of administrative, financial, and support staff have a technical background.
- We have more problem finding highly knowledgeable analog engineers.
- Will hire at Bachelor's level, but prefer masters - also a big shortage at associate's degree level for surveyors and CAD

9. **Are there any licenses, certificates, industry certifications, or other credentials outside of the postsecondary degree types listed above that are critical for your firm's employees to hold?**

Respondents with (primarily) Computer and Information Sciences and Support Services demand:

- A variety of certifications in IT and computer networking, as well as cloud computing certifications (can't recall the names offhand, but there are several cloud certifications from Microsoft, Google, and AWS that I think would be immensely useful for us).
- Actual portfolio of Project results. Most Computer science can be self taught from online resources and is best learned when applied.
- AWS certified cloud practitioner Certified cloud security professional (CCSP) Certified data privacy solutions engineer (CDPSE) Certified data professional (CDP) Certified ethical hacker (CEH) Certified information security manager (CISM) Certified information systems security professional (CISSP) Cisco certified internetwork expert (CCIE) Cisco certified network professional (CCNP) CompTIA (A+, Cloud+, Security+) Microsoft Certified Azure Solutions Architect Microsoft certified solutions associate/expert (MCSA/MCSE) Information technology infrastructure library (ITIL) Oracle database and MySQL administration certifications Project management professional (PMP) Salesforce certified development lifecycle and deployment designer
- AWS credentials are valuable. Web technology certificates are also good.
- CISSP (need 5 years of experience to take the test), Security+, Offensive Security Certified Professional (OSCP)
- Cloud platform certifications (AWS, GCP) are desirable but not required for all positions.

- Depends on the position - Safety certifications, health physics, etc. as needed.
- For more experienced positions additional credentials might help, but we don't have any requirements today.
- I am less concerned about 4 year degrees and more concerned about people who know how to write code. The code camp schools are leaving plenty to be desired in most candidates.
- Network Certifications, IT Certifications, Sales, Business and SAP ERP certifications
- There are a lot of options and pathways, but nothing that is critical.
- We have hired engineers that have been through bootcamps and some with four year degrees. The education that they receive is so behind that we've found, more often than not, we're better off to hire those that dropped out and are self-taught.
- We're finding that real world experience and/or code schools are generally producing employees with skill sets closer to what we need for our software application positions. These don't typically correspond with licenses, certificates, etc.

Respondents with (primarily) Engineering demand:

- All of our engineering/geology staff are required to pass the Fundamentals of Engineering/ Fundamentals of Geology to obtain their Engineer-in-training (E.I.T.) or Geologist-in-training (G.I.T.) certification, AND then pass their respective professional license exams to become licensed as a Professional Engineer (P.E.) or Professional Geologist (P.G.).
- All staff need certifications, and some need to attain professional engineering licensure
- Construction inspector certifications, HAZWOPER, OSHA 10-hour, CADD and BIM certificates, Civil 3D skills
- Construction testing certifications, WAQCT
- EI, PE
- Fundamentals of Engineering (FE), Professional Engineer (PE), Structural Engineer (SE)
- Fundamentals of Engineering exam. PE exam and licensure.
- HAZWOPER, WAQTC Certifications
- Licenses: Professional Engineer, Professional Land Surveyor, PTOE, AICP

- Multiple cybersecurity specialized certifications.
- None required, professional licenses are encouraged.
- P.E., ENV SP, LEED
- PE is great but not necessary
- PE license for Civil Engineers
- PE licenses for engineers
- PE seal
- PE, various IT Certifications
- PE's, EIT's, structural Engineering
- PMP, PE
- Professional Engineer
- Professional Engineer (PE).
- Professional Engineer License (PE)
- Professional Engineer, Professional Geologist.
- Professional Engineer; IT and cyber security credentials;
- Professional Engineering license preferred but not critical/required.
- Professional Engineers (PE), Professional/Registered Geologist (P/RG), Licensed Engineer Geologist (LEG)
- Tech certs of all kinds
- United States Patent and Trademark Office registration (strong preference); state bar registration (strong preference); J.D. degree (strong preference)
- We seek engineers with experimental graduate research experience

10. **What role do Idaho colleges and universities—or other sources—play in producing the engineering and computer/information technology employees you need?**

		NUMBER					PERCENT				
		Strongly Agree	Somewhat Agree	No Opinion or N/A	Somewhat Disagree	Strongly Disagree	Strongly Agree	Somewhat Agree	No Opinion or N/A	Somewhat Disagree	Strongly Disagree
Computer and Information Sciences and Support Services	We prefer to hire locally and/or have employees on premises	8	10	1	2	1	36%	45%	5%	9%	5%
	Hiring graduates from Idaho colleges and universities is important to us	8	9	4	1	0	36%	41%	18%	5%	0%
	There are sufficient applicants from Idaho universities for our needs	0	1	3	10	8	0%	5%	14%	45%	36%
	There are sufficient applicants from Idaho community colleges for our needs	0	0	10	3	9	0%	0%	45%	14%	41%
	There are sufficient applicants from non-college training programs for our needs	2	3	11	3	3	9%	14%	50%	14%	14%
	We rely on training provided by Idaho colleges or universities to upskill our current workforce	1	8	4	5	4	5%	36%	18%	23%	18%
	Colleges or universities outside the state provide skillsets that Idaho colleges and universities do not	5	6	3	6	2	23%	27%	14%	27%	9%
	We have specific strategic targets that are hard to fulfill from Idaho colleges or universities (e.g., grant requirements, diversity goals, etc.)	4	2	8	5	3	18%	9%	36%	23%	14%
	Other factors are more important than where the employee originates (please specify)	11	6	4	0	0	52%	29%	19%	0%	0%

		NUMBER					PERCENT				
		Strongly Agree	Somewhat Agree	No Opinion or N/A	Somewhat Disagree	Strongly Disagree	Strongly Agree	Somewhat Agree	No Opinion or N/A	Somewhat Disagree	Strongly Disagree
Engineering	We prefer to hire locally and/or have employees on premises	30	12	2	1	0	67%	27%	4%	2%	0%
	Hiring graduates from Idaho colleges and universities is important to us	26	11	4	2	2	58%	24%	9%	4%	4%
	There are sufficient applicants from Idaho universities for our needs	1	10	5	16	13	2%	22%	11%	36%	29%
	There are sufficient applicants from Idaho community colleges for our needs	0	5	12	14	14	0%	11%	27%	31%	31%
	There are sufficient applicants from non-college training programs for our needs	0	8	18	11	8	0%	18%	40%	24%	18%
	We rely on training provided by Idaho colleges or universities to upskill our current workforce	8	12	8	9	8	18%	27%	18%	20%	18%
	Colleges or universities outside the state provide skillsets that Idaho colleges and universities do not	7	15	12	8	3	16%	33%	27%	18%	7%
	We have specific strategic targets that are hard to fulfill from Idaho colleges or universities (e.g., grant requirements, diversity goals, etc.)	7	9	17	9	3	16%	20%	38%	20%	7%
	Other factors are more important than where the employee originates (please specify)	19	9	13	2	0	44%	21%	30%	5%	0%

11. **Other information:**

Respondents with (primarily) Computer and Information Sciences and Support Services demand:

- Ability to deliver results, innovation, and demonstrated initiative.
- Culture, acumen, knowledge
- Even local employees often work remote. Being humble, hungry, and people smart far outweighs location.
- I grew up in Idaho and attended an Idaho college for a short time. However, the education was not at all what I needed to be successful in my field. It fell very short. I would be surprised to find a candidate from an Idaho university that would meet the needs of my organization.
- Qualifications: areas of study and practical experience from projects or (preferably) internships.
- SAP has an Alliances University offering for free. Dozens of US universities leverage this program to help certify SAP resources. In short, the business community is screaming for this need. Idaho universities can get content for free and quickly generate Business Certification Revenue.
- Skills are the most critical thing for hiring, they assess these during their interview process
- Skillset matters most.
- total compensation requirements, skill sets, and experience are still the most important factors for hiring.
- Training and experience are more important than origination. For my teams' positions I would rather hire a strong researcher from an out-of-state institution than an Idaho-trained individual with no research experience.
- We are an early stage startup company so assessing these questions is somewhat hard at this stage.
- We have non-college training candidates but very few of them have the requisite skills.
- We target employees who are capable in data management (set theory, Structured Query Language - SQL, Dimensional Data Modeling, Data Vault Data Modeling). While Idaho's employment laws are often superior from an employer perspective, we look elsewhere because these skills are not produced from standard ID universities and colleges.
- We're most interested in qualifications. We like the idea of hiring software engineers with four-year degrees, but we have not been able to find them from our recruiting at BYU-Idaho and Idaho State.

Respondents with (primarily) Engineering demand:

- Applicable skills in: Education Experience
- Because we cannot find/hire sufficient students from Idaho Colleges and Universities to meet our current staffing needs, we also recruit from other schools in Utah and Washington.

- Best qualified individual for the need. U of I graduates routinely meet that need and in many areas excel over graduates from other universities.
- Candidates are evaluated on their skills and potential to fill the need of the specific position, regardless of where they are from or which university they attended.
- Credentials, experience, and cultural fit are important factors regardless of where the employee originates.
- For the specific skills like communications circuit engineering (analog transmitter/mixer/modulator) work at high frequencies hiring someone with experience is safer.
- If an employee originates from outside the state but is very qualified and meets/exceeds our expectations, that's more important than location.
- If we can find people with a seismic background that is very important, and there is little in any Idaho curriculum to support that (U of I does some, BSU used to have a structural dynamics course, but it has not run for some time).
- ISU could, or should, provide engineering focus on PE end goal for graduates.
- It is sometimes difficult to draw people to north Idaho, so drawing people who are local is helpful for retention. But the biggest factor is really just getting the right individuals and team fit, which can be from most anywhere. Aerospace engineering is a skillset that Idaho colleges don't offer, so that would be useful -- but mechanical and electrical engineering degrees are usually acceptable.
- My company's main office is outside of Idaho. Some employees work remotely FROM Idaho. On-site preference is for non-Idaho employees.
- Need to be willing to live in a small town
- Other factors- education, skillset, and diversity are more important than where the employee originates
- Passion about the field and baseline embedded systems knowledge.
- Previous experience is typically more important than where the degree comes from. Idaho degrees are not specifically a hiring criteria
- Quality of candidate
- Soft and team/collaborative skills, as well as effective communication are critically important.
- The graduate research programs in Idaho do not produce the skillsets or experience we require in our advanced engineering business. Consequently, our senior hires have had to come from out of state. We obviously can preference origin location over the requisite skills for our positions.
- Their skillset and availability.
- Upper bound of estimated hires is impossible to say – we will hire engineers wherever. People can be anywhere now – could theoretically hire as many as came out of programs.

- We hire all qualified candidates no matter where they went to school but prefer ones from Idaho.
- We like the small town background for work ethic and hands-on experience. Workers from larger cities seem to have slightly better education.
- Where they are from is not important at all. proximity to clients/office is more of a factor in choosing to hire, as is CV
- Work ethic, experience & previous training

NCHEMS Student Flow Model

Project/Model Description

NCHEMS was contracted to modify their base Student Pipeline Model to accommodate data provided by the Idaho Office of the State Board of Education to track the progress of Idaho students from 9th grade through college completion and to allow users to adjust performance at selected points along the pipeline to ascertain the overall impact on postsecondary enrollments and completions for selected program areas (computer science, engineering, and engineering tech) out to the year 2030.

User Note

NCHEMS Base Student Flow Model strictly utilizes publicly available data and publications to generate the dashboard metrics and background calculations for the model. Sources of data include the National Center for Education Statistics (NCES), the NCES Integrated Postsecondary Education Data System (IPEDS), Western Interstate Commission for Higher Education (WICHE) secondary enrollment and high school graduate projections, Census Bureau population estimates, and the Census Bureau's American Community Survey (ACS). For this project, the Idaho Office of the State Board of Education was able to provide program-level enrollment and completions data by sector (public 4-year, public 2-year) to help inform the model to produce program-level enrollments and completions. Although the model inputs and outputs enrollment and completions numbers in precision, there is inherently error propagating through the model due to imperfect data and missing data elements. Differences in the multiple data sets used within the model create some error as does lack of detail at the institution level and on the various types of students moving through the pipeline. Users should focus on the magnitude of change and directional patterns observed in enrollment and completions distributions when drawing conclusions.

College Participation Metrics (User adjustable within the model)

High School Graduation Rates

Sources: National Center for Education Statistics (NCES) Digest of Education Statistics, public high school 4-year adjusted cohort graduation rate (ACGR). Idaho Office of the State Board of Education, 9th grade and high school graduate numbers 2010–11 through 2021–22 (projections calculated by WICHE).

Description: The adjusted cohort graduation rate (ACGR) is the percentage of public high school freshmen who graduate with a regular diploma within 4 years of starting 9th grade. Students who are entering 9th grade for the first time form a cohort for the graduating class. This cohort is "adjusted" by adding any students who subsequently transfer into the cohort and subtracting any students who subsequently transfer out, emigrate to another country, or die. Additional high school graduates entering postsecondary education 2022–23 through 2029–30 are calculated using 9th grade and high school graduate projections.

In-State College-going Rates Directly Out of High School

Sources: NCES, IPEDS Fall Residency and Migration Surveys for Fall 2016, 2018, and 2020 (mandatory reporting in even years only). Western Interstate Commission for Higher Education, Knocking at the College Door: Projections of High School Graduates, 2020. https://knocking.wiche.edu/data/knocking-10th-data/. High school graduates for academic years 2015–16, 2017–18, and 2019–20.

Description: In-State Fall first-time students directly out of high school (within the past year) as a percent of recent high school graduates (the previous spring), 3-year weighted average 2016, 2018, and 2020.

Out-of-State College-Going Undergraduates Directly Out of High School

Sources: NCES, IPEDS Fall Residency and Migration Surveys for Fall 2016, 2018, and 2020 (mandatory reporting in even years only).

Description: Number of out-of-state first-time undergraduates directly from high school attending Idaho Title IV institutions.

First-Time Participation Rate of 20–44 Year Olds

Sources: NCES, IPEDS Fall Residency and Migration Surveys for Fall 2016, 2018, and 2020 (mandatory reporting in even years only). U.S. Census Bureau July 1 Population Estimates by age, 2016, 2018, and 2020.

Description: Fall first-time students not directly out of high school as a percent of 20–44 year-olds (3-year weighted average 2016, 2018, and 2020).

College Retention and Progression (User adjustable within the model)

Postsecondary Progression Rates by sector, student type, program, and postsecondary year of enrollment

Sources: Idaho Office of the State Board of Education, year-to-year progression of undergraduate students by student type, sector, program, and postsecondary year, 2016–17 through 2021–22 (overall average figures for this period calculated by NCHEMS). NCES, IPEDS fall 2020 enrollment files (fall 2020 retention rates by sector). NCES, IPEDS 2018–19, 2019–20, and 2020–21 instructional activity files. NCES, IPEDS 2018–19, 2019–20, and 2020–21 Completions files.

Description, Public 4-year: Average enrollment and progression rates for first-to-second, second-to-third, and third-to-fourth year undergraduate enrollment for selected programs (computer science, engineering, and engineering tech). These three progression years are used to model overall enrollment trends at public 4-year institutions. IPEDS awards, enrollment, and first-to-second year retention for public 4-year institutions were used to inform an estimated split of the Idaho progression data into public research and public comprehensive institutions.

Description, Public 2-year: Average enrollment and progression rates for first-to-second and second-to-third year undergraduate enrollment for selected programs (computer science, engineering, and engineering tech). These two progression years are used to model overall enrollment trends at public 2-year institutions.

Description, Private Institutions: IPEDS enrollment, completions, and retention were used to compare with public 4-year institutions to estimate progression of undergraduate students for first-to-second, second-to-third, and third-to-fourth year for selected programs (computer science, engineering, and engineering tech). These three progression years are used to estimate overall enrollment trends at private institutions.

College Completion (User adjustable within the model)

Undergraduate degrees and certificates produced per 100 FTEs

Sources: Idaho Office of the State Board of Education, completions and FTE enrollment by program and postsecondary year, 2016–17 through 2021–22 (overall average figures for this period calculated by NCHEMS). NCES, IPEDS 2017–18, 2018–19, and 2019–20 instructional activity files (total FTE enrollment by sector). NCES, IPEDS 2017–18, 2018–19, and 2019–20 completions files (total undergraduate awards by sector).

Description: Undergraduate credentials (certificates of at least 12 weeks in length, associates, and bachelor’s) awarded per 100 full-time equivalent undergraduates by sector and program (computer science, engineering, and engineering tech). Idaho figures by sector and program are an average for 2016–17 through 2021–22. IPEDS figures for sector totals are a 3-year weighted average for 2017–18, 2018–19, and 2019–20.

ENDNOTES

1 The relatively close relationship between bachelor (and above) degree holders in engineering and computer-related fields and employer hiring demand for these types of roles was less clear for engineering technologists (who might be hired at the bachelor's or associates level, or trained on the job), therefore, these data are not presented in the executive summary.

2 Bureau of Labor Statistics. (2022, September 8). *Occupational outlook handbook: Architecture and engineering occupations.* U.S. Department of Labor. https://www.bls.gov/ooh/architecture-and-engineering/home.htm

3 WICHE analysis of IPEDS data & data provided by the Idaho State Board of Education. The research presented here utilizes SLDS Data from the Idaho State Board of Education (SBOE) and the Idaho State Department of Education (SDE). Any errors are attributable to WICHE.

4 Krebs, B., McHugh, C., & Mehl, A. (2023, January). *Educated in Idaho, employed in Idaho.* Idaho State Board of Education. https://boardofed.idaho.gov/resources/educated-in-idaho-employed-in-idaho/

5 Bureau of Labor Statistics. (2022, May). Occupational employment and wage statistics. U.S. Department of Labor. https://www.bls.gov/oes/tables.htm

6 ACEC Research Institute. (2023, May). *Engineering business sentiment 2023 Q2.* American Council of Engineering Companies. https://programs.acec.org/impact-report-21

7 While WICHE generally prefers precision in using defined terms, there are substantial gray areas in usage on the ground, so further analyses will provide substantial analysis of this point. For additional context, please see National Center for Education Statistics. (n.d.). *The classification of instructional programs: Detail for CIP code 11, computer and information sciences and support services.* U.S. Department of Education Institute of Educational Sciences. https://nces.ed.gov/ipeds/cipcode/cipdetail.aspx?y=55&cipid=88073.

8 Bureau of Labor Statistics. (2022, September 8). *Occupational outlook handbook: Architecture and engineering occupations.* U.S. Department of Labor. https://www.bls.gov/ooh/architecture-and-engineering/home.htm.

9 Within the Bureau of Labor Statistics' *Occupational employment and wage statistics* tables, "Computer" occupations include all occupations within SOC Code 15-1200 "Computer Occupations" (due to changes to the SOC Classification system between 2010 and 2018. Computer Occupations were defined as 15-1100 from 2010 to 2017 and use 15-1200 beginning in 2018. These data generally reflect the same "bucket" of occupations although specific detailed occupations were added and deleted over this time period as well as 11-3021 "Computer and Information Systems Managers" within 11-3000 "Operations Specialties Managers." According to the BLS occupational profiles, entry-level work in each of these fields typically requires a bachelor's degree. Bureau of Labor Statistics. (2022, May). Occupational employment and wage statistics. U.S. Department of Labor. https://www.bls.gov/oes/tables.htm

10 Bureau of Labor Statistics. (2022, May). *Occupational employment and wage statistics.* U.S. Department of Labor. https://www.bls.gov/oes/tables.htm

11 Bureau of Labor Statistics. (2023). *Occupational employment and wage data, May 2022.* Idaho Department of Labor. https://lmi.idaho.gov/data-tools/oews/

12 Bureau of Labor Statistics. (2023). *Occupational employment and wage data, May 2022:* Table 1.05. Idaho Department of Labor. https://lmi.idaho.gov/data-tools/oews/

13 Idaho Department of Commerce. *Key Industries.* https://commerce.idaho.gov/site-selection/key-industries/

14 Becker, M., Pace, L., & Spolsdoff, J. (2022, October). Utah's engineering and computer science workforce: Higher education and economic trends. Kem C. Gardner Policy Institute, University of Utah. https://gardner.utah.edu/wp-content/uploads/ECS-Report-Oct2022.pdf

15 National Center for Education Statistics. (n.d.). The classification of instructional programs: Detail for CIP code 11, computer and information sciences and support services. U.S. Department of Education Institute of Educational Sciences. https://nces.ed.gov/ipeds/cipcode/cipdetail.aspx?y=55&cipid=88073

[16] National Center for Education Statistics. (n.d.). The classification of instructional programs: Detail for CIP code 14, engineering. U.S. Department of Education Institute of Educational Sciences. https://nces.ed.gov/ipeds/cipcode/cipdetail.aspx?y=55&cipid=88196

[17] National Center for Education Statistics. (n.d.). *The classification of instructional programs: Detail for CIP code 15, engineering technologies/technicians.* U.S. Department of Education Institute of Educational Sciences. https://nces.ed.gov/ipeds/cipcode/cipdetail.aspx?y=55&cipid=88196

[18] The relatively close relationship between bachelor (and above) degree holders in engineering and computer-related fields and employer hiring demand for these types of roles was less clear for engineering technologists (who might be hired at the bachelor's or associates level, or trained on the job), therefore, these data are not presented in the executive summary.

[19] National Center for Education Statistics. (2023, May). *Postsecondary education: Undergraduate enrollment. U.S. Department of Education Institute of Educational Sciences.* https://nces.ed.gov/programs/coe/indicator/cha/undergrad-enrollment

[20] Idaho State Board of Education. *College-Going Dashboard.* https://dashboard.boardofed.idaho.gov/CollegeGoingDashboard.html

[21] National Center for Education Statistics. (2023, May). *Immediate college-going rate of high school completers.* U.S. Department of Education Institute of Educational Sciences. https://nces.ed.gov/programs/coe/indicator/cpa/immediate-college-enrollment-rate

[22] Western Interstate Commission for Higher Education. (2020, December). *Knocking at the college door: Projections of U.S. high school graduates.* WICHE. https://knocking.wiche.edu/
National Center for Education Statistics. (n.d.). *Digest of education statistics.* U.S. Department of Education Institute of Educational Sciences. https://nces.ed.gov/programs/digest/d17/tables/dt17_304.10.asp)
Utah System of Higher Education. (2023). *Headcount.* https://ushe.edu/institutional-data-resources-headcount/

[23] WICHE cleaned the data using transparent and appropriate processes. For specific detail on the approaches used, please see the appendix. Because of these cleaning approaches, data presented here may differ slightly from other sources and reports.

[24] Department of Education. (2022.) *Understanding your student's scores on the i=Idaho standards achievement test in English language arts/literacy and mathematics.* State of Idaho. https://www.sde.idaho.gov/assessment/files/shared/isat/Understanding-Your-Student-Scores-ISAT-ELA-Math.pdf

[25] Research on the topic is voluminous. See for example: Lent, Robert W., Matthew J. Miller, Paige E. Smith, Bevlee A. Watford, Robert H. Lim, and Kayi Hui. "Social cognitive predictors of academic persistence and performance in engineering: Applicability across gender and race/ethnicity." *Journal of Vocational Behavior* 94 (2016): 79-88; and Lee, Hang-Shim, Lisa Y. Flores, Rachel L. Navarro, and Marlen Kanagui-Muñoz. "A longitudinal test of social cognitive career theory's academic persistence model among Latino/a and White men and women engineering students." *Journal of Vocational Behavior* 88 (2015): 95-103.

[26] Bureau of Labor Statistics. (2022, September 8). *Occupational outlook handbook: Architecture and engineering occupations.* U.S. Department of Labor. https://www.bls.gov/ooh/architecture-and-engineering/home.htm

[27] This conclusion is drawn from WICHE's analysis of IPEDS data & data provided by the Idaho State Board of Education.

[28] Krebs, B., McHugh, C., & Mehl, A. (2023, January). *Educated in Idaho, employed in Idaho.* Idaho State Board of Education. https://boardofed.idaho.gov/resources/educated-in-idaho-employed-in-idaho/

[29] Krebs, B., McHugh, C., & Mehl, A. (2023, January). *Educated in Idaho, employed in Idaho.* Idaho State Board of Education. https://boardofed.idaho.gov/resources/educated-in-idaho-employed-in-idaho/

[30] Krebs, B., McHugh, C., & Mehl, A. (2023, January). *Educated in Idaho, employed in Idaho.* Idaho State Board of Education. https://boardofed.idaho.gov/resources/educated-in-idaho-employed-in-idaho/

31 Research on the topic is voluminous. See for example: Lent, Robert W., Matthew J. Miller, Paige E. Smith, Bevlee A. Watford, Robert H. Lim, and Kayi Hui. "Social cognitive predictors of academic persistence and performance in engineering: Applicability across gender and race/ethnicity." *Journal of Vocational Behavior* 94 (2016): 79-88; and Lee, Hang-Shim, Lisa Y. Flores, Rachel L. Navarro, and Marlen Kanagui-Muñoz. "A longitudinal test of social cognitive career theory's academic persistence model among Latino/a and White men and women engineering students." *Journal of Vocational Behavior* 88 (2015): 95-103.

32 Although not reported here, WICHE performed numerous post-regression tests to assess the quality of the model, including goodness-of-fit; the discriminatory power of the model; the accuracy, sensitivity, and specificity of the model; and the functional form. The results of these tests suggest the model performs well and is correctly specified.

33 Idaho State Board of Education. *College-Going Dashboard.* https://dashboard.boardofed.idaho.gov/CollegeGoingDashboard.html

34 Idaho State Board of Education. (n.d.) *2022 The Facts: Facts about Idaho's public education system.* https://boardofed.idaho.gov/resources/fact-book/.

35 Kolenovic, Z. & Strumbos, D. (2020, March). *ASAP Students in STEM Majors: Results from the Fall 2015 Cohort.* The City University of New York (CUNY) Office of Academic Affairs. http://www1.cuny.edu/sites/asap/wp-content/uploads/sites/8/2020/04/30099_CUNY_ASAP_STEM_Brief_2019_WEB_m2.-1.9MBpdf.pdf

36 WICHE analysis of May 2010 through May 2021 BLS OEWS Occupational Profiles. For purposes of this analysis, Engineering" occupations are defined as all occupations within SOC Code 17-2000 "Engineers" and 11-9041 "Architecture and Engineering Managers".
Bureau of Labor Statistics. (2022, May). Occupational employment and wage statistics. U.S. Department of Labor. https://www.bls.gov/oes/tables.htm

37 Cecil-Cantrell, C. (2017, May). *Licensed engineers and land surveyors.* Idaho Department of Labor Communications & Research. https://www.labor.idaho.gov/publications/Engineering_Surveyor_Study.pdf

38 Idaho Department of Labor. https://lmi.idaho.gov/data-tools/oews/
Bureau of Labor Statistics. (2022, May). Employment Projections:
Table 1.2 Employment by detailed occupation, 2021 and projected 2031
(Numbers in thousands). https://www.bls.gov/emp/tables/emp-by-detailed-occupation.htm

39 ACEC Research Institute. (2023, May). *Engineering business sentiment 2023 Q2.* American Council of Engineering Companies. https://programs.acec.org/impact-report-21

40 Micron. (2022, September 1). *Micron to invest $15 billion in new Idaho fab, bringing leading-edge memory manufacturing to the U.S.* [Press release]. https://investors.micron.com/news-releases/news-release-details/micron-invest-15-billion-new-idaho-fab-bringing-leading-edge

41 WICHE staff interview with Idaho Department of Labor staff.

42 While WICHE generally prefers precision in using defined terms, there are substantial gray areas in usage on the ground, so further analyses will provide substantial analysis of this point.
National Center for Education Statistics. (n.d.). The classification of instructional programs: Detail for CIP code 11, computer and information sciences and support services. U.S. Department of Education Institute of Educational Sciences. https://nces.ed.gov/ipeds/cipcode/cipdetail.aspx?y=55&cipid=88073.

43 Bureau of Labor Statistics. (2022, September 8). *Occupational outlook handbook: Architecture and engineering occupations.* U.S. Department of Labor. https://www.bls.gov/ooh/architecture-and-engineering/home.htm.

44 Krebs, B., McHugh, C., & Mehl, A. (2023, January). *Educated in Idaho, employed in Idaho.* Idaho State Board of Education. https://boardofed.idaho.gov/resources/educated-in-idaho-employed-in-idaho/

45 Krebs, B., McHugh, C., & Mehl, A. (2023, January). *Educated in Idaho, employed in Idaho.* Idaho State Board of Education. https://boardofed.idaho.gov/resources/educated-in-idaho-employed-in-idaho/

[46] Again, although not reported in detail here, the model performed appropriately on standard post-estimation diagnostic tests.

[47] Idaho Department of Labor. https://lmi.idaho.gov/data-tools/oews/
Bureau of Labor Statistics. (2022, May). *Employment Projections: Table 1.2 Employment by detailed occupation, 2021 and projected 2031* (Numbers in thousands). https://www.bls.gov/emp/tables/emp-by-detailed-occupation.htm

[48] Autor, D. H. (2016, July). *Why are there still so many jobs? The history and future of workplace automation and anxiety.* MIT Initiative on the Digital Economy. https://ide.mit.edu/sites/default/files/publications/IDE_Research_Brief_v07.pdf

[49] Smith, M. (2023, February 3). Despite big layoffs, it's still a great time to work in tech, experts say: 'I've seen bad job markets… this is not it'. *CNBC.* https://www.cnbc.com/2023/02/03/despite-big-tech-layoffs-its-still-a-good-time-to-work-in-tech.html ; https://www.ziprecruiter.com/blog/laid-off-tech-workers/

[50] Becker, M., Pace, L., & Spolsdoff, J. (2022, October). *Utah's engineering and computer science workforce: Higher education and economic trends.* Kem C. Gardner Policy Institute, University of Utah. https://gardner.utah.edu/wp-content/uploads/ECS-Report-Oct2022.pdf