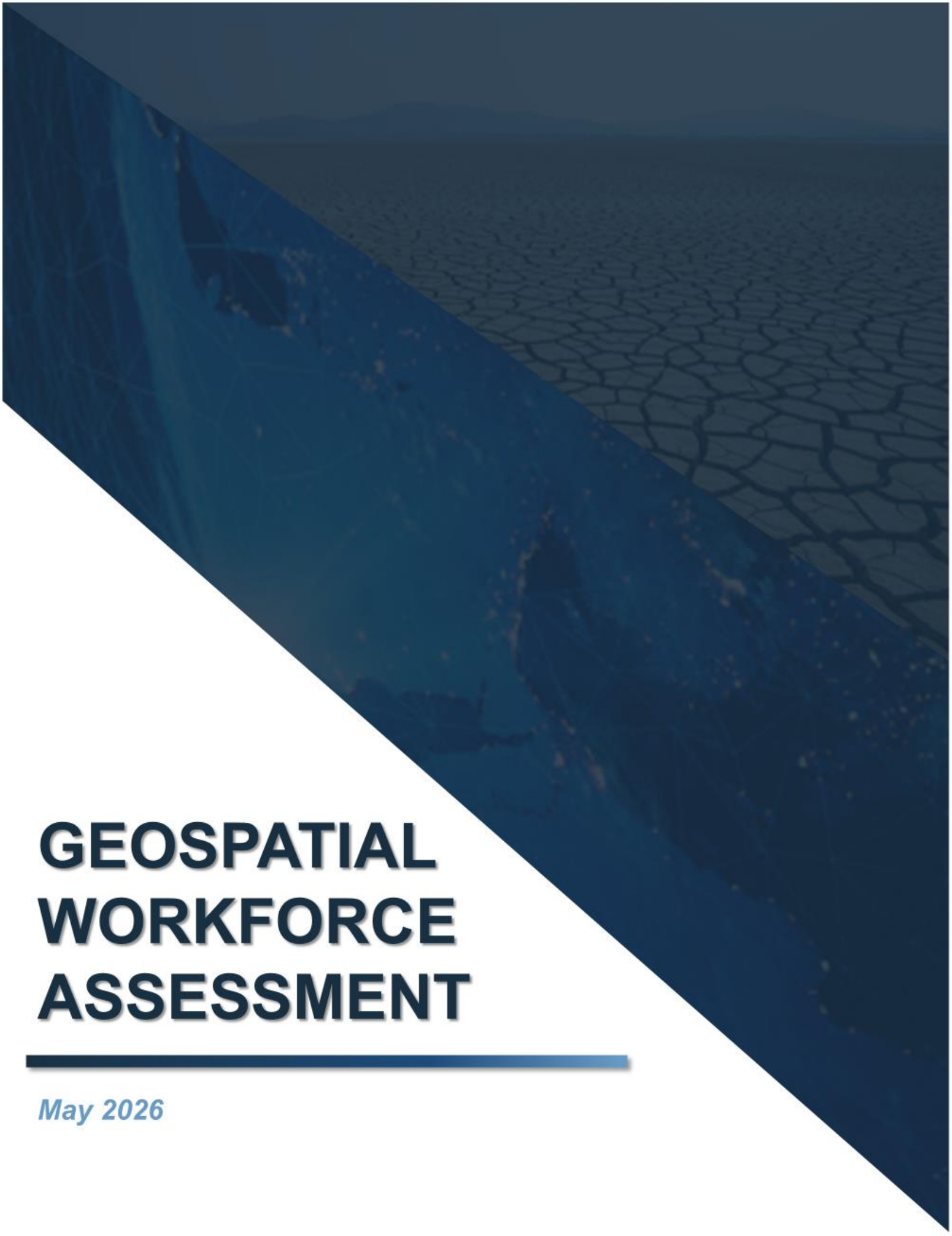


GEOSPATIAL WORKFORCE ASSESSMENT

May 2026

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EXECUTIVE SUMMARY: THE BIGGER PICTURE

Executive Summary: The Bigger Picture

Setting the Stage

As **evolving technologies and expanding use cases reshape how geospatial missions are executed**, employers across government, contractors, and industry are competing for a **limited pool of specialized talent**. The National Defense Authorization Act (NDAA) for Fiscal Year (FY) 2025 established the Geospatial Workforce Development Pilot Program to focus on expanding and accelerating education, training, certification, and research in geospatial science and technology. The purpose of this study is to assess the demand for geospatial technology skills in both military and civilian sectors in proximity to NGA facilities in accordance with Section 6618 of The National Defense Authorization Act for FY2025, "Pilot Program on Establishing a Geospatial Workforce Development Program. In line with these priorities, this assessment **examines geospatial workforce demand, talent supply, and education-to-workforce pathways to inform near- and long-term workforce planning** across two regions: the Washington, D.C., and St. Louis metropolitan statistical areas (MSAs)[1] (*see Appendix Figure 1 for details*).

TWO REGIONS, ONE MISSION

Washington, D.C. is a mature federal and defense geospatial market with deep institutional infrastructure and well-established talent pools. Meanwhile, **St. Louis, anchored by National Geospatial-Intelligence Agency's (NGA) new campus**, is a rapidly emerging hub that has rapidly cultivated a growing ecosystem of employers, academic institutions, and mission-aligned partners.

Together, these two regions form an interconnected network that drives the nation's geospatial intelligence mission. As both regions continue to grow and evolve, understanding **who is entering the workforce, what education and training programs are teaching, which skills employers need, and where gaps exist is not just valuable, it is mission-critical**. A clear view of talent availability, skill demand, and pipeline readiness is essential for forward-looking workforce strategy.

What This Assessment Examines

Because geospatial workforce capacity takes time to build—including training, clearance, credentialing, and pipeline development—organizations need a current view of supply, demand, and educational curriculum, as well as a practical understanding of how to close emerging gaps. To inform workforce decisions over time, this assessment examines the following questions:

- What roles and skills are in supply and demand today?

[1] References to Washington, D.C. and St. Louis in this assessment refer to the respective MSAs unless otherwise noted

- What skills are taught through today's education and training landscape, and how well do they align with current workforce needs?
- How might geospatial workforce needs evolve over the next decade?
- How do demand signals differ between a mature market and an emerging hub?
- What are the primary challenges and opportunities in hiring geospatial talent?
- How can education, training, and work-based pathways better prepare talent for future geospatial roles?
- How can the future workforce apply geospatial capabilities across sectors?

The Opportunity Ahead

The geospatial market is at an inflection point. Demand is growing, technology is evolving, and the ways geospatial capabilities are applied are expanding across sectors. At the same time, employers are competing for a limited pool of specialized talent, while skill needs are shifting beyond traditional geospatial expertise toward analytics, automation, cloud-enabled collaboration, and GeoAI. **Several trends underscore the value of strengthening the geospatial workforce**:

- **Geospatial capabilities are expanding**: Applications are growing beyond traditional defense and national security sectors, creating opportunities to apply geospatial skill sets across a broader range of use cases
- **GeoAI is reshaping skill needs**: Employers increasingly expect geospatial professionals to go beyond operating software by automating workflows and interpreting AI-driven results to inform decisions
- **Workforce capacity takes time to build**: As employers compete for a limited talent pool, organizations will need to broaden pipelines while investing in talent development and strategic upskilling

As a result, the challenge is no longer simply filling roles—**it is building a workforce that can adapt to a rapidly changing mission and technology landscape**.

This **creates an opportunity for employers and educators to act now**. Broadening talent pipelines, aligning education and training to emerging skill needs, and creating more practical pathways into geospatial work can help organizations address near-term hiring pressures while building longer-term workforce resilience. This includes expanding awareness of geospatial careers, strengthening work-based learning, tapping adjacent talent pools, and supporting continuous upskilling as needs evolve.

Organizations that invest now will be better positioned to meet future mission demands. More importantly, they can help shape a workforce that is not only larger, but also more agile, more technically prepared, and better equipped to apply geospatial capabilities in new and evolving ways. The opportunity ahead is to **build the foundation for the next generation of geospatial mission capability**.

HOW FINDINGS WERE DEVELOPED

Using a mixed-method approach, this assessment combines labor market analysis, education and curriculum review, stakeholder input, and secondary research to provide a practical view of the geospatial workforce in Washington, D.C., and St. Louis and where demand may be headed:

- **Drew on 21+ billion records** through a global data repository to analyze current geospatial workforce composition, including geospatial skills, demand, hiring trends, and future workforce projections (*see Appendix Figure 2 for details*)
- **Engaged ~80 stakeholders** across government, military, industry, academia, and the nonprofit space through four focus groups, six interviews, and a survey to capture diverse perspectives on the geospatial workforce landscape[2]
- **Leveraged a defined list of 14 geospatial-specialized Classification of Instruction Program (CIP) codes**[3] to identify 119 regional programs across 24 postsecondary institutions using the Integrated Postsecondary Education Data System (IPEDS)[4] (*see Appendix Figure 6 for the 24 postsecondary institutions and Appendix Figure 7 for the CIP codes used for the analysis*)
- **Catalogued 24 institutions' curricula** through their websites and IPEDS to assess each CIP code's delivery mode, average number of annual graduates, and curriculum alignment to geospatial-specialized skill categories (*see Appendix Figure 9 for details*)
- **Evaluated alumni outcomes across 24 institutions** through a global data repository to identify common employers, job titles, and salary patterns for geospatial-specialized program graduates
- **Referenced 47 secondary sources** to identify further insight into how geospatial skills are being applied and how they can be leveraged in the future, as well as how leading public- and private-sector employers and academic institutions address geospatial-specialized workforce gaps

Together, these inputs provide a view of today's geospatial workforce landscape and educational curriculum, as well as emerging needs, **equipping workforce leaders with the insights needed to advance the talent pipeline and national geospatial intelligence mission**.

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[2] Stakeholders represent a subset of the broader ecosystem and not an exhaustive list of all perspectives
[3] CIP codes are a federally standardized taxonomy for postsecondary fields of study, leveraged in this assessment to identify geospatial-specialized programs by discipline
[4] IPEDS is the U.S. Department of Education's national database that collects standardized, annual postsecondary institution data. At the time of this assessment, IPEDS data were only available through 2024; therefore, any programs launched after 2024 are not included in this study

***Disclaimer**: NGA's mission work is highly classified, limiting the availability of workforce data. As a result, this assessment includes only limited, publicly releasable NGA talent supply data, analyzed separately from the rest of geospatial workforce data. However, findings remain directionally relevant to NGA and the broader geospatial market.*

How the Assessment is Organized

The assessment is organized around **6 connected sections** that build from current geospatial market, education, and workforce conditions toward future workforce action.

UNDERSTANDING THE GEOSPATIAL TALENT MARKET LANDSCAPE

The assessment begins with an overview of today's geospatial talent market, encompassing the characteristics of the current geospatial workforce, as well as who is hiring and what roles are in demand.

MAXIMIZING GEOSPATIAL APPLICATIONS ACROSS SECTORS

With that market context in place, this section explores how geospatial work is evolving. It examines expanding use cases across sectors, showing how broader adoption is reshaping the geospatial ecosystem and increasing demand for future-ready skills.

THE SKILL INFLECTION: EVOLVING FOR FUTURE NEEDS

Building on these shifts in geospatial applications, this section explores how workforce needs are changing. It describes the move beyond tool-based proficiency toward stronger analytic thinking, workflow automation, cloud collaboration, and emerging AI.

GROWING, ATTRACTING, AND RETAINING THE WORKFORCE

This section outlines actions employers, educators, and the workforce can take to meet future geospatial demand. It focuses on strategies to strengthen the talent pipeline and highlights key hiring and retention barriers and opportunities to address them.

FROM CLASSROOM TO GEOSPATIAL PROFESSIONAL

This section identifies which postsecondary institutions develop geospatial talent, what knowledge and skills are being delivered across credential levels through postsecondary programs and industry certifications, and how well graduates are prepared to transition into the workforce.

GEOSPATIAL JOURNEY MAP: DISCOVER, BUILD, ENTER, & GROW

Building on insights from the landscape analysis, this final section translates key gaps and opportunities into a cohesive geospatial talent journey. The journey map follows the path from early exposure to geospatial careers through mid-career advancement, highlighting actions that postsecondary institutions, employers, and individuals can take to advance the pipeline at each stage.

UNDERSTANDING THE GEOSPATIAL MARKET LANDSCAPE

Understanding the Geospatial Market Landscape

Behind every geospatial intelligence effort is a skilled workforce grounded in purposeful training and shaped by years of institutional expertise. That workforce is not static: it is shifting, expanding, and concentrating in Washington, D.C. and St. Louis—two regions that are becoming centers of geospatial capability.

Two Segments within the Market

To reflect the full geospatial workforce, not only professionals already in traditional geospatial roles, this assessment distinguishes between two workforce segments: **geospatial-specialized and geospatial-related**.

This section examines both segments to establish the full scope of the geospatial talent market landscape, while the **remainder of this assessment focuses on the geospatial-specialized segment**.

GEOSPATIAL-SPECIALIZED SEGMENT

The geospatial-specialized segment represents **individuals who are directly engaged in geospatial work or explicitly being recruited for geospatial roles**.

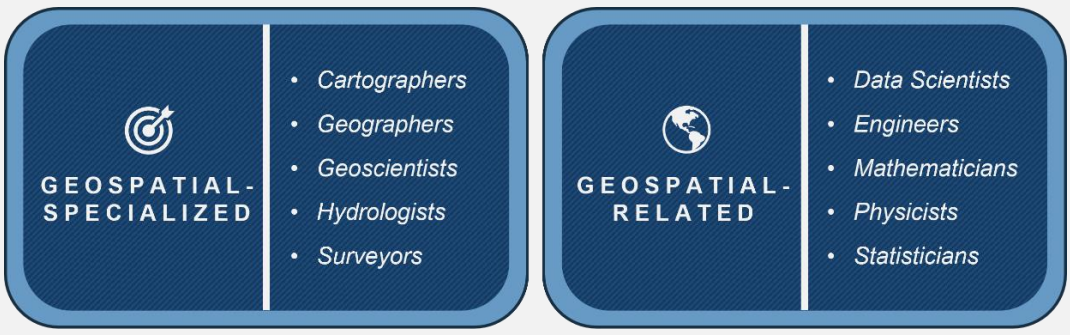
This captures professionals and job postings using a defined set of Occupational Information Network (ONET) codes for geospatial professions, supplemented by a 93-term geospatial keyword filter (*see Appendix Figures 3a and 3b for details*). The keyword filter captures geospatial work performed in other sectors where ONET codes may not explicitly reflect geospatial responsibilities.

GEOSPATIAL-RELATED SEGMENT

The geospatial-related segment captures **adjacent technical roles that commonly overlap with or support geospatial work**.

This segment includes professionals and job postings in related occupations identified via ONET codes and represents a key opportunity: **with targeted upskilling, these professionals could shift into geospatial roles and help close talent gaps** (*see Appendix Figure 4 for details*).

Figure 1: Example Job Roles for Each Geospatial Segment



The Recruitment Lever: From Related to Specialized

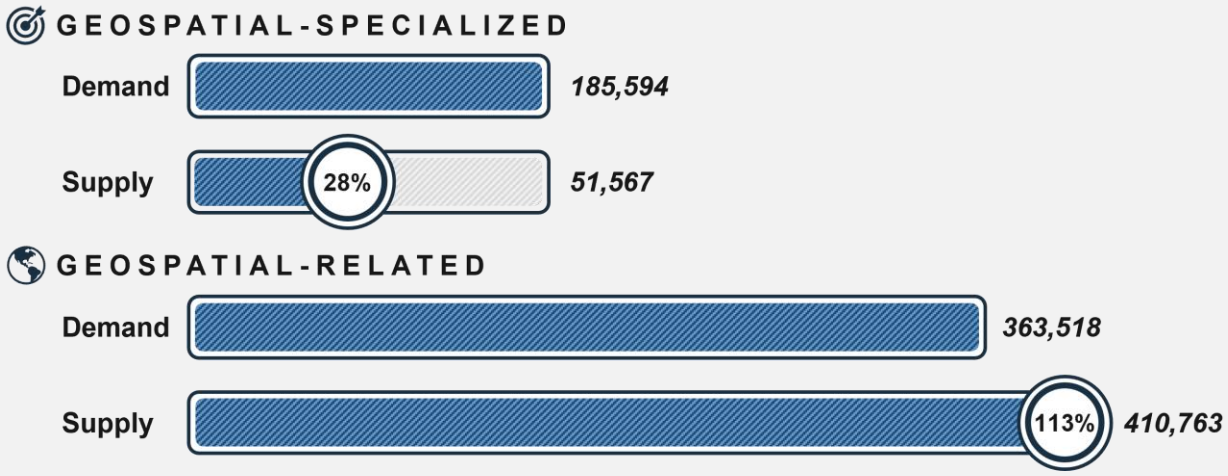
Understanding where the geospatial market stands today requires examining the supply and demand to identify what opportunities exist and where the market falls short:

- **Supply**: Active workers currently employed in relevant geospatial roles, estimated by aggregating profiles and signals from about 6,000 public sources (e.g., government surveys, talent networks, social media, and alumni groups)
- **Demand**: Job postings for geospatial roles, sourced from approximately 60,000 company websites and assessed over the past 24 months (January 2024 – January 2026) to account for seasonality and short-term market volatility

Across Washington, D.C. and St. Louis, supply and demand reveal where the geospatial market is thriving and where gaps are beginning to surface.

- **In the geospatial-specialized segment, demand significantly outpaces supply**: The current talent supply meets only 28% of employer demand, signaling a structural shortage in the talent pipeline
- **In the geospatial-related segment, supply exceeds the demand**: The current supply covers 113% of employer demand, revealing a substantial pool of adjacent talent that can be recruited into the geospatial-specialized segment to help meet market needs

Figure 2: Supply and Demand by Geospatial Segment Across Both Regions



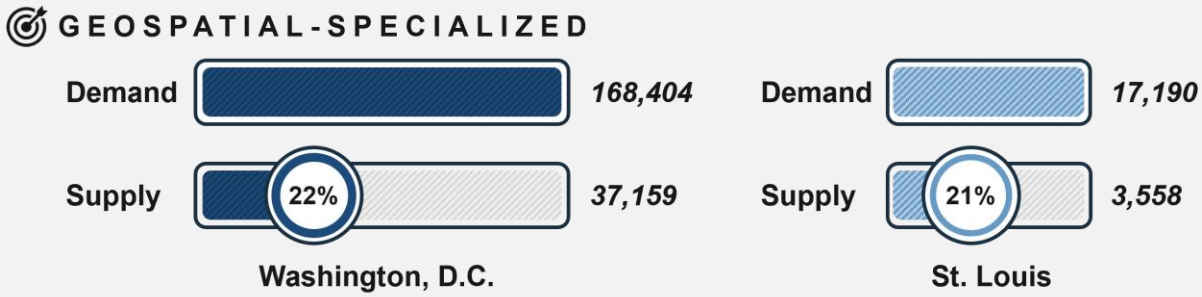
The following sections compare supply and demand across Washington, D.C. and St. Louis regions to show the position of each region and where the clearest opportunities to close the gap exist.

GEOSPATIAL-SPECIALIZED SEGMENT

Both Washington, D.C. and St. Louis exhibit geospatial-specialized shortages.

- **Both regions face significant shortages**: Supply covers just 22% of employer demand in Washington, D.C. and 21% of demand in St. Louis
- **Fewer than one in four roles can be filled with existing talent**: Both regions share the same constraint despite differences in market size

Figure 3: Regional Breakdown of Geospatial-Specialized Supply and Demand[5]



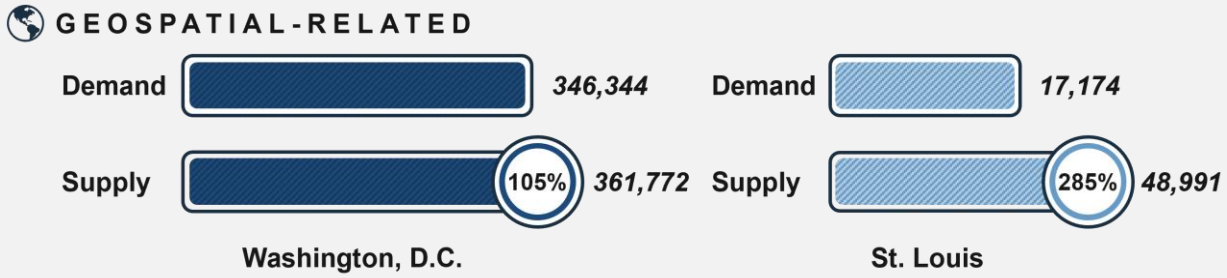
Together, these regions point to a shortage that goes beyond what incremental hiring can solve. Closing the gap will require a deliberate strategy to grow, develop, and retain geospatial-specialized talent across both regions.

GEOSPATIAL-RELATED SEGMENT

In contrast to the geospatial-specialized segment, both regions show a surplus in the geospatial-related segment supply relative to employer demand.

- **Washington, D.C. is nearly in equilibrium**: Supply covers 104% of demand, meaning adjacent talent and employer needs are closely aligned
- **St. Louis shows a notable surplus**: Supply covers 285% of demand and far exceeds current market absorption

Figure 4: Regional Breakdown of Geospatial-Related Supply and Demand



[5] NGA supply data is excluded from the regional breakdown of the geospatial-specialized segment because it has not yet been provided by NGA, although its exclusion does not have affect findings.

Given the sizeable geospatial-related segment across both regions, this assessment explores how talent from this segment can be strategically recruited into geospatial-specialized to help meet the market demand.

IMPLICATION FOR WORKFORCE STRATEGY

The research in this assessment indicates that the geospatial market will not rebalance quickly without deliberate pipeline action. **The market can grow its workforce by mobilizing the existing geospatial-related pipeline**.

To position the next generation of geospatial professionals with the needs in the market, organizations will need sustained investment in academic programs, early career exposure, and workforce development initiatives (*see The Skills Inflection: Evolving for Future Needs for details*).

From here, recruitment becomes the most immediate and actionable lever. Talent in geospatial-related roles already has transferable technical foundations, positioning them to step into specialized roles with intentional support and upskilling (*see Growing, Attracting, and Retaining the Workforce for details*).

Through this lens, Washington, D.C. and St. Louis are well positioned to build on these priorities to **close the geospatial-specialized talent gap and build a future-ready geospatial workforce**. To realize this potential, a better understanding of today's geospatial-specialized talent supply and demand is needed, which is further explored in the following section.

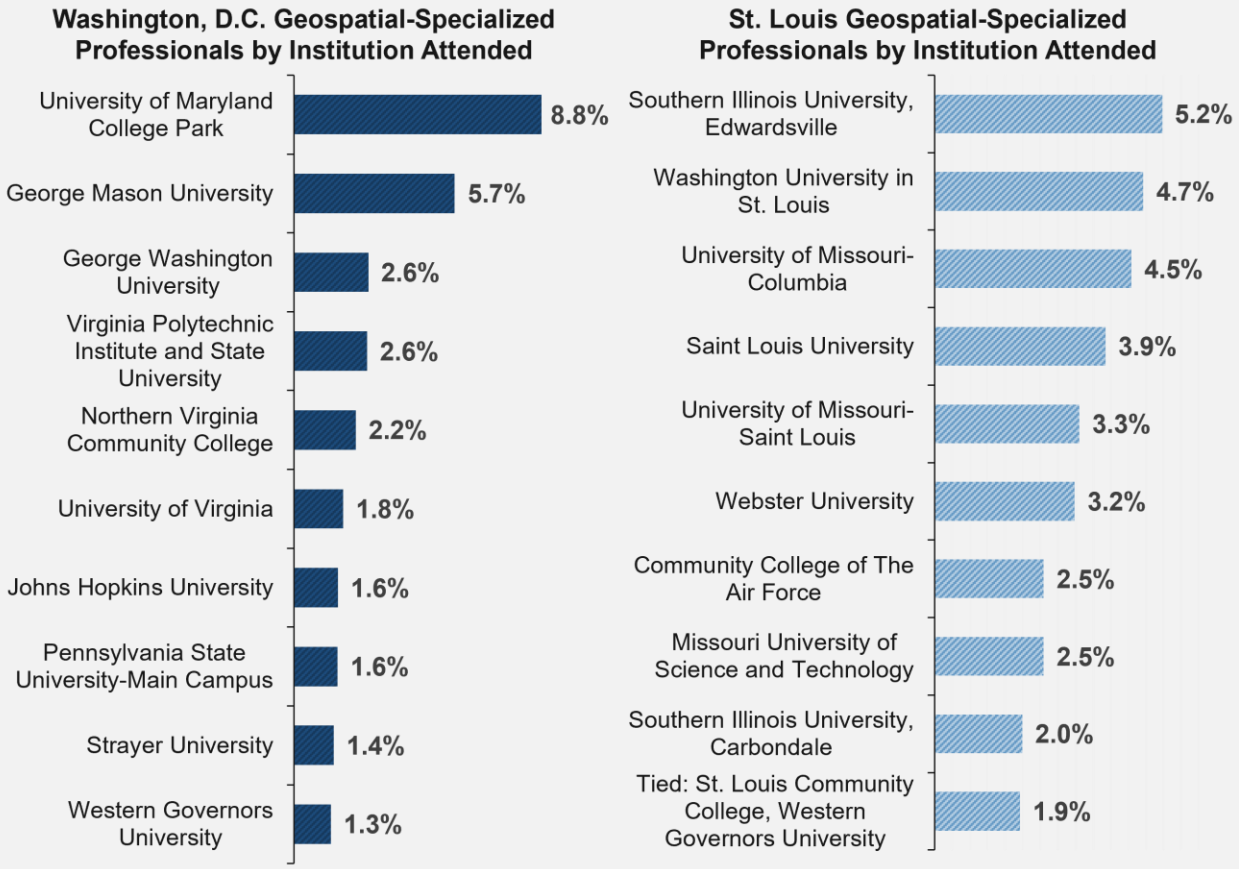
Characteristics of Geospatial-Specialized Supply

Geospatial-specialized talent emerges from multiple sources, shaped by educational backgrounds, prior roles, and career experience. The sections below examine these supply-side dimensions, highlighting the depth of existing talent across both regions.

WHERE GEOSPATIAL-SPECIALIZED PROFESSIONALS ARE EDUCATED

Roughly **87% of the geospatial-specialized professionals hold a bachelor's degree or higher, graduating from 2,586 unique institutions**—spanning large research universities to smaller regional colleges.[6]

Figure 5: Regional Breakdown of Top 10 Institutions Professionals Attended



By knowing which institutions graduate the most geospatial talent, employers can design effective engagement strategies. While no single institution dominates in either region, a small set of schools consistently cultivate the highest concentration of talent.

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[6] Figure 5 identifies the top institutions attended by the geospatial-specialized workforce in each region; however, this should not be interpreted to mean that those institutions are located within the two regions or that the relevant coursework was specifically geospatial.

Washington, D.C.

Washington, D.C.'s talent is concentrated among a small set of local institutions, supported by community college, online, and military-adjacent pathways. Most institutions fall within the Washington, D.C. corridor, reflecting ties to federal and defense careers.

Table 1: Washington, D.C.: Key Characteristics of the Educational Supply Pipeline

Characteristic	Details
Talent is concentrated in a small set of institutions	While professionals come from 2,430 institutions, the top 20 account for 38% of the region's workforce.
The pipeline is anchored in the Washington, D.C. corridor	Among the top 10 institutions, 90% of professionals come from schools local to the Washington, D.C. MSA, with University of Maryland College Park leading at 9%, followed by George Mason University at 6%
Community colleges are a meaningful feeder	Within the top 20, Northern Virginia Community College and Montgomery College contribute a combined 8% of the workforce in the region
Military-adjacent institutions are visible contributors	In the top 20, Community College of the Air Force and American Military University provide 5%, with additional defense-linked schools appearing beyond the top tier
Online-first universities add a notable share	In the top 20, Western Governors University and Strayer represent 3% of the region's workforce

St. Louis

St. Louis talent is far more concentrated than Washington, D.C., with 79% fewer institutions contributing regional talent. In St. Louis, a larger share of the geospatial-specialized workforce is supplied by out-of-region institutions.

Table 2: St. Louis: Key Characteristics of the Educational Supply Pipeline

Characteristic	Details
Talent is concentrated in a small set of institutions	While professionals come from 521 institutions, the top 20 account for 48% of the region's workforce, with Southern Illinois University Edwardsville and Washington University in St. Louis leading the way, each contributing ~5%
The pipeline is local to the St. Louis corridor, but less so than Washington, D.C.	Among the top 10 institutions, 40% of professionals come from schools in the St. Louis region
Out-of-region institutions are a meaningful feeder	In the top 20, out-of-region schools, such as University of Maryland College Park, account for 7% of the local workforce
Beyond the core institutions, supply is widely dispersed across many institutions	74% of geospatial-specialized professionals with at least a bachelor's degree come from institutions with three or more professionals, spread across dozens of schools, followed by many institutions with one or two professionals each

Across both regions, the schools producing the most geospatial talent provide an opportunity for high-impact partnerships, where targeted collaboration on curriculum alignment, credentialing, and job placement can deliver meaningful results.

Meanwhile, broader awareness and outreach efforts are better suited to engage talent across the wider set of contributing schools that produce smaller volumes of geospatial graduates (*see Growing, Attracting, and Retaining the Workforce for details*).

WHAT ROLES GEOSPATIAL-SPECIALIZED PROFESSIONALS HOLD

The geospatial-specialized professionals across both regions hold **20,432 unique job titles**, indicating a highly diverse set of career paths.

In the Washington, D.C. region, the most frequently occurring job titles fall within the **security and cyber role families** (e.g., Cybersecurity Engineer, Security Engineer), alongside **core geospatial and imagery roles** (e.g., Geographic Information Systems (GIS) Analyst, Cartographer, Geographer, and Imagery Analyst).

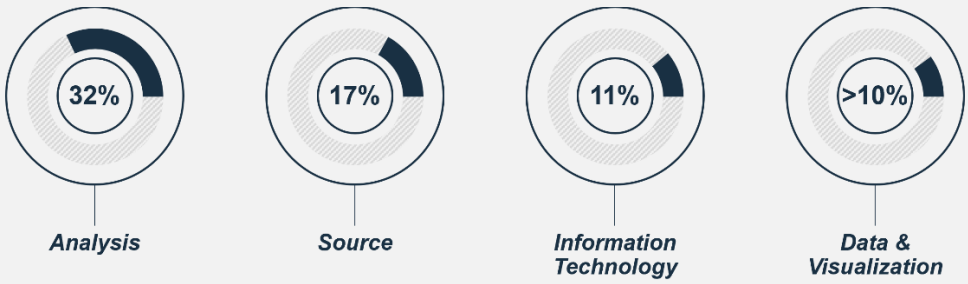
This mix reflects the region's strong focus on secure, mission-critical work, where clearance requirements shape both who can fill roles and how quickly positions can be staffed (*see Growing, Attracting, and Retaining the Workforce for details*).

In St. Louis, **geospatial and imagery roles** are the most common, alongside **security-focused** and a concentration of **field and survey roles** (e.g., Land Surveyor, Surveyor, Geologist). Together, these role families point to a workforce that spans both technical and field-based geospatial work.

Within NGA specifically, the 10,850 geospatial-specialized professionals across both regions are distributed across four career fields as seen in Figure 6: Analysis (32%), Source (17%), Information Technology (11%), and Data & Visualization (>10%).

The **majority of NGA's geospatial-specialized workers** are **concentrated in analytical and source roles**, reflecting the core intelligence and data collection functions central to NGA's mission.

Figure 6: NGA Geospatial-Specialized Professionals by Career Fields Across Both Regions



The range of positions the geospatial-specialized segment represents makes clear that **geospatial expertise is not limited to a single job family; it is a cross-cutting capability leveraged across many parts of the workforce**.

WHERE GEOSPATIAL-SPECIALIZED PROFESSIONALS ARE EMPLOYED

Where geospatial-specialized talent sits today shapes everything from hiring competition to partnership strategy. The supply of 40,717 specialized professionals across both regions is **distributed across more than 4,000 unique employers**. **No single organization employs more geospatial-specialized professionals across both regions than NGA**, which accounts for 10,850 professionals across Washington, D.C. and St. Louis.

In Washington, D.C., the primary industries employing geospatial-specialized talent are the defense and defense-adjacent organizations. The top employers include the **U.S. Department of War (DOW)**, **Booz Allen Hamilton**, **Leidos**, **MITRE**, and **Deloitte**.

In St. Louis, the geospatial-specialized segment is more evenly distributed across defense, aerospace, academia, and adjacent sectors. **Boeing and the DOW** are tied as the largest geospatial-specialized employers, followed by **Washington University in St. Louis, Leidos, and Bayer.**

The top employers reflect where the geospatial-specialized talent is concentrated, although, most geospatial-specialized professionals sit outside of these organizations, representing **a wide and accessible talent pool** for employers of all sizes. While the talent base is broad, finding professionals with the right combination of skills and

experiences remains competitive (*see Growing, Attracting, and Retaining the Workforce for details*).

Characteristics of Geospatial-Specialized Demand

Where geospatial talent exists matters, but it is equally important to consider where the talent is most needed. Demand for geospatial-specialized professionals is shaped by which organizations are hiring and how that demand has shifted over time. The sections below explore these demand dimensions, showing who is competing for geospatial-specialized talent across the two regions and how the market has evolved.

WHO IS HIRING GEOSPATIAL-SPECIALIZED PROFESSIONALS

The geospatial-specialized talent market is active and competitive, with hiring spread across many employers rather than dominated by a single employer. Federal contractors account for a substantial share of open roles, aligning with continued defense and intelligence community investment. At the same time, direct federal hiring over the past two years appears comparatively muted due to hiring constraints and freezes that affected many agencies in 2025—even though the federal ecosystem remains a major source of geospatial talent.

In Washington, D.C., there are **4,598** unique geospatial employers. **CACI International leads active hiring, followed by Leidos and General Dynamics**, underscoring Washington, D.C.'s concentration of federal contracting-driven demand.

In comparison, St. Louis shows a more concentrated market with only **840 employers**. **SSM Health and Boeing** lead regional recruitment, signaling meaningful geospatial demand outside traditional federal contracting, including healthcare delivery and aerospace manufacturing.

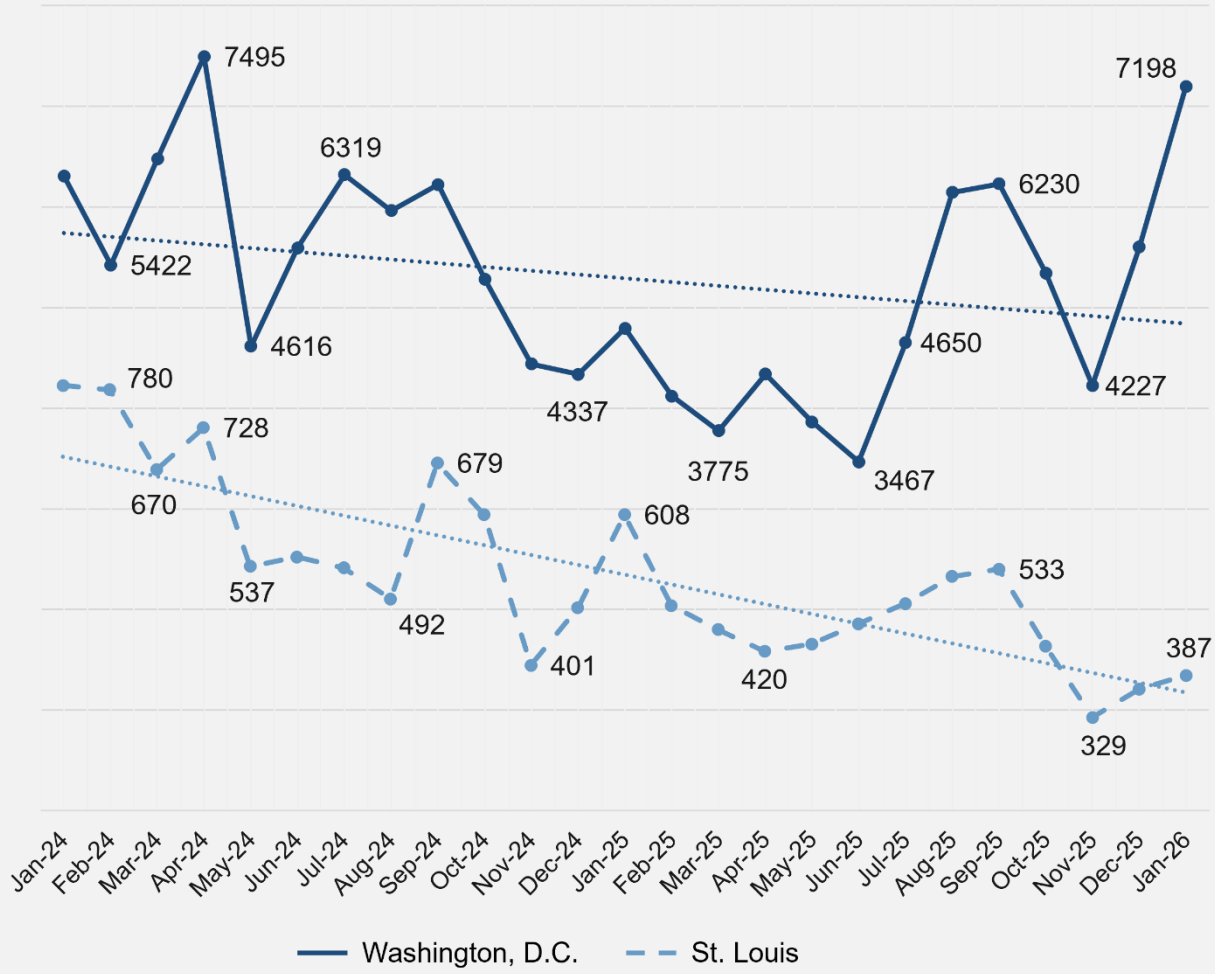
Taken together, the range of hiring organizations reinforces that **geospatial demand extends well beyond the federal government itself**, spanning federal contractors and an expanding set of private-sector and non-traditional industries (e.g., healthcare, aerospace, and broader technology use cases).

HOW DEMAND FOR GEOSPATIAL-SPECIALIZED TALENT HAS SHIFTED

Demand for geospatial-specialized professionals fluctuates month to month, reflecting changes in hiring cycles and broader workforce trends. To better understand these changes, this assessment provides a view of how demand has evolved from January 2024 – January 2026 using insights from monthly job postings.

Overall, Washington, D.C. consistently posted substantially higher job volumes than St. Louis. **Monthly demand in D.C. frequently reached the thousands**, while St. Louis generally remained in the hundreds. Despite the scale difference, both regions showed similar monthly movement, **consistent with cyclical hiring patterns in defense and government-adjacent sectors**.

Figure 7: Monthly Demand for Professionals Across Both Regions



Both regions **peaked in April 2024, when Washington, D.C. reached 7,495 postings and St. Louis reached 728 postings**, indicating a concentrated period of hiring activity, likely associated with finalized budgets and an associated surge in hiring. Demand softened for both regions toward the end of 2025, with a noticeable pullback by November 2025. This contraction aligns with government-related policy (e.g., the reduction of the federal workforce) and heightened budget uncertainty in late 2025, which may have prompted some employers to slow hiring decisions.

It is important to contextualize these trends. While both regions show a downward movement from January 2024 – January 2026, **this does not indicate long-term decline in geospatial demand**. In fact, **the geospatial market is projected to grow more than twice as fast as the overall U.S. job market by 2034**[7] (*see Maximizing Geospatial Applications Across Sectors for details*).

[7] https://www.bls.gov/data/

This two-year drill-down illustrates the effects of seasonality and short-term market volatility. Geospatial demand, much like the broader job market, tends to increase when budgets are released and organizations begin meeting short-term staffing needs, typically in the early part of the year and the spring. Hiring then slows during mid-year reprioritization periods and year-end slowdowns are associated with budgeting cycles and holiday closures. These **patterns are consistent with typical staffing cycles, rather than indicating a sudden change in underlying need for geospatial skills**.

Overall, Washington, D.C. remains the largest and most consistently active market for geospatial talent, while St. Louis continues to demonstrate steady demand aligned with its role as a growing national geospatial hub.

With the current talent market established, the next section shows how **expanding geospatial applications across sectors are driving sharper demand for talent, new skills, and greater workforce adaptability**.

MAXIMIZING GEOSPATIAL APPLICATIONS ACROSS SECTORS

Maximizing Geospatial Applications Across Sectors

Geospatial capabilities are already embedded across a wide range of sectors, where location-based data supports high-value, mission-critical work. What began primarily as map production and GIS data management has **matured into an enterprise capability that informs planning**, **day-to-day operations**, and **strategic decision-making across sectors**.

As new skills evolve and technologies like GeoAI mature, **the sectors where geospatial adds value will continue to expand**. The applications outlined in this section reflect where geospatial stands today and the direction it is headed as the workforce evolves to meet the ecosystem's future needs.

Geospatial Across Sectors

Location-based tools are already used for valuable work across sectors, such as site selection and economic development, transportation and environmental planning, national security analysis, digital modeling of infrastructure, medical logistics, and more.

But **current applications represent only a fraction of what is possible**. As the workforce builds deeper capabilities in GeoAI (*see The Skills Inflection: Evolving for Future Needs for details*), the sectors where geospatial adds value will expand and deepen. Organizations that invest in those capabilities now will be better positioned to act on that potential.

Table 3: Current and Future Applications of Geospatial Across Sectors

Sector	Existing Application	Future Growth Potential
Agtech	• Supporting precision agriculture by tracking soil conditions, crop performance, and irrigation needs to optimize productivity and resource use • Measuring plant physiology, estimating phenotyping, and visualizing plant health to detect stress, disease, or high-performing varieties for better farm management	• Continued development of complex technology (e.g., sensor networks) for automated crop monitoring, predictive modeling, and integration of spatial analytics • To illustrate this, a leading organization is developing an integrated, fully automated smart farm system with machine learning and AI capabilities to improve crop productivity[8]

[8] https://www.danforthcenter.org/news/danforth-center-scientist-receives-1-4m-grant-to-develop-smart-farm-technology/

Sector	Existing Application	Future Growth Potential
Communications	• Planning network infrastructure, identifying optimal tower locations, and modeling wireless coverage in geographic areas • For instance, space companies are leveraging data from satellite constellations to map coverage and optimize signal routing, delivering broadband in remote areas and reducing reliance on traditional ground-based infrastructure[9]	• Continued expansion driven by 5G deployment, broadband infrastructure expansion, and improved geospatial modeling of network performance • In the future, providers could leverage AI-driven, satellite-integrated networks that dynamically adjust coverage in real-time (e.g., automatically boosting connectivity in areas experiencing natural disasters)
Construction	• Supporting land surveys, infrastructure design, and construction planning through aerial imagery and mapping technologies to assess terrain conditions, track project progress, and manage built assets	• Greater adoption of digital twins, automated site monitoring, and geospatial analytics integrated into infrastructure planning and asset lifecycle management • For instance, companies could integrate GIS and Building Information Modeling workflows to advance digital twins[10]
Defense and National Security	• Enabling surveillance, intelligence analysis, and operational planning through satellite imagery, terrain modeling, GeoAI, unmanned aerial vehicles and maritime systems, and autonomous land vehicles • For instance, NGA utilizes Imagery and Warning (I&W) systems to detect patterns that may signal emerging threats[11]	• Continued growth in automated imagery analysis, computer vision models, predictive maintenance, real-time geospatial intelligence systems, and integration of GeoAI and spatial analytics with advanced defense technologies • Enhancing autonomous warfare technology to perform persistent surveillance, target recognition, and strike support
Economic Planning	• Evaluating economic activity, workforce distribution, and	• Expanded use of geospatial analytics to support economic

[9] https://starlink.com/us/technology
[10] https://www.sciencedirect.com/science/article/abs/pii/S0926580522000395
[11] https://breakingdefense.com/2025/05/ai-unchained-ngas-maven-tool-significantly-decreasing-time-to-targeting-agency-chief-says/

Sector	Existing Application	Future Growth Potential
	infrastructure access to guide regional development strategies	forecasting, regional competitiveness analysis, and strategic investment planning
Environmental Management and Climate Monitoring	• Tracking environmental change, monitoring natural resources, and assessing climate risks through spatial analysis	• Increased support for climate adaptation strategies, ecosystem monitoring (e.g., sea level changes), disaster response, and sustainable resource management
Financial Services and Risk Management	• Evaluating geographic risk exposure, assessing property and infrastructure vulnerability and analyzing economic trends • Supporting underwriting, risk management, and investment analysis in the early stages	• Expanded modeling of risks and opportunities (e.g., identifying underserved micro-markets or overbanked areas) and supporting geographically informed financial decision-making
Human Health	• Supporting disease surveillance, healthcare access analysis, and epidemiological research by identifying patterns in disease spread, health risks, and service availability	• Expanded use in real-time disease monitoring, population health analytics, and integration of environmental and health data to inform public health planning • For instance, wearable data (e.g., heart rate, sleep activity) can be used with geospatial data to map population-level health trends, track life expectancy, and identify environmental factors affecting wellness
Mining and Natural Resources	• Supporting geological mapping, mineral exploration, sourcing, and environmental monitoring to identify resource deposits and manage land use impacts associated with extraction activities	• Increased use of remote sensing and advanced spatial analytics to improve exploration efficiency and environmental oversight

Sector	Existing Application	Future Growth Potential
Retail and Consumer Analytics	• Analyzing customer behavior, identifying optimal store locations, and supporting distribution planning through business use location intelligence	• Increased use of real-time location data to personalize marketing, optimize retail networks, and integrate spatial analytics with customer and mobility data • For instance, GeoAI integrated with real-time consumer movement can predict population movement patterns to help companies adjust supply chains and target services where demand surges
Transportation and Logistics	• Supporting route optimization, traffic modeling, fleet tracking, and supply chain visibility and improving transportation and delivery network efficiency • For instance, the United Parcel Service (UPS) monitors drivers' locations in near-real-time to determine the most efficient routes to reduce delivery times and fuel consumption[12]	• Greater integration with autonomous mobility systems, predictive logistics models, and geospatial tools that enhance supply chain resilience and transportation planning
Urban Development	• Mapping existing roads, utilities, and buildings and monitoring urban growth patterns for land use planning, housing development, infrastructure placement and monitoring, and forecasting future growth • For instance, in St. Louis, ArcGIS was leveraged to develop an immersive, digital twin of the Dr. Martin Luther King corridor, visualizing potential improvements across areas[13]	• Growth of smart city initiatives that integrate geospatial data with real-time sensors, digital twins, and advanced analytics • For instance, Google's novel AlphaEarth Foundations AI model can track city growth trends, detect land-use changes, model infrastructure impacts, and support predictive modeling for sustainable urban planning decisions[14]

[12] https://atlas.co/gis-use-cases/ups-parcel-delivery/
[13] https://www.esri.com/arcgis-blog/products/unreal-engine/developers/arcgis-maps-sdk-for-unreal-engine-empowers-st-louis-to-bridge-urban-divides
[14] https://deepmind.google/blog/alphaearth-foundations-helps-map-our-planet-in-unprecedented-detail/

Sector	Existing Application	Future Growth Potential
Utilities	• Mapping and managing critical infrastructure, such as power grids, pipelines, and water systems and supporting maintenance planning and outage response	• Expanded use of infrastructure digital twins, predictive maintenance, and real-time monitoring systems that improve infrastructure resilience and reliability

GEOSPATIAL MATURITY VARIES ACROSS SECTORS

As the table above shows, geospatial adoption is widespread but uneven. While most sectors use location data in some form, the depth of integration varies significantly across sectors and organizations:

- **Leading environments**: Geospatial has evolved from ad hoc map-making to a **core organizational capability** with advanced technologies—especially GeoAI—embedded in day-to-day workflows
- **Less mature environments**: Geospatial remains **siloed and specialist-led**, relying on basic tools and limited cross-department coordination

The differences in technology adoption shape how geospatial is applied, allowing some organizations to operationalize location analytics quickly while others are still early in their integration journey.

Closing the gap is not only a technology challenge. It also requires deliberate investment in the talent needed to leverage and advance geospatial capabilities (*see Growing, Attracting, and Retaining the Workforce for details)*.

What Drives Geospatial to Scale

Geospatial capabilities are becoming central to how an increasing number of organizations plan, operate, and make decisions.

As the geospatial workforce evolves to meet future market needs, several forces are accelerating the adoption of geospatial data and driving sustained demand for geospatial applications. These drivers include **data democratization, automation and AI, integration with enterprise data systems, and partnerships and collaboration**.

DATA DEMOCRATIZATION

Access to geospatial data has expanded through cloud-based platforms, open-data programs, and commercial satellite and sensor networks.

Geospatial adoption grows as data is democratized and becomes easy to locate, reliable, and available for use across an organization. Rather than being limited to specialist teams, geospatial data becomes embedded in routine decision-making. In practice, this means:

- **Expanding access through shared cloud-based platforms (e.g., Microsoft Azure, Amazon Web Services)** to make datasets easy to discover and use across the ecosystem
- **Aligning data through common standards and metadata** to improve interoperability and consistency across teams, organizations, and industries
- **Establishing clear data-sharing agreements and governance** to clarify permissions, enable responsible use, and manage risk
- **Continuously improving data quality** to build confidence that teams can apply spatial insights in everyday decisions
- **Establishing clear security and ethical data use practices** to create strong governance frameworks, including role-based access controls, embedded privacy practices (e.g., masking sensitive fields), and regular audits and privacy impact reviews

Organizations that treat data access as a strategic asset, not an administrative function, are better positioned to scale geospatial capabilities across their operations.

AUTOMATION AND AI

Advances in automation and AI are making geospatial work faster, more repeatable, and easier to scale. Instead of relying on manual, project-by-project analysis, organizations can **operationalize location intelligence through automated pipelines and AI-assisted workflows** that deliver consistent outputs at enterprise speed.

Organizations can leverage automation and AI by:

- **Automating large-scale geospatial data processing**: Deploy models to process satellite imagery, LiDAR data, and sensor feeds at scale, allowing professionals to rapidly identify patterns and insights
- **Integrating predictive analytics into geospatial workflows**: Leverage advanced GeoAI models to forecast trends (e.g., urban growth, environmental risk), supporting more proactive decision making
- **Streamlining data integration**: Utilize automation to merge and standardize datasets from satellites, drones, ground sensors, and databases

- **Expanding access to geospatial analysis**: Embed AI-driven tools into user-friendly platforms and dashboards, enabling non-specialists to generate maps, run spatial queries, and interpret geospatial data

As tools continue to simplify and automate core tasks, geospatial capabilities are becoming embedded across organizational roles. Organizations that build AI literacy into their geospatial workforce today will be better positioned to capture the shift as it accelerates.

INTEGRATION WITH ENTERPRISE DATA SYSTEMS

Geospatial technology is **increasingly integrated with enterprise data platforms** and **operational systems**. Rather than operating as standalone mapping tools, spatial data is combined with operational, financial, and environmental datasets to give organizations a more complete view of assets, infrastructure, and operations. This integration helps visualize complex systems, surface spatial patterns in performance data, and supports more informed decision-making.

In sectors such as infrastructure, transportation, and urban development, this integration also powers digital twins: dynamic digital representations of physical environments used to monitor conditions, test scenarios, and guide future investments.

Organizations that **connect geospatial data to their broader infrastructure will get value from both**. Those that keep it siloed will continue to underuse one of their most powerful analytical assets.

PARTNERSHIPS AND COLLABORATION

Many of the most pressing challenges that geospatial technologies are positioned to solve, from climate monitoring to national security, necessitate cross-sector collaboration. No single organization has the data, authorities, talent, or operating footprint to address them alone.

As a result, **partnerships across the public and private sectors and academia are essential to accelerate geospatial innovation and adoption**—linking academic curricula to real operational needs, sharing leading practices, and expanding access to high-value datasets.

Execution-oriented collaboration should focus on:

- **Modernizing academic curricula to match evolving employer needs**: Co-develop curricula with employers, so graduates build the most essential skills aligned with evolving workforce demands
- **Sharing leading practices across sectors**: Adapt proven approaches from one sector to another to shorten learning curves and reduce reinvention. For example, geofencing—widely used in fleet and logistics—can support organ transport by geofencing donor and recipient hospitals to trigger real-time alerts and reduce delays during time-critical transfers

- **Establishing data-sharing agreements**: Define common standards and protections that enable data-sharing within organizations and across sectors

Collaboration is one of the most critical enablers of geospatial impact and workforce readiness. Without deliberate, sustained cross-sector partnerships, progress will remain fragmented and constrained by avoidable gaps in data access, standards, and talent.

The clearest mandate from stakeholders is to collaborate more and earlier because this is the fastest, most reliable path for meaningful impact at scale across the entire geospatial ecosystem.

To fully realize the future value of geospatial capabilities, the workforce must evolve in step with emerging demands. The next section highlights **the skills employers need most today and those expected to matter even more in the future**.

THE SKILLS INFLECTION: EVOLVING FOR FUTURE NEEDS

The Skills Inflection: Evolving for Future Needs

Geospatial work is at an inflection point, shifting from producing maps and GIS datasets to automating workflows, applying GeoAI, and delivering analytics that can be repeated and trusted at scale.

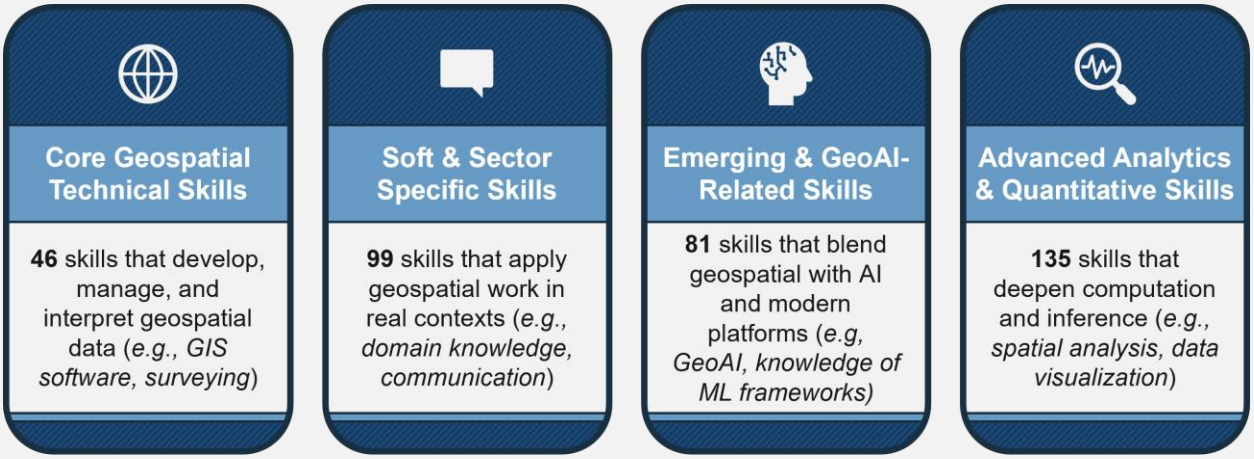
This shift is not only technical. As AI and automation accelerate outputs, the differentiator will increasingly be the ability to translate those outputs into decision-ready insights through critical thinking and domain expertise.

Against this backdrop, the assessment highlights where geospatial skills are in surplus or in short supply today and how these needs are expected to shift as the ecosystem evolves over the coming years.

A PRACTICAL SKILLS FRAMEWORK

This assessment organizes **361 geospatial workforce skills** into four categories to determine existing surpluses and gaps, as well as future market needs. These skills vary in importance and prevalence across the geospatial-specialized workforce.

Figure 8: Geospatial Skills Framework



Current State: Where the Market Shows Surplus vs. Gap

Across both regions, market analysis found that only one skills category shows a gap: **Emerging & GeoAI-Related Skills**, while the other three are in surplus: **Core Geospatial Technical Skills, Soft & Sector-Specific Skills, and Advanced Analytics & Quantitative Skills**.

However, stakeholders perceived a gap in **Advanced Analytics & Quantitative Skills**, where the market analysis indicates a surplus, because these skills are sometimes overstated on resumes and do not consistently translate into job-ready proficiency.

SKILLS SURPLUSES

Both Washington, D.C. and St. Louis show notable surpluses in foundational skills, which is helpful for staffing today but not sufficient for scaling next-generation delivery:

- **Washington, D.C. shows a 0.1% surplus** and **St. Louis shows a 6.6% surplus in Core Geospatial Technical Skills**: The market can support traditional geospatial delivery
- **Washington, D.C. shows a 6% surplus** and **St. Louis a 9.5% surplus in Soft & Sector-Specific Skills**: There is strong availability of collaboration and domain-adjacent capabilities that support delivery and stakeholder alignment
- **Washington, D.C. shows a 2.6% surplus** and **St. Louis shows a 14.38% surplus in Advanced Analytics & Quantitative Skills**: There is broader analytic capacity that can support automation and scalable workflows

Stakeholder feedback supports these market research findings for Core Geospatial Technical Skills and Soft & Sector-Specific Skills.

However, it diverges on Advanced Analytics & Quantitative Skills: **41% perceived a small gap** and **34% perceived a strong gap** in this skill bucket. Analytics skills may exist in the market, but they do not consistently translate into geospatial job-ready capabilities (e.g., applied spatial statistics, geospatial data engineering, workflow automation, production-grade tooling), supported by **stakeholders finding lack of relevant experience to be one of the largest hiring impediments**.

According to the Society for Human Resource Management (SHRM), this is consistent with the broader U.S. labor market, where roughly one-third of job openings are affected by "occupational mismatch," where potential candidates may have general skills but lack the specific experience required to meet employer needs.[15]

Stakeholders also shared that candidates at times overstate analytics proficiency, particularly when resumes are AI-enhanced, resulting in skills on resumes that are not demonstrated at the required role level.

SKILLS GAPS

The largest constraint in capabilities appears in **Emerging & GeoAI-Related Skills**.

Washington, D.C. shows an 11.46% gap, while **St. Louis is close to balance with a 0.4% gap**. This indicates that scaling GeoAI delivery is more likely to be capacity constrained in Washington, D.C., even where other skills appear adequately supplied.

[15] https://www.shrm.org/about/press-room/new-shrm-research-on-the-u-s--labor-shortage--occupational-misma

This gap is consistent with stakeholder views on availability: Emerging & GeoAI-Related Skills were most frequently described as in short supply, with **44% indicating a small gap** and **38% indicating a strong gap**.

The current skills gaps and shortages highlight where the market is misaligned today. While this snapshot is useful for understanding the current state, this assessment now turns to the projected future state and how these surpluses and gaps may be exacerbated, shift, or prove beneficial in meeting future demand.

Future State: Rapidly Shifting Trends

The geospatial market is shifting from traditional GIS execution toward AI-enabled solutions and repeatable, enterprise-grade decision support. As automation reduces the need for baseline mapping and standard analyses, differentiation will come from proven outcomes, cross-functional skill sets, and the domain context and communication needed to maximize the impact of geospatial solutions.

While a variety of geospatial skills will be needed, Emerging & GeoAI-Related Skills, Advanced Analytics & Quantitative Skills, and Soft & Sector-Specific Skills are projected to be especially valuable for the future workforce.

DEMAND IS SHIFTING TOWARD GEOAI AND SCALABLE ANALYTICS

As the geospatial ecosystem evolves, stakeholders rank **GeoAI and machine learning as the leading future capability in demand, followed by big data and distributed analytics**. Demand is consolidating around AI-enabled methods and repeatable, scaled analytics that can be operationalized, monitored, and reused across teams rather than delivered as one-time analyses. Beyond the geospatial workforce, **53% of companies are educating the broader workforce to raise overall AI fluency**, underscoring how scaling AI depends on building capability across roles.[16]

In parallel, several GIS capabilities are expected to become less differentiating over time. Stakeholders most frequently anticipate declining differentiation from cartography and mapping, GIS software proficiency, and remote sensing. These skills remain essential for baseline delivery, but they are less likely to distinguish top-performing teams as the market evolves.

For example, the role of a traditional imagery analyst is already evolving due to GeoAI and will continue to change:

- **Today, a traditional imagery analyst relies primarily on Core Geospatial Technical Skills**: Manually selecting and preparing raw imagery (e.g., satellite, aerial), visually detecting and measuring features and patterns (e.g., terrain change), assessing change over time, and delivering written assessments

[16] https://www.deloitte.com/content/dam/assets-zone3/us/en/docs/services/consulting/2026/state-of-ai-2026.pdf

- **As the market evolves, an imagery analyst will need to leverage emerging technology**: GeoAI models will become more accurate at identifying patterns and change at scale, and the imagery analyst will add value by providing the correct inputs, validating and supervising model outputs, and translating results into clear, decision-relevant conclusions

AI AND AUTOMATION ARE RESHAPING ANALYTICS SKILL NEEDS

Advanced Analytics & Quantitative Skills remain important but are increasingly a baseline expectation rather than a differentiator. Traditional jobs associated with these skills (e.g., software engineers) will not disappear, but AI and automation will change their application. As these tools become embedded in delivery, the **advantage shifts to people who can use them effectively and translate outputs into decisions**.

For example, as automation and AI handle more routine mapping and measurement tasks, geodesy and photogrammetry professionals will increasingly focus on checking and assuring data accuracy because AI systems depend on reliable spatial data. This quality assurance is especially critical in high-precision uses, such as autonomous vehicles and infrastructure modeling, where accuracy is essential.

At the same time, AI is making geospatial capability more accessible: more professionals can run analyses through packaged tools, automated pipelines, and assisted coding. This is reducing the need for large, specialist-heavy coding teams with employers increasingly valuing those who can apply these tools most effectively.

Stakeholders anticipate leaner teams organized around **workflow ownership, data readiness, and interpretation of outputs** as humans will remain accountable for accuracy and appropriate use.

GROWTH WILL FAVOR BLENDED SKILLS AND TEAMS

Employer signals reinforce that the market will increasingly require blended capability, with **cross-functional ability as a key need**. Rather than narrowly defined technical roles, organizations are prioritizing professionals who can combine analytics, delivery execution, and business context.

At the same time, the market is becoming more collaborative, with multi-contractor and multi-group teams working in shared environments. According to Deloitte's Center for Integrated Research, 91% of respondents who cite capturing stronger outcomes from AI also report their teams hire for varied skill sets, and 86% say they hire for diverse experiences.[17] Success depends on professionals who can align stakeholders and operate across organizational boundaries.

SOFT SKILLS WILL DRIVE ADOPTION AND IMPACT

[17] https://www.deloitte.com/us/en/insights/topics/talent/ai-roi-and-team-structure.html

Stakeholders shared that delivery is increasingly shaped by human judgment and communication, not just technical output.

Stakeholders see communication and storytelling as an emerging differentiator: only 4% cite it as the most valuable skill today, but 12% expect it to be the most valuable in the future, reflecting a market that will increasingly value professionals who can translate findings into clear, decision-ready support. The future of geospatial will rely on applying spatial thinking to translate geospatial data into useful information.

While the data reveals a current surplus of soft and sector-specific skills, that surplus will be exactly what the market needs next as demand increases for people who can leverage analytical thinking to contextualize data and guide decisions because algorithms cannot replace nuanced human judgment.

DOMAIN EXPERTISE IS BECOMING A PRIMARY DIFFERENTIATOR

As GeoAI and automation increase the volume and speed of outputs, teams will rely more heavily on sector context and operational understanding to appropriately interpret and apply results. Stakeholder input also identifies **industry knowledge as one of the most meaningful hiring considerations and domain expertise as not only critical today but expected to become even more important over time**.

For example, in agtech, professionals must have sector-specific expertise to capitalize on how geospatial insights can be applied to support precision agriculture, such as by improving crop yields and advancing sustainability goals.

Overall, domain expertise is essential for translating geospatial capability into real-world outcomes, because each sector has distinct decisions, constraints, and value levers for using geospatial applications effectively.

As geospatial skill needs evolve, the challenge shifts from identifying capability gaps to addressing the hiring and retention barriers that prevent organizations from closing them. The next section **examines the workforce issues and practical considerations stakeholders raised for growing, attracting, and retaining geospatial talent**.

GROWING, ATTRACTING, AND RETAINING THE WORKFORCE

Growing, Attracting, and Retaining the Workforce

Understanding today's challenges and opportunities is essential to bridge the gap between current employability and future readiness, and to prepare the workforce for rapidly shifting trends.

The geospatial market is projected to grow by **12.6% in Washington, D.C**. and by **9.1% in St. Louis by 2034**, well above overall projected job growth of 6.2% in Washington, D.C. and 4.5% in St. Louis.[18]

However, growth alone does not guarantee alignment between supply and demand. It is necessary to examine the barriers to hiring qualified geospatial talent—and the practical opportunities to address them—so the workforce can scale in step with market needs.

With supply already limited, the focus shifts from competing for scarce candidates to building capability faster than the market evolves. This includes institutionalizing on-the-job apprenticeship and mentoring, delivering targeted upskilling for emerging needs, and adopting hiring practices designed to produce proof of proficiency.

DEVELOPING APPRENTICESHIP AND UPSKILLING OPPORTUNITIES

CHALLENGE

The already constrained talent supply does not meet current demand and is not projected to meet future needs. **Stakeholders cited rapidly changing toolsets as further widening this gap** by outpacing hiring systems and educational curricula, underscoring the need for continuous upskilling to keep capabilities aligned with evolving ecosystem demands.

Surpluses in Core Geospatial Technical Skills provide a practical base to build future capacity through two approaches:

- **On-the-job apprenticeship and mentoring**: Institutionalize peer learning so organization-specific practices are transferred quickly and continuously as tools evolve (e.g., a paired-delivery model where a junior and senior co-own a pipeline, with structured shadowing and progressive handoff of responsibility)
- **Targeted upskilling for emerging needs**: Shift development toward the skills most needed now and in the future, such as machine learning and AI-enabled geospatial analytics, and design training to generate evidence of proficiency (e.g., producing a reusable automation accelerator)

Similarly, potential candidates can build their portfolio through applied projects and internships, while maintaining a skills log that shows progression.

[18] https://www.bls.gov/

RECRUITING FROM THE GEOSPATIAL-RELATED SEGMENT

CHALLENGE

With limited geospatial-specialized supply, the traditional geospatial talent pipeline cannot meet the demand alone.

Employers can expand the talent funnel by recruiting from geospatial-related roles (e.g., software engineering, data engineering) and then training on geospatial domain context, such as through structured ramp programs.

This approach recognizes that relevant capabilities often exist in the broader market even when geospatial-specialized, production-ready depth is constrained.

INCREASING AWARENESS OF GEOSPATIAL USE CASES

CHALLENGE

Many employers do not fully recognize or clearly communicate where geospatial capabilities apply, so demand concentrates where geospatial is already established, often in cleared work. As a result, candidates with transferable skills may not see geospatial roles as relevant and may not apply.

Stakeholders emphasized two practical remedies to address this awareness gap:

- **Increasing public awareness**: Increasing awareness of the applications of geospatial professionals and how to leverage geospatial data
- **Improving role messaging**: Describing jobs through concrete tasks and outputs (e.g., building pipelines) rather than niche labels, making the work legible to a broader pool of candidates and thereby reducing self-selection out

Existing talent can also help bridge the gap by proactively learning relevant geospatial use cases and bringing those applications, along with examples and pilot ideas, into their current organizations.

Stakeholders shared that academic institutions have a key role in closing the awareness gap by making geospatial use cases visible across disciplines. A low-cost, high-impact approach could be a cross-department elective or guest lecture series that demonstrates how different fields use geospatial data, expanding student exposure while supporting departments' curriculums, research interests, and enrollment goals.

NAVIGATING CLEARANCE REQUIREMENTS

CHALLENGE

In Washington, D.C., 12.7% of job postings require at least a Secret clearance, compared to 10.6% in St. Louis. However, fewer than 1% of the available talent supply in either region holds one.

The constraint is compounded by perception: some candidates assume all geospatial roles require clearances and self-screen out, even when roles are non-cleared.

While clearances will remain essential for certain work, particularly in the private sector, applying them only where needed and labeling roles consistently (e.g., clearance required, eligible, preferred) allows roles to reach the widest appropriate applicant pool.

On the supply side, those interested in geospatial careers should learn which roles commonly require clearance and, where relevant, start the clearance process early, since timelines can be lengthy.

Near-term, employers can help close gaps by prioritizing candidates in geospatial-related roles who already hold clearances. Over time, continuing to grow non-cleared geospatial work can create more pathways into the ecosystem and reduce overreliance on cleared hiring.

DEMONSTRATING PROOF OF GEOSPATIAL SKILLS

CHALLENGE

Stakeholders consistently rate demonstrated technical skills and a portfolio of work as the most important inputs to hiring decisions, yet these signals are often the least visible or least standardized across candidates.

Even so, the market still uses degrees as a front-end screen, especially in government contexts where a bachelor's degree is often required:

- **Job postings reflect this pattern**: 89% request a bachelor's degree or higher (27% request a master's, 10% a PhD)
- **The talent supply largely meets those expectations:** 87% have a bachelor's (35% have a master's, 5% a PhD)

Because the educational baseline is largely being met, degrees often function as a minimum threshold rather than a differentiator. The more persistent bottleneck is applied readiness, and the ability for candidates to credibly prove it.

This creates an **opportunity for certifications and educators to amplify what employers value most by pairing learning with verifiable proof of proficiency**.

Meanwhile, employers can retain educational requirements where truly necessary but remove them when they are not, expanding the talent pool to those without traditional degrees and adopting a skills-based hiring approach.

In parallel, employers and training partners should align on clear proficiency expectations (e.g., which certifications are most valuable), so selection criteria and training outcomes reinforce one another. For instance, a 2025 Geospatial Professional Network (GPN) survey reported that professionals holding a Geographic Information Systems Professional (GISP) certification **earned, on average, $20,000 more than their non-GISP contemporaries**, indicating higher desirability by employers.[19]

Employers should validate whether this still holds and which certifications most consistently correlate with demonstrated performance and hiring outcomes today. **NGA is well positioned to lead by defining a concise set of priority skills and recognized credentials**, paired with example deliverables that reliably signal competence to employers.

STRENGTHENING RETENTION IN ST. LOUIS

CHALLENGE

In St. Louis specifically, stakeholders report stronger retention for hires with local ties to the region, making geography a practical constraint. The most frequently cited hiring challenge was limited local supply, identified by 43% of survey respondents.

As St. Louis matures as a geospatial hub, the location constraint should ease.

In the meantime, academic institutions can expand the local talent base earlier by strengthening K–12, community college, and university pathways, so more candidates develop both roots in the region and early professional momentum.

Employers can strengthen local pipelines (e.g., universities, apprenticeships, work-based learning) and improve retention levers for non-local hires to reduce churn. This is also an opportunity for employers to investigate the primary reasons talent leaves the region and coordinate targeted actions to address the most significant drivers.

[19] https://thegpn.org/general/custom.asp?page=salarysurvey

COMPETING FOR A LIMITED TALENT SUPPLY

CHALLENGE

Geospatial roles compete in a high-wage market, averaging $121k advertised annual salary across both regions ($124k in Washington, D.C. and $92k in the St. Louis market).

Competition intensifies as many high-paying roles overlap with technology and defense/intelligence contracting, drawing from the same limited talent pool.

Stakeholders echoed this pressure, citing competition for candidates from adjacent roles (13%) and salary competition (13%) as top hiring challenges.

In an already low supply market, employers can broaden the talent pool through targeted conversion of geospatial-related talent. Other opportunities include differentiating offers beyond pay, such as by emphasizing mission impact, investing in on-the-job learning opportunities, increasing additional benefits, and providing faster growth pathways.

While hiring and retention pressures shape today's workforce challenges, long-term talent strength will depend on whether education and certification pathways are building the right capabilities. The next section **assesses how postsecondary curricula and industry certifications in both regions map to future geospatial skill needs**.

FROM CLASSROOM TO GEOSPATIAL PROFESSION

From Classroom to Geospatial Profession

The geospatial workforce of the future will be defined by job-ready skills (e.g., spatial analysis, applied domain insight), and postsecondary and industry credentials are where many professionals first begin to build that foundation.

While employers will continue developing talent through on-the-job learning, formal credential pathways provide baseline knowledge and scalable training that shape what the workforce knows, how those capabilities are developed, and how quickly professionals can contribute.

To identify where and how these pathways can be strengthened, it is critical to **establish a baseline of what is currently being taught** in each region and then use that baseline to **pinpoint the most actionable opportunities for improvement**.

Current State: Who's Producing Geospatial Talent and How

The depth and diversity of geospatial education within each region directly shape the talent available to employers and the career pathways students are equipped to enter. Building on the analysis of the current geospatial-specialized workforce and where they were educated, **this section focuses on the postsecondary institutions and industry certifications that build the workforce's geospatial skillset**.

LANDSCAPE OVERVIEW: POSTSECONDARY INSTITUTIONS

This analysis examines postsecondary institutions in Washington, D.C. and St. Louis that offer geospatial-specialized programs.[20] Across both regions, **24 postsecondary institutions offer 119 such programs spanning 14 standardized CIP codes**.[21]

Table 4: Regional Breakdown of Postsecondary Institutions and Geospatial-Specialized Programs

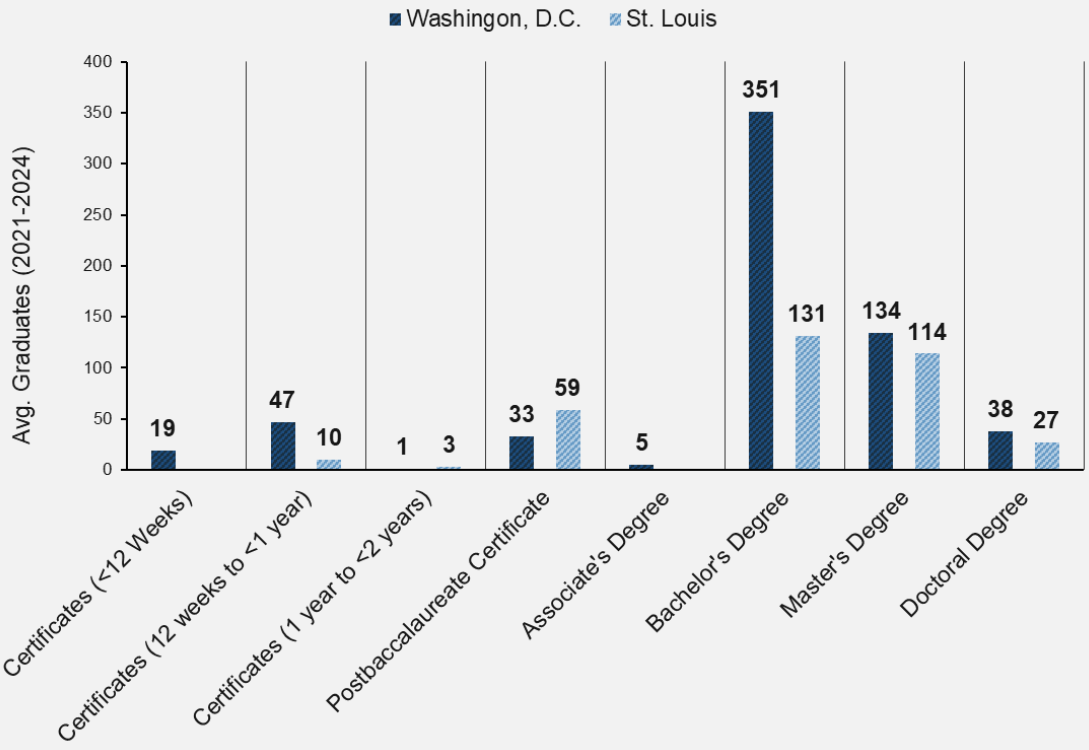
Region	Postsecondary Institutions	Geospatial-Specialized Programs
Washington, D.C. 	15	66
St. Louis 	9	53
Total	**24**	**119**

[20] This assessment reflects only institutions within the two regions, though institutions outside the regions also produce graduates who study geospatial topics and later work in these regions.
[21] Geospatial-related programs (e.g., computer science, urban planning) are not reflected in the analysis to maintain focus on geospatial-specialized curricula and alumni outcomes.

Despite Washington, D.C.'s geospatial-specialized workforce being more than 10 times the size of St. Louis's, its postsecondary footprint is only modestly larger. **Washington, D.C. hosts nearly twice the number of postsecondary institutions** teaching geospatial-specialized programs as St. Louis, while **St. Louis concentrates more programs within a smaller number of postsecondary institutions**.

Furthermore, the distribution of various credential levels across both regions reveals how each contributes differently to the overall graduate output. Bachelor's degrees account for the largest share:

Figure 9: Regional Breakdown of Average Number of Graduates by Credential Level (2021–2024)



From 2021–2024, these programs produced **an average of 972 graduates per year** (628 in Washington, D.C. and 344 in St. Louis). The credential level breakdown represents a range of pathways into the geospatial field:

- **Certificates are meaningful, accessible pathways**: Certificates account for 172 annual graduates across multiple credential levels, reflecting a mix of students with an early interest in the field and professionals returning to formalize geospatial skills. Certificate production is concentrated with University of Mary Washington leading Washington, D.C. with 40%, and Missouri University of Science and Technology leading St. Louis with 74%
- **Bachelor's degrees account for nearly half of all graduates**: The four-year degree remains the primary entry point for the geospatial workforce, with James

Madison University representing 24% of the bachelor's degrees in Washington, D.C. and Southern Illinois University Edwardsville contributing 28% to St. Louis

- **Master's degrees represent the second largest credential level (26%)**: This group signals professionals seeking advanced specialization. Washington, D.C.'s master's degree landscape is more distributed, with the University of Maryland, College Park leading at 40%, while St. Louis's is more concentrated, where Missouri University of Science and Technology represents 50%
- **Doctoral degrees are a sizable credential type**: Both regions produce a total of 65 annual average graduates, pointing to a steady pipeline of advanced researchers and specialists. University of Maryland, College Park and the University of Illinois Urbana-Champaign each comprise 37% of their region's doctoral degrees

Notably, **nine postsecondary institutions offer a full bachelor's-to-doctorate geospatial-specialized program pathway**. The University of Maryland, College Park (Washington, D.C.) and Missouri University of Science and Technology (St. Louis) offer the most full pathways in their respective regions, positioning them as key anchors for sustained talent development, advanced research, and regional specialization.

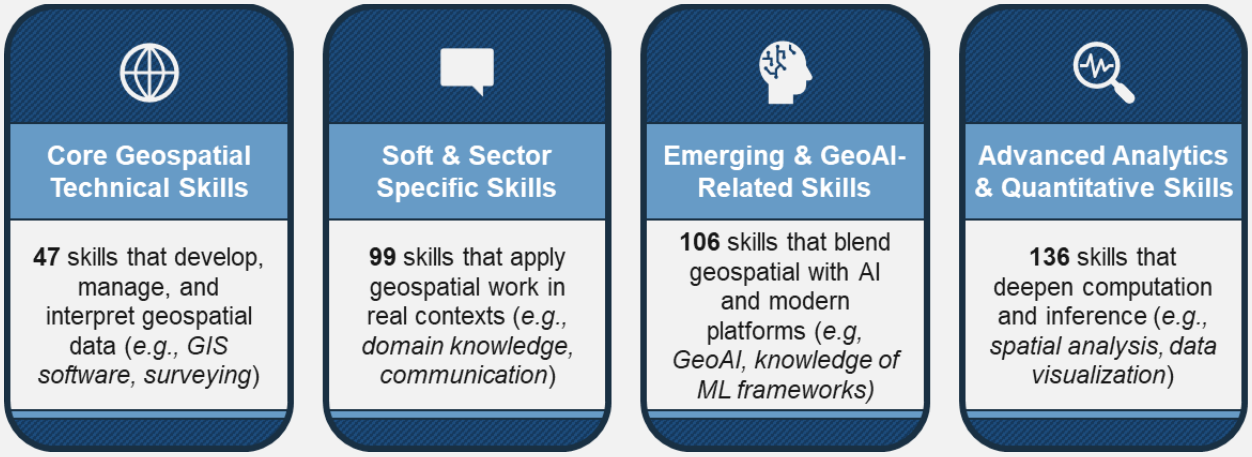
Together, these insights **highlight the landscape of the geospatial postsecondary institution landscape, as well as where the strongest institutional capacity exists to produce, retain, and advance talent over time**. The next section builds on this by examining how these programs shape the skills and capabilities individuals bring into the geospatial workforce.

INSIDE THE CLASSROOM: POSTSECONDARY INSTITUTIONS CURRICULUM

Understanding the geospatial workforce requires not only examining **where geospatial talent comes from, but also the knowledge and skills individuals develop in postsecondary institutions before entering the geospatial workforce**.

This section uses the Geospatial Skills Framework established to translate postsecondary curriculum into the skills graduates are most likely developing. The framework consolidates 361 geospatial workforce skills into four categories (*see Appendix Figure 9 for details*).

Figure 10: Geospatial Skills Framework



To compare academic pathways across Washington, D.C. and St. Louis, the analysis classifies each of the 119 geospatial-specialized programs into one of 14 CIP codes, further distinguishing them by credential level to reflect differences in program depth. Each regional analysis then focuses on the top 10 highest-producing CIP codes, based on average graduates from 2021 to 2024.

Curriculum signals from these CIP codes are then mapped to the Geospatial Skills Framework using a keyword-based approach:

- **Keyword Mapping**: Keywords from the Geospatial Skills Framework are identified across required and elective courses for each CIP code to indicate where a skill appears in the stated curriculum
- **Skill Coverage**: A skill is considered reflected in the curriculum if at least one mapped keyword appears, suggesting likely exposure within the program

Disclaimer*: This approach indicates whether a skill is reflected in course descriptions, but it does not measure depth, proficiency, or confirmed classroom instruction. As a result, coverage may be understated or overstated when source materials are high-level, outdated, or incomplete.*

The regional program breakdown that follows highlights where the curricula associated with **the top 10 highest-producing CIP codes place stronger or weaker emphasis across the four skill categories**.

Washington, D.C.

Washington, D.C.'s geospatial program landscape is anchored in a small set of high-producing CIP code pathways, with its **top 10 CIP codes capturing 82% of the region's total average annual graduates**.

Table 5: Washington, D.C.: Top 10 CIP codes by Average Number of Annual Graduates

CIP Codes	Credential Level	Curriculum Coverage				Average Graduates (2021 – 2024)
						
Geography	Bachelor's Degree	✓	✓		✓	177
Geology/Earth Science	Bachelor's Degree	✓	✓			78
Geographic Information Science and Cartography	Master's Degree	✓	✓	✓	✓	62
Oceanography, Chemical and Physical	Bachelor's Degree	✓	✓			40
Geography	Master's Degree	✓	✓		✓	37
Geographic Information Science and Cartography	Bachelor's Degree	✓	✓		✓	34
Geography	Certificate *(12 weeks to <1 year)*	✓			✓	25
Geographic Information Science and Cartography	Postbaccalaureate Certificate	✓			✓	24
Signal/Geospatial Intelligence	Master's Degree	✓		✓	✓	19
Geography	Certificate *(<12 weeks)*	✓				19

KEY

 *Core Geospatial Technical Skills*

 *Soft & Sector Specific Skills*

 *Emerging & GeoAI-Related Skills*

 *Advanced Analytics & Quantitative Skills*

The top 10 CIP codes in Washington, D.C. collectively cover all four skill categories, but the **distribution and depth of coverage vary by program**:

- **Core Geospatial Technical Skills:** Covered by **100%** of programs regardless of credential level
- **Soft & Sector-Specific Skills:** Covered by **60%** of programs, concentrated primarily at the bachelor's and master's credential level
- **Emerging & GeoAI-Related Skills:** Covered by **20%** of programs, limited to graduate-level credentials
- **Advanced Analytics & Quantitative Skills:** Covered by **70%** of programs across multiple credential levels

The top **six CIP codes tend to incorporate Soft & Sector-Specific Skills**, while the bottom four generally do not—a pattern that aligns with the narrower focus of certificate programs and highly technical advanced degrees on building **Core Geospatial Technical Skills** (e.g., a master's in Signal/Geospatial Intelligence). While the assessment identifies a Soft & Sector-Specific Skills surplus, it also projects **stronger future demand, so programs without this dimension are less aligned with where the market is heading**.

Certificates, meanwhile, present a more nuanced signal. Although they account for three of the top 10 CIP codes**, they represent just 13% of total annual graduates across this group**. That smaller share does not necessarily indicate limited interest, as certificates are often preferred because they are shorter and commonly offered online. Instead, it reflects the many short-form ways learners build geospatial skills, including industry certifications (*see Outside the Classroom: Industry Certifications for details*).

Geospatial graduates in Washington, D.C. are coming from a notably concentrated set of academic pathways. At the center is the **Geography CIP code at the bachelor's level**, which accounts for **34% of average annual graduates** across the top 10 CIP codes. This signals that foundational training **remains the most common entry point into geospatial education in Washington, D.C.**

That concentration deepens when the next largest program (bachelor's in the Geology/Earth Science CIP code) is added. Together, **those two programs comprise 50% of annual graduates across the top 10 CIP codes**, underscoring how heavily regional talent production depends on foundational bachelor's degrees.

Overall, Washington, D.C.'s geospatial postsecondary pipeline is uneven in how it prepares learners for emerging workforce needs. At the same time, its strong base of credentials focused on Core Geospatial Technical Skills and Advanced Analytics & Quantitative Skills **gives the region a solid foundation for building more responsive pathways into geospatial careers** (*see Geospatial Journey Map: Discover, Build, Enter, & Grow for recommendations to address these gaps*).

St. Louis

St. Louis offers 53 geospatial-specialized programs across its nine postsecondary institutions, yielding a total of 344 graduates per year. Its **top 10 CIP codes comprise 65% of the region's total average annual graduates**.

Table 6: St. Louis: Top 10 CIP codes by Average Number of Annual Graduates

CIP Codes	Credential Level	Curriculum Coverage				Average Graduates (2021 – 2024)
						
Geological/ Geophysical Engineering	Master's Degree	✓	✓	✓	✓	57
Geological/ Geophysical Engineering	Postbaccalaureate Certificate*	✓		✓	✓	45
Geography	Bachelor's Degree	✓	✓		✓	37
Geology/Earth Science	Bachelor's Degree	✓	✓			28
Geography and Environmental Studies	Bachelor's Degree	✓	✓		✓	21
Geological/ Geophysical Engineering	Bachelor's Degree	✓		✓	✓	17
Geographic Information Science and Cartography	Bachelor's Degree	✓	✓		✓	17
Geology/Earth Science	Master's Degree	✓	✓		✓	15
Geography and Environmental Studies	Master's Degree	✓	✓			15
Geographic Information Science and Cartography	Master's Degree	✓	✓	✓	✓	11

KEY

 *Core Geospatial Technical Skills*

 *Soft & Sector Specific Skills*

 *Emerging & GeoAI-Related Skills*

 *Advanced Analytics & Quantitative Skills*

The top 10 CIP codes collectively cover all four skill categories, but the **distribution and depth of coverage vary by program**:

- **Core Geospatial Technical Skills**: Covered by **100%** of programs, regardless of credential level
- **Soft & Sector-Specific Skills**: Covered by **80%** of programs, concentrated primarily at the bachelor's and master's credential levels
- **Emerging & GeoAI-Related Skills**: Covered by **40%** of programs, limited almost exclusively to graduate-level credentials
- **Advanced Analytics & Quantitative Skills**: Covered by **80%** of programs across multiple credential levels

While St. Louis's educational supply currently **concentrates in foundational capabilities and falls short of the Emerging & GeoAI-Related Skills** increasingly shaping employer demand, the region is scaling its offerings in this skill category.

For instance, the region has a significant and growing **concentration of talent in the Geological/Geophysical Engineering CIP code**. This specific area of study stands as the single largest CIP code across three credential levels (*bachelor's, postbaccalaureate certificate, and master's degree*) and accounts for **45% of total average annual graduates** in the top 10 CIP codes. That concentration indicates that **St. Louis is already producing a substantial talent pool with exposure to the emerging geospatial capabilities the market requires**.

Missouri University of Science and Technology's launch of the nation's first geospatial engineering master's program in 2025 reinforces this trajectory toward emerging capabilities.[22] With project-based coursework focused on future-driven applications (e.g., autonomous robotics), the program reflects **a deliberate shift toward applied, technology-enabled capabilities that are increasingly shaping the market**.

Additionally, the assessment highlights the untapped potential of certificate programs. With only **one of the top 10 CIP codes being at the certificate level**, the region may be overlooking a highly effective talent development tool. Certificates are a flexible and scalable solution for rapidly upskilling professionals and transitioning individuals from adjacent fields. By expanding these offerings, St. Louis could more effectively **target specific skill gaps and accelerate the growth of its geospatial talent pipeline**.

Overall, St. Louis has a strong foundation and growing momentum, and it is well positioned to expand its emerging geospatial capabilities further (*see Geospatial Journey Map: Discover, Build, Enter, & Grow for recommendations*).

[22] https://www.stlmag.com/business/missouri-st-geospatial-masters-program-st-louis/

Postsecondary Institutions Across Regions

While the top 10 CIP codes in both regions provide a strong foundational skill set, they **often do not provide a clear pathway from core technical knowledge to the advanced and emerging capabilities demanded by the market**.

To better understand what these programs actually teach, the analysis below outlines the common courses associated with each CIP code across both regions.

- **Core Geospatial Technical Skills**: Common courses include *Introduction to GIS*, *Cartography and Geovisualization*, *Remote Sensing*, *Geospatial Data Models (Raster/Vector)*, *Field Methods/GPS*, and *Spatial Data Infrastructure*, helping build durable competencies in spatial data handling and standard workflows that employers expect
- **Soft & Sector-Specific Skills**: Many programs also integrate applied learning through *Geospatial Project Management*, *Professional Practice/Capstone Studio*, and sector courses such as *Urban Planning GIS*, *Environmental Applications*, *Public Health GIS*, *Transportation GIS*, or *Emergency Management*, which are critical as employees translate stakeholder needs, navigate governance and policy constraints, and communicate insights for decision-making
- **Advanced Analytics & Quantitative Skills:** While some programs offer courses like *Spatial Statistics*, *Geostatistics*, *Spatiotemporal Analysis*, *Network Analysis*, *Optimization/Location-Allocation*, and *Applied Modeling for Spatial Data*, the coverage is inconsistent, signaling a gap in moving students beyond simple visualization to more practical, data-driven analysis
- **Emerging & GeoAI-Related Skills:** Despite the importance of this category, very few programs include courses such as *GeoAI/Geospatial Data Science*, *Machine Learning for Geospatial*, *Deep Learning for Remote Sensing*, *Cloud-Native Geospatial*, *Automation and Scripting for GIS (Python/APIs)*, and *Real-Time/IoT Geospatial*. The lack of focus on these areas leaves graduates less prepared for the scale, speed, and advanced problem-solving increasingly required across all sectors

The inconsistency across Advanced Analytics & Quantitative Skills and Emerging & GeoAI-Related Skills highlights **the growing need not only to refine this curriculum, but also to invest in alternative learning pathways**, including industry certifications available outside formal postsecondary institutions.

OUTSIDE THE CLASSROOM: INDUSTRY CERTIFICATIONS

In addition to postsecondary credentials, **industry certifications deepen geospatial knowledge** (e.g., GIS Professional (GISP), NGA GEOINT Professional Certification (GPC)) (*see Appendix Figure 8 for a full list*). They help professionals—whether they are entering the market from geospatial-related fields or looking to deepen existing knowledge—build and signal competence across the four distinct skill categories:

- **Core Geospatial Technical Skills**: Industry certifications, such as those offered by the American Society for Photogrammetry and Remote Sensing (ASPRS) across specialties (e.g., remote sensing, photogrammetry), are in abundance to validate foundational geospatial knowledge across a range of core competencies. Similarly, certifications, such as the Esri Technical Certifications, emphasize foundational platform-specific skills that provide valuable baseline knowledge for the workforce (e.g., ArcGIS, computer mapping)
- **Advanced Analytics & Quantitative Skills**: Certification coverage does not span the full range of capabilities needed today or in the future. For instance, Esri Technical Certifications primarily focus on ArcGIS-based workflows that intersect with analytics and automation (e.g., data visualization, digital dashboards) but do not extend far beyond the ArcGIS platform. In contrast, geospatial-related certifications (e.g., AWS, Python) often build modern analytics foundations (e.g., AWS Lambda, Python programming) outside a geospatial context and require supplementation to be applied effectively to geospatial work
- **Soft & Sector-Specific Skills**: Certification coverage exists but tends to emphasize professional practice and domain readiness rather than transferable soft skills (e.g., communication, storytelling). For example, the GISP credential validates professional standards (e.g., ethics, responsible data use) and signals maturity beyond purely technical tool proficiency. Separately, sector-aligned certifications exist that validate domain knowledge. FAA Part 107 Remote Pilot is an example for drone-based mapping in architecture/engineering/construction (AEC), utilities, and public safety, while NGA GPC is role-aligned for defense and GEOINT work. Paired with a core geospatial credential, these certifications signal the ability to operate effectively within a specific mission
- **Emerging & GeoAI-Related Skills**: Despite being the most critical areas for the future, industry certifications in emerging capabilities remain scarce. Geospatial-related certifications can build foundational knowledge, but they generally do not teach how to apply these methods to complex geospatial data and workflows. Geospatial training is beginning to emerge to help fill this gap (e.g., Esri's GeoAI offerings[23]) but has not yet matured into widely recognized industry certifications

[23] https://www.esri.com/en-us/capabilities/geoai/overview

Today's certification ecosystem only partially aligns with future skill needs. It is effective at validating **core geospatial competencies, GIS proficiency, professional practice, and important enabling and sector context (e.g., cloud, privacy, and delivery)**. However, it remains insufficient in building the emerging capabilities that will matter most, including geospatially grounded GeoAI, automation at scale, and advanced analytics (*see Geospatial Journey Map: Discover, Build, Enter, & Grow for recommendations to address these gaps*).

ALUMNI OUTCOMES: FROM CLASSROOM TO CAREER

Beyond measuring how well graduates are prepared to enter the workforce, **another key indicator of the geospatial talent pipeline's effectiveness is graduates' labor market outcomes**. This section examines career outcomes for alumni of geospatial-specialized postsecondary programs in Washington, D.C., and St. Louis, **offering insight into employer demand, where graduates are being hired, and the roles they are filling**. Strong salary and employment outcomes in both regions point to robust and growing demand for geospatial expertise.

Washington, D.C.

Graduates of Washington, D.C.-area postsecondary institutions **earn an average salary of approximately $100,000**—well above the regional average of $88,000[24]—underscoring the strong market value of their skills.

Employment outcomes also demonstrate meaningful breadth. Alumni are hired into roles across the federal ecosystem, extending well beyond defense and national security. Top employers include the National Oceanic and Atmospheric Administration, U.S. Department of State, U.S. Geological Survey, and Naval Facilities Engineering Systems Command, alongside private-sector organizations such as Esri, academic institutions, and energy companies. This range demonstrates that **geospatial talent is relevant across scientific, technical, policy, and operational environments**.

Graduates' job titles further reinforce this point. Roles, such as GIS analyst, geologist, environmental scientist, solutions engineer, software engineer, and data scientist, indicate that, **even though postsecondary programs do not consistently teach all of the skills increasingly needed for the future, they are still producing talent with transferable, high-demand capabilities** that apply across sectors and functions.

St. Louis

Alumni from St. Louis-based institutions also **earn an average salary of approximately $100,000**, reflecting even stronger demand for geospatial talent, especially when compared with an average regional salary of approximately $55,000.[25]

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[24] https://www.bls.gov/cew/
[25] https://www.bls.gov/cew/

Their employment outcomes reflect both concentration and diversity in the local market. A higher share of graduates join NGA, consistent with its role as the region's largest geospatial employer. Others are absorbed into local government organizations (e.g., the Illinois State Geological Survey, the Missouri Department of Natural Resources), as well as federal employers (e.g., the U.S. Army Corps of Engineers). Graduates also enter research-oriented environments (e.g., Sandia National Laboratories, the Ken C. Gardner Policy Institute), with a notable share pursuing research and professorship tracks. Taken together, **these outcomes position St. Louis as a deep geospatial market with pathways across government, industry, research, and academia**.

Common job titles such as geologist, geospatial analyst, geotechnical engineer, software engineer, professor, and project manager further illustrate the range of technical and leadership roles these alumni fill. They also reflect how often **graduates move into positions that combine domain expertise, analytical capability, and applied problem-solving**.

Alumni Outcomes Across Regions

Across both regions, the labor market for geospatial talent is strong, well compensated, and diverse. Graduates are entering roles across federal agencies, private-sector firms, research institutions, academia, and public-sector organizations, confirming that geospatial skills have broad and growing relevance.

At the same time, these career pathways also reveal a critical insight: **many of the roles that graduates fill increasingly require Advanced Analytics & Quantitative Skills and Emerging & GeoAI-Related Skills that remain underrepresented in many postsecondary curricula**. Employer demand for geospatial talent is strong, but academic preparation is not yet fully keeping pace with the direction of the field. Closing this gap will require coordination across academia, employers, and talent supply (*see Geospatial Journey Map: Discover, Build, Enter, & Grow for details*).

Future State: Where the Pipeline is Headed

The annual number of graduates with geospatial-specialized credentials from Washington, D.C. and St. Louis remains strikingly low: just 972 graduates each year for a labor market approaching 200,000 professionals. As a result, a substantial share of **geospatial roles will continue to be filled by talent from other educational backgrounds and by professionals transitioning from geospatial-related fields** until these programs expand in scale, visibility, and market relevance.

Looking ahead, the highest-value professionals will be those who can apply geospatial capabilities beyond Core Geospatial Technical Skills. Success will require **advanced analytics, domain fluency, and the ability to leverage AI effectively to interpret complex outputs and translate insights into actionable decisions**.

This shift, driven by the convergence of geospatial methods with modern data and AI practices, demands a coordinated response. The following *Geospatial Journey Map:*

Discover, Build, Enter, & Grow section outlines a set of practical, interconnected actions that stakeholders can take to **close the gap between academic preparation and rapidly evolving workforce needs to build a future-ready geospatial workforce**.

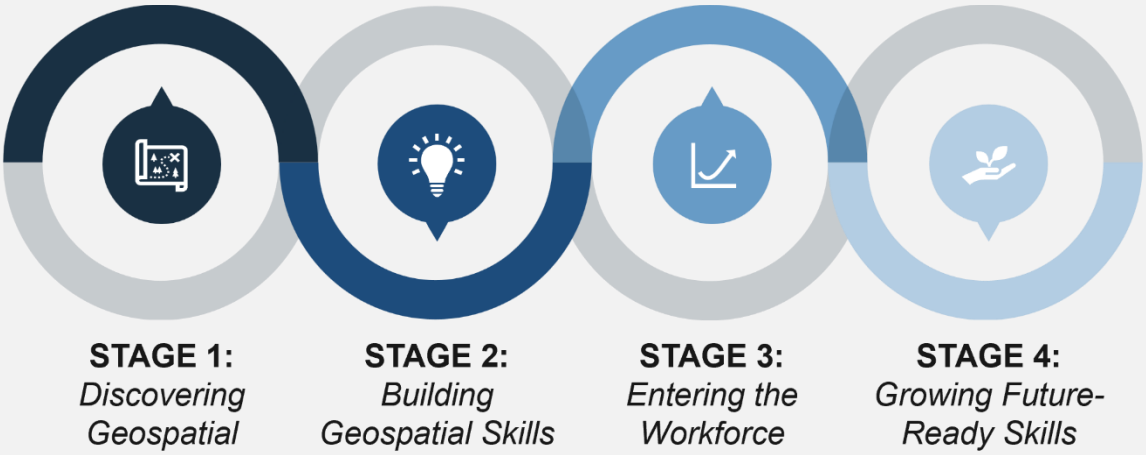
GEOSPATIAL JOURNEY MAP: DISCOVER, BUILD, ENTER, & GROW

Geospatial Journey Map: Discover, Build, Enter, & Grow

Closing the gap between current program offerings and future skill needs requires looking across the entire geospatial talent journey, from early awareness and exposure to workforce entry and ongoing upskilling as professionals advance in their careers.

This section maps that journey, highlighting what typically occurs at each stage and where academic institutions, employers, and individuals can take decisive action to **close capability gaps, accelerate workforce readiness, and build a stronger, more future-ready geospatial talent pipeline**.

Figure 11: Geospatial Journey Map



Stage 1: Discovering Geospatial

OVERVIEW

This stage establishes the foundational awareness needed to expand and sustain the geospatial talent pipeline. It focuses on introducing the field to a broad range of individuals, from K–12 students encountering geospatial for the first time to geospatial-related professionals in adjacent fields exploring a more specialized geospatial career path.

The purpose of this stage is to provide students and the broader community with exposure to what geospatial work involves, what it enables, and how its applications extend across sectors. Awareness is the critical entry point: **it drives informed interest, reduces attrition before it starts, and increases the likelihood that potential candidates will view geospatial as a viable and compelling career path**.

EARLY K–12 EXPOSURE

This discovery is most effectively achieved through early, accessible touchpoints, particularly K–12 programs that spark interest at formative stages through formats such as summer camps and seminars.

For instance, James Madison University, a leading institution in the Washington, D.C. region for geospatial education, offers its "Geospatial Semester," a collaboration between 31 high schools across Virginia and the university's College of Integrated Science and Engineering.[26] The program supports high school seniors in exploring geospatial technology through classes delivered at their home schools while earning university credit, **helping convert early exposure into sustained interest in geospatial pathways for 9,000 students and counting**.

In St. Louis, the University of Missouri–St. Louis hosts a Geospatial Science Summer Camp for high school students, where they introduce students to geospatial science and provide hands-on experience in various geospatial technologies to get students interested in the field. This program serves to **develop the workforce pipeline that will support St. Louis' rapidly growing geospatial market**.[27]

Other successful programs include Esri's ArcGIS for Schools program, which provides K–12 schools with free access to ArcGIS tools and classroom-ready materials (e.g., 15-minute map-based activities designed to fit into lessons).[28] This **lowers common adoption barriers (e.g., cost, teacher preparation time), while offering standards-aligned activities that can be used immediately for students**.

Similarly, GeoMentors, launched in 2015 by the American Association of Geographers (AAG) and Esri, connects geospatial professionals with K–12 schools to support educators in introducing geographic concepts and geospatial technology.[29] The program also emphasizes mentors from diverse geospatial backgrounds, helping students see how broadly geospatial capabilities apply across subjects and career pathways.[30]

A practical opportunity for a K–12 school to grow geospatial awareness and even begin introducing future in-demand skills could be to **offer a geospatial-based lab through** an existing science class. Students could use accessible, browser-based mapping tools and public imagery to investigate a small set of questions near their school, such as heat hotspots, tree-canopy gaps, land-use change over time, or pedestrian safety around key intersections. This lab would **build early spatial reasoning, data literacy, and even foundational GeoAI concepts (e.g., pattern detection), alongside responsible practices such as validating results and discussing uncertainty**.

These examples show that early exposure can turn initial awareness into sustained interest in geospatial pathways. Expanding these programs across more K–12 schools, while strengthening partnerships with postsecondary institutions and industry mentors, can better prepare students for future career opportunities in a rapidly growing field.

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[26] https://www.jmu.edu/cise/geospatial-semester/index.shtml
[27] https://www.umsl.edu/geospatial/events/2025-high-school-geospatial-science-summer-camp.html
[28] https://www.esri.com/en-us/industries/K–12-education/schools-software
[29] https://www.aag.org/geomentors/
[30] https://www.esri.com/about/newsroom/arcnews/geomentor-program-exceeds-1000-volunteers

DISCOVERY BEYOND K–12 EXPOSURE

Beyond K–12 programming, discovery can be reinforced through community events and other visible engagement opportunities that turn curiosity into practical understanding. These experiences help **clarify what geospatial roles involve, the skills and credentials they require, and the pathways available to enter the field**. This reduces confusion that can lead individuals, especially from geospatial-related fields, to self-select out based on incorrect assumptions about their eligibility or preparedness.

Academic institutions and employers alike have a role to play in creating low-barrier opportunities for engagement. For example, Saint Louis University is hosting the 2026 Geo-Resolution at its Student Center and offering free access to both the public and the broader student body.[31] By making the event highly visible and easy to attend, the university creates an **approachable entry point for students and community members to learn about geospatial and explore its real-world relevance**.

In St. Louis, employers are well positioned to engage professionals through established conveners, such as the T-REX Geospatial Innovation Center.[32] Co-hosted sessions can be marketed intentionally to professionals in geospatial-related fields (e.g., software engineers, data professionals) with a **value proposition focused on transferable skills and near-term opportunities**. This approach is further strengthened by ecosystem coordination through GeoSTL, which helps **lower barriers to entry** by connecting nontraditional talent to real-world problem statements, networks, and regional demand beyond traditional geospatial-specialized pathways.[33]

In Washington, D.C., employers could similarly anchor outreach in established convenings that already draw ecosystem stakeholders, and then **deliberately broaden participation by inviting professionals in adjacent disciplines**. Events, such as FedGeoDay, offer a credible platform focused on open geospatial ecosystems and federal data stewardship,[34] while United States Geospatial Intelligence Foundation (USGIF) programming offers a channel for exposing nontraditional entrants to geospatial use cases and career pathways through sustained community touchpoints.[35]

As awareness increases, individuals **are better positioned to take concrete next steps toward a geospatial career** by participating in available opportunities, pursuing independent learning, or selecting a pathway into the workforce (e.g., formal education, certification, military transition, career change) based on their experience and goals.

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[31] https://www.slu.edu/news/2026/march/geo-resolution.php
[32] https://downtowntrex.org/geospatial/
[33] https://geostl.ai/
[34] https://www.fedgeo.us/
[35] https://usgif.org/event/

Stage 2: Building Geospatial Skills

OVERVIEW

Once professionals have been introduced to geospatial and developed a foundational understanding through early exposure, they are ready to deepen their knowledge. This stage focuses on how they can build more advanced capabilities and develop the geospatial skills needed for the future.

With the supply of geospatial-specialized professionals meeting only 28% of demand, it is increasingly important both to **expand geospatial-specialized education and to build geospatial capabilities among individuals outside traditional geospatial degree** programs through postsecondary credentials, industry certifications, and other alternative learning pathways.

COLLABORATE WITHIN AND ACROSS INSTITUTIONS AND INDUSTRY

Each region's geospatial ecosystem should first align around a focused set of shared priorities and future workforce needs. Although emerging skill demands should inform that alignment, those priorities must **ultimately be translated into specific, coordinated actions across academic institutions, employers, and ecosystem conveners**. Institutions can operationalize this alignment by:

- **Defining future competencies**: Convene employers and academic leaders to agree on a short list of target competencies (e.g., spatial machine learning, responsible and ethical GeoAI). For example, in St. Louis, GeoSTL is well positioned to support this effort by bringing stakeholders together and translating regional priorities into clear talent signals and curriculum needs
- **Coordinating delivery across institutions**: Where scale or specialized expertise is constrained, use shared delivery models (e.g., cross-listed courses, joint capstones) to increase student reach without compromising program outcomes. For instance, James Madison University's Geographic Science and Intelligence Analysis programs collaborated to develop a GEOINT Certificate by sharing resources to expand access to students across programs[36]
- **Keeping curricula market-responsive**: Institutionalize frequent program reviews and ongoing employer-faculty feedback loops, such as through advisory councils, to maintain alignment between academic curriculum, graduate capabilities, and evolving hiring needs[37]

[36] https://usgif.org/reaccreditation-james-madison-university/
[37] https://www.deloitte.com/us/en/insights/industry/articles-on-higher-education/2026-higher-education-trends.html

ALIGN DEGREES TO HIGHEST-DEMAND FUTURE SKILLS

Once employers and institutions align on future workforce needs, the next critical step is for academia to connect curriculum to employers' highest-demand future needs by:

- **Mapping learning to outcomes**: Map each future in-demand skill to where it is taught across credential levels at each postsecondary institution for coverage, coherence, and measurable progression
- **Requiring work products**: Require an applied artifact each term (e.g., a model, technical documentation), so students can graduate with evidence of capability, not only course completion
- **Sequence learning for application**: Build structured learning pathways that intentionally progress from concepts to methods to mission-grade application, including human-machine collaboration and professional/ethical considerations

Academic institutions need to address the most significant skill gaps, particularly Emerging & GeoAI-Related Skills and Advanced Analytics & Quantitative Skills, through their geospatial-specialized programs such as geography, as these capabilities will be increasingly important in the future workforce. At the same time, despite the abundance of Soft & Sector-Specific Skills in the geospatial-specialized market, it is still **critical for academic institutions to continue reinforcing these core outcomes for students**. For instance, Southern Illinois University Edwardsville, states its objective of building "strength in critical thinking and communication, especially in writing" as a key outcome of its Master's in Geography degree.[38]

To better align with market demand, aspiring **geospatial professionals should also aim to build a skillset that pairs strong foundational competence with emerging capabilities**. In practice, until a widely recognized GeoAI industry certification becomes available, professionals can combine a Core Geospatial Technical Skill credential with a complementary enabling credential (e.g., AI, Python, cloud) and an applied portfolio that demonstrates those skills in context alongside Soft & Sector-Specific Skills.

INVEST IN POSTSECONDARY CERTIFICATES AND INDUSTRY CERTIFICATIONS

With these foundations in place, academic institutions should update existing certificates and expand non-degree offerings where future demand is clear, particularly in emerging competencies. Policy changes, such as the new Workforce Pell Grant program (expected to start in July 2026), may also increase demand for short-term

[38] https://www.siue.edu/arts-and-sciences/geography/graduate/index.shtml

credentials by allowing Pell Grants to support eligible programs as short as eight weeks.[39]

If shorter programs become a more common pathway into geospatial roles, **university certificates and industry certifications will become even more important as primary vehicles for building future-ready skills**. Because these pathways often show the greatest gaps in Soft & Sector-Specific Skills, institutions should be intentional about strengthening those capabilities alongside technical training.

At the same time, institutions should be disciplined about which credentials they scale. While U.S. postsecondary education offers nearly 1.9 million credentials[40], research shows only 12% of non-degree credentials deliver significant wage gains. [41] This makes it critical for certificate content to be anchored in validated, forward-looking competencies. Broadening certificate-based pathways can **expand access to geospatial learning while remaining more responsive to evolving demand**.

DEVELOP NEW CREDENTIALS

In addition to updating existing offerings, postsecondary institutions and industry stakeholders should **selectively launch new credentials in emerging needs**. This is especially important as AI and automation increasingly take on more routine geospatial analysis, shifting demand toward stronger spatial reasoning.

In this environment, **fields such as geomatics will become even more important**. AI systems depend on trusted, high-accuracy location data, and geomatics is what produces, validates, and maintains that data (e.g., LiDAR, GNSS, field-to-cloud QA/QC). **Universities can respond by offering certificates or micro-credentials aligned to these high-demand skills**, giving learners faster and more flexible pathways to build relevant skills.

Some institutions are already moving in this direction. For instance, Washington University in St. Louis developed a Certificate in Applied GeoAI that is expected to launch in Fall 2026, focused on spatial data management, imagery analysis, and locational intelligence.[42] Similarly, Harris-Stowe State University[43] and Maryville University[44] are building net-new priority geospatial programs in coordination with NGA.

Organizations that lead the ecosystem, such as GeoSTL and NGA, should build on this momentum by spearheading a multi-stakeholder effort with leading postsecondary

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[39] https://www.ed.gov/about/news/press-release/us-department-of-education-issues-proposed-rules-implement-working-families-tax-cuts-acts-workforce-pell-grants
[40] https://credentialengine.org/
[41] https://www.burningglassinstitute.org/research/holding-credentials-accountable-to-outcomes
[42] https://caps.washu.edu/programs/certificates/certificate-in-applied-geoai/
[43] https://sensorsandsystems.com/introducing-geohornet-lab-harris-stowe-state-universitys-geospatial-hub-at-t-rex/
[44] https://www.maryville.edu/mpress/maryville-partners-with-national-geospatial-intelligence-agency/

institutions to define, develop, and pilot new industry-recognized certifications, such as a GeoAI Practitioner credential. Such a credential would **establish a benchmark for the advanced skills the market demands while also providing a targeted upskilling pathway for the existing workforce**.

INVEST IN ALTERNATIVE LEARNING METHODS

In addition to formal postsecondary credentials and industry certifications, employers, academic institutions, and training providers can use **alternative learning methods (e.g., bootcamps, online trainings, short modules) to address specific capability gaps in the geospatial workforce**. These formats can provide targeted instruction in high-priority, future-relevant areas (e.g., geodesy, geomatics) in a more accessible way than pursuing a full credential when the need is targeted skill supplementation.

A range of training providers already offer this kind of flexible instruction through in-person, live online, and even self-paced formats, giving learners flexible ways to build job-relevant skills. For instance, Esri's "Introduction to AI in ArcGIS" course supports professionals to build a specific skill conveniently through an online format.[45]

These modules are most valuable when they are **integrated in a coherent learning pathway, aligned to employer demand, and designed to close a clearly defined skill gap for a particular role or employee population**.

TEACH GEOSPATIAL CONTENT IN GEOSPATIAL-RELATED PROGRAMS

To strengthen the talent pipeline, geospatial content should be **embedded beyond traditional geospatial-specialized programs into geospatial-related disciplines where geospatial skills are increasingly relevant**. Expanding exposure in this way helps institutions reach students who may not initially consider geospatial as a career path, but whose technical or analytical backgrounds align well with the field's evolving workforce needs.

Postsecondary institutions can do this through **targeted electives, interdisciplinary modules, and guest speakers from industry and government**. For example, in 2024 the University of Missouri–St. Louis's Department of Computer Science hosted a guest lecture from NGA for students in adjacent fields to explore geospatial career paths relevant to computer science.[46]

Efforts like these should continue and expand because they **make the geospatial field more visible, accessible, and tangible to a broader student population**. They help students see how broad majors (e.g., computer science, environmental studies) can translate into specialized geospatial careers. Over time, this exposure can **expand the**

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[45] https://www.esri.com/training/catalog/690a491c702c5f8cd44fd45a/introduction-to-ai-in-arcgis/
[46] https://calendar.umsl.edu/event/special-guest-lecture-national-geospatial-intelligence-agency-history-and-mission

pool of students prepared to enter geospatial roles and better align academic preparation with workforce demand.

EMPHASIZE INTERDISCIPLINARY, SECTOR-SPECIFIC APPLICATIONS

As domain context becomes increasingly important for the future workforce, geospatial programs should **place greater emphasis on interdisciplinary and sector-specific applications**. Employers increasingly value professionals who can apply geospatial thinking within a mission, industry, or operational context. One way to do this is by structuring coursework around applied domains (e.g., construction, economic planning, human health, transportation and logistics, urban development).

James Madison University does this through its "Applied Geospatial Information Science" concentration within its Bachelor's in Geography degree. [47] The program includes coursework that pairs geospatial methods with subjects such as environmental issues, natural disaster response, and population geography, helping students connect geospatial to specific use cases and decision-making environments. This kind of interdisciplinary design **strengthens both student readiness and program relevance**.

Similarly, Georgetown University offers an "Advanced Applications in GIS" course through its Master's in Urban and Regional Planning degree, giving students hands-on experience using geospatial analysis to study cities and regions.[48] This elective allows students to **build practical geospatial skills and apply spatial analysis to issues already familiar in their field**, making geospatial skills feel practical and directly relevant to their career interests.

As workforce needs continue to shift, programs that **combine geospatial instruction with applied domain knowledge will be better positioned to prepare students for the next generation of geospatial careers**.

PROVIDE APPRENTICESHIP AND INTERNSHIP OPPORTUNITIES

In addition to postsecondary curriculum, internships and apprenticeships are an effective way to strengthen the connection between academic preparation and workforce entry. These experiences **give students meaningful opportunities to apply and demonstrate their skills in real-world settings, which is a critical factor in hiring geospatial talent**. Research from the Strada Education Foundation found that 73% of graduates who completed a paid internship secured a first job requiring a degree, compared with 44% of those without an internship.[49]

Employers can strengthen this pathway by designing paid internships, apprenticeships, and applied projects around a **focused set of observable competencies needed in**

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[47] https://catalog.jmu.edu/preview_program.php?catoid=62&poid=27200
[48] https://scs.georgetown.edu/programs/356/master-of-professional-studies-in-urban-regional-planning/course-schedule
[49] https://www.strada.org/focus-areas/work-based-learning

the future workforce (e.g., reproducibility, stakeholder communication). In parallel, academic institutions can update credentialing models, so these work-based experiences count toward degree or certificate completion, making programs more responsive to employer demand while reinforcing hands-on learning.

For example, NGA's College Internship Program gives students hands-on experience in geospatial intelligence and has a presence in both St. Louis and Washington, D.C.[50] The program is designed for college students pursuing mission-relevant degrees, making it a strong example of how internships can build directly relevant, employer-recognized skills. Similarly, Gateway Global's Geospatial & IT Workforce and Apprenticeship Campus (GIWAC) in St. Louis provides training, credentials, and apprenticeships in geospatial and IT fields.[51]

By embedding work-based learning more intentionally into the talent pipeline, institutions and industry partners can help students and **professionals gain relevant knowledge and validated experience before entering the workforce**. This, coupled with updating geospatial-specialized credentials to reflect future-focused skills and making them accessible to all populations, close key talent gaps and strengthen talent supply readiness for geospatial careers.

Stage 3: Entering the Workforce

OVERVIEW

This stage focused on individuals entering the workforce. Talent typically enters through two primary pathways: geospatial-specialized entrants who deliberately trained for geospatial work and bring baseline domain knowledge, and geospatial-related professionals who transition from adjacent technical roles with strong transferable skills but less geospatial context.

Whether talent comes from the geospatial-specialized segment or transitions from the geospatial-related segment, entering the workforce is the **shift from learning tools** to **leveraging those tools to produce mission-aligned outputs**. This also means adapting quickly to constraints, such as data governance, accuracy requirements, security protocols, cross-functional team delivery, and sector-specific expectations.

The effectiveness of workforce entry, especially skills-based hiring, onboarding, and ramp-up, **directly affects how quickly new hires can contribute and how successfully organizations can close capability gaps**. Professionals from both the geospatial-specialized and geospatial-related segments can succeed when employers focus on demonstrated skills and provide structured support to accelerate readiness.

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[50] https://www.nga.mil/careers/Student_Opportunities.html
[51] https://www.downtownnorthstl.com/news/giwac-campus-grand-opening

IMPLEMENT SKILLS-BASED HIRING TO EXPAND THE TALENT PIPELINE

Entry pathways that evaluate demonstrated skills can materially widen entry into geospatial-specialized roles and improve hiring outcomes. Today, many employers still screen proxies (e.g., degrees, prior titles, keyword matches), and while these may be appropriate as baseline qualifications for some roles, they are often paired with automated screening processes that can accidentally filter out qualified candidates while advancing others who are not well suited for the job.

In response, the policy environment is shifting to **emphasize skills and competencies over degrees**, where the federal government's Chance to Compete Act of 2024 now requires federal agencies to use technical assessments to fill most competitive service positions.[52] **The geospatial ecosystem across sectors has the real opportunity to lead this shift rather than follow it by**:

- **Using role-based work samples to improve hiring quality**: Ask candidates to submit short, practical deliverables that reflect the job, plus a brief narrative of approach, validation steps, and how results were communicated
- **Keeping roles current with employer input**: Establish an advisory group of hiring managers and technical leads to calibrate what good performance looks like for priority roles, and regularly update scoring rubrics to reflect current tools, workflows, and expectations
- **Develop structured hiring assessments**: Build practical, job-relevant assessments that measure the competencies most predictive of success in the role, allowing candidates to demonstrate capability directly rather than being screened out based on traditional prerequisites

This approach enables employers to tap into the substantial geospatial-related talent pool (e.g., data engineering, software development) and **convert qualified adjacent professionals into job-ready geospatial practitioners far faster than relying on traditional degree pipelines alone**.

SUPPORT EFFECTIVE ONBOARDING AND RAMP-UP

Effective onboarding is a practical way to **reduce early turnover** and **accelerate time-to-contribution for new geospatial hires**, particularly in the first few months when access, expectations, and day-to-day often determine whether a new team member can succeed. According to industry benchmarking, 69% of employees are more likely to stay for three years when they experience great onboarding, while only 12% strongly agree their organization does an excellent job onboarding.[53]

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[52] https://www.opm.gov/about-us/reports-publications/agency-reports/chance-to-compete-act-of-2024-consolidated-report-to-congress.pdf

[53] https://www.gallup.com/workplace/235121/why-onboarding-experience-key-retention.aspx

For many geospatial hires, the learning curve is not just about learning the tools; it is also about **learning how to apply rapidly evolving tools within the context of the role's data, standards, and review processes** so that work is consistent, scalable, and reusable. As automation and GeoAI become more common, onboarding must also build disciplined, repeatable ways of working rather than one-off analytical approaches.

In practice, geospatial organizations can improve early ramp-up by pairing first-day expectations with a practical 30/60/90-day plan tailored to each talent segment. Geospatial employers can operationalize this by:

- **Starting before the first day**: Provide a simple role overview and performance scorecard that outlines delivery expectations. Confirm tool access, share sample datasets, assign a small initial task, and provide a concise list of key contacts and their roles
- **Laying out a practical 30/60/90-day plan**: Begin with shadowing and guided workflows, then transition to independent execution. By Day 90, assign a clearly scoped end-to-end task, with explicit quality and documentation expectations
- **Setting up structured support**: Assign a manager for priorities and weekly check-ins, a buddy for day-to-day navigation, and a technical mentor to transfer standards and best practices
- **Checking progress at set points**: Hold check-ins at two weeks, 30, 60, and 90 days to assess work quality, documentation, responsiveness, and growing independence, then adjust coaching or training as needed

The 30/60/90-day plan should also be tailored by talent segment, accelerating workflow ownership for geospatial-specialized hires while providing a more structured domain ramp-up for geospatial-related hires who need additional context. Once new hires can deliver independently with light oversight, **the focus can shift from onboarding to sustained skill development and longer-term growth**.

Stage 4: Growing Future-Ready Skills

OVERVIEW

This stage sustains the workforce through continuous learning and deeper specialization. Ongoing development helps professionals keep pace with evolving tools, data, and mission demands while preparing them to take on roles that shape standards, quality, and trusted decision-making across geospatial missions.

As geospatial professionals move beyond initial onboarding, their **long-term effectiveness depends on their ability to deliver increasingly complex, mission-relevant outcomes**.

This requires stronger judgment, deeper technical specialization, and the ability to apply geospatial capabilities in real-world operating environments. Because many academic programs still underemphasize emerging capabilities, both academia and employers need to play a more active role in building advanced skills through continuous upskilling.

ON-THE-JOB APPRENTICESHIP AND MENTORING

As geospatial work evolves, organizations **need practical ways to help professionals build new skills on the job through sustained, applied development**. Organizations can strengthen emerging skills through:

- **Embedding apprenticeship and mentoring**: Pair early- and mid-career practitioners with senior experts on real deliverables (e.g., imagery workflows, geocoding quality assessments, pipeline automation) to reinforce discipline around quality thresholds, uncertainty, and validation
- **Using structured applied learning models**: Combine short bootcamps with coached application on mission datasets, so learning translates into repeatable, mission-grade performance rather than remaining theoretical
- **Building communities of practice and use case libraries**: Curate mission-relevant examples and establish reusable patterns, templates, and checklists to promote consistency, speed, and alignment to organizational standards

These mechanisms help **geospatial professionals build the analytic rigor, communication habits, and judgment required to operate reliably in increasingly AI-enabled environments**. They also cultivate the stewardship behaviors (e.g., data quality, governance, metadata discipline) that employers consistently identify as critical for trusted geospatial outcomes.

REDESIGN THE GEOSPATIAL WORKFORCE FOR AI-DRIVEN DELIVERY

While apprenticeships and mentoring are effective for transferring existing knowledge and leading practices, the rise of AI in geospatial delivery presents a more fundamental challenge that requires rethinking the very structure of work itself. As AI becomes embedded in geospatial delivery, the workforce challenge is no longer teaching employees how to use new tools. **AI is fundamentally changing how work is structured**, shifting routine tasks into automated and AI-assisted workflows while increasing the importance of human judgment in governance, validation, and decision support. In this environment, **roles, workflows, job architectures, and operating models designed for pre-AI work can create friction**, making it harder for the geospatial workforce to understand how their responsibilities are changing and what that means for long-term career growth.

To adapt, geospatial organizations should consider:

- **Redesigning work around AI, rather than retrofitting AI into legacy processes**: Deloitte's 2026 Global Human Capital Trends Report shows that

organizations that intentionally redesign work to integrate AI are twice as likely to exceed their Return on Investment expectations.[54] This involves reconfiguring workflows so AI handles repeatable processing and pattern detection, while people focus on higher-value activities such as quality review, exception handling, contextual interpretation, and mission decision support

- **Building governance and accountability for AI-assisted decisions**: As AI takes on a larger role in producing outputs, organizations should define who is responsible for validation, review thresholds, exception escalation, and the appropriate use of AI-generated insights
- **Giving the workforce a visible path forward through role transitions**: To counter the uncertainty that AI can create, it's crucial to publish clear career paths and internal mobility options. This shows how legacy roles can evolve into higher-value positions, such as lead analyst, GeoAI specialist, or architect, and helps "futureproof" the workforce for rapid shifts in the industry

To make this transition tangible for the workforce, organizations **can illustrate how legacy roles will evolve into higher-value, AI-enabled positions**. For example, a GIS analyst who manually digitizes features, performs routine geoprocessing, and creates static maps can evolve into an AI-enabled geospatial solutions specialist who manages automated pipelines, validates AI outputs, advises stakeholders on applying dynamic spatial insights, and identifies new opportunities to leverage AI.

By redesigning work, clarifying accountability, and making role transitions visible, organizations can reduce friction in the shift to AI-driven delivery while giving the workforce a more credible path into higher-value geospatial work. Creating this path forward also **requires building a sustainable talent pipeline and providing the current workforce with access to continuous learning**, which makes strategic educational partnerships a critical component of any long-term talent strategy.

EDUCATIONAL PARTNERSHIPS FOR CONTINUOUS UPSKILLING

As geospatial professionals grow into more advanced roles, academic institutions play a powerful role in sustaining their development beyond the early-pipeline education they provide in Stage 2: Building Geospatial Skills. To strengthen long-term regional geospatial readiness in Washington, D.C. and St. Louis, **universities should partner with employers to deliver continuous, market-aligned learning by**:

- **Co-developing applied labs**: Embed mission-realistic constraints (e.g., data sensitivity, quality thresholds, time pressure) so training mirrors operational requirements

[54] https://www.deloitte.com/us/en/insights/topics/talent/human-capital-trends/2026/human-ai-interaction-design.html

- **Offering stackable, modular upskilling options**: Provide short, employer-informed courses that let working professionals build advanced skills incrementally
- **Maintaining alumni upskilling pipelines**: Offer ongoing access (e.g., learning subscriptions, periodic skills assessments) informed by industry to keep talent current as tools and needs evolve
- **Providing specialized opportunities**: Partner with employers to define in-demand specialty tracks for advanced careers (e.g., geomatics, photogrammetry) and align electives, projects, and credentials accordingly

For example, USGIF formed the University Academic Consortium (UAC) to support NGA's GEOINT Learning through Academic Programs (GLAP) initiative. Through coordination among USGIF, UAC universities, and NGA, GLAP delivers condensed GEOINT training and supports a two-way exchange of industry and educator input on curriculum and pedagogy, **helping geospatial education stay aligned to mission needs and evolving workforce demand**.[55] Employers can reinforce this model by supporting employee participation in geospatial upskilling programs through dedicated time and benefits (e.g., professional development leave, paid time off).

These approaches help professionals refresh and deepen skills without needing to pursue additional full degrees mid-career, **keeping the regional workforces adaptable, future-ready, and employer-aligned**.

EXTERNAL LEARNING OPPORTUNITIES

To broaden technical perspective and support continuous development, employers should **sponsor external learning opportunities, and professionals should participate in them regularly**, including:

- **Cross-sector conferences**: Expose practitioners to new tools, analytic techniques, and innovations beyond day-to-day work to provide visibility into how geospatial is applied across sectors (e.g., construction and utilities, human health, transportation and logistics). For instance, the DMV GIS Day brings together leaders across government, academia, and industry to showcase cross-sector innovation[56]
- **Professional associations and geospatial communities**: Groups such as USGIF, FedGeoDay, GeoSTL, and academia–industry partnerships provide sustained connection to the broader ecosystem, offering exposure to real mission problems, employer demand signals, certification pathways, and emerging technologies. NGA can help shape this ecosystem through sustained engagement (e.g., signaling priority future skill sets, participating in convenings),

[55] https://usgif.org/usgif-assembles-academic-consortium/
[56] https://projectgeospatial.org/coverage/dmv-gis-day-2025

enabling these communities to keep programming and training aligned with mission and workforce needs

By engaging with the broader ecosystem, practitioners stay current with evolving capabilities and bring back relevant, actionable methods that strengthen the quality and impact of organizational geospatial delivery.

Taken together, these recommendations show that **closing geospatial talent gaps and building a future-ready workforce will require coordinated action across the entire talent lifecycle**, with employers, educators, and ecosystem partners each playing a role in strengthening readiness, relevance, and resilience over time. Without that sustained effort, **organizations will struggle to meet growing demand, keep pace with technological change, and fully realize the value of geospatial capabilities**.

This study was conducted at the direction of the United States Government and in support of the Geospatial Workforce Development Program by Deloitte Consulting LLP.

APPENDIX

Appendix

Appendix Figure 1: Metropolitan Statistical Areas

Washington, D.C. Metropolitan Statistical Area



23 Counties/Cities

West Virginia

Jefferson

Maryland

Calvert | Charles | Frederick | Montgomery | Prince George's

District of Columbia

Virginia

Albemarle | Arlington | Alexandria | Clarke | Fairfax | Fauquier | Loudoun | Prince William | Spotsylvania | Stafford | Warren | Fairfax | Falls Church | Fredericksburg | Manassas | Manassas Park

St. Louis Metropolitan Statistical Area



15 Counties/Cities

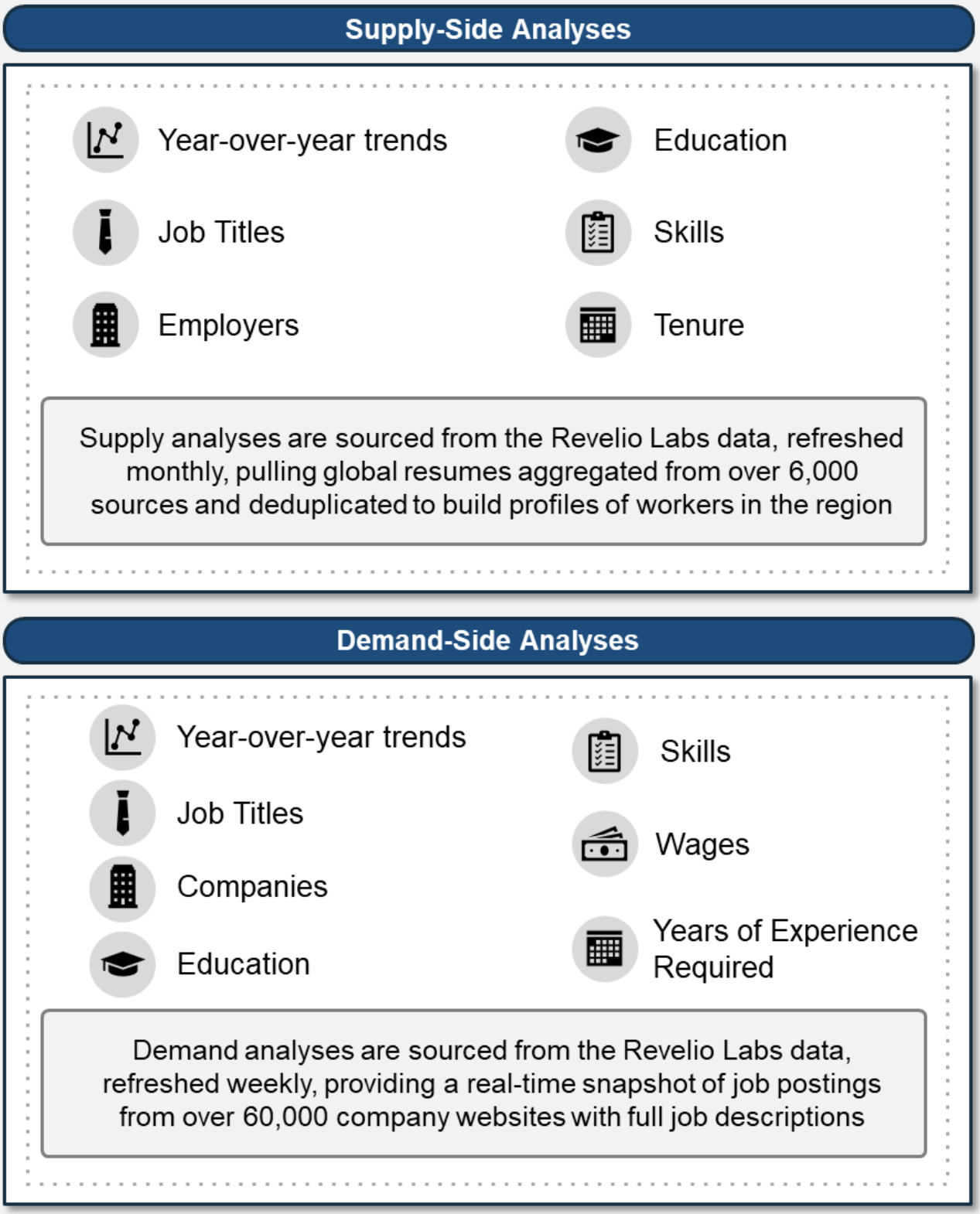
Missouri

Franklin | Jefferson | Lincoln | St. Charles | St. Louis | St. Louis City | Warren

Illinois

Bond | Calhoun | Clinton | Jersey | Macoupin | Madison | Monroe | St. Clair

Appendix Figure 2: Quantitative Analysis High Level Methodology



Appendix Figure 3a: 14 ONET Codes for Geospatial-Specialized Segment

Title	ONET	Description
Cartographers & Photogrammetrists	17-1021.00	Collect, measure, and interpret geospatial data
Geodetic Surveyors	17-1022.01	Measure the Earth's surface using satellite observations or related sources
GIS Technologists and Technicians	15-1299.05	Develop/maintain GIS data & applications
Geographers	19-3092.00	Study the nature and use of areas of the Earth's surface.
Geological Technicians	19-4043.00	Assist scientists or engineers in the use of electronic, sonic, or nuclear measuring instruments to obtain data
Geoscientists	19-2042.00	Study the composition, structure, and other physical aspects of Earth
Geospatial Information Scientists	15-1299.02	Research/design geospatial tech solutions
Hydrologists	19-2043.00	Research the distribution, circulation, and physical properties of underground and surface waters
Hydrologic Technicians	19-4044.00	Collect and organize data concerning the distribution and circulation of ground and surface water
Remote Sensing Scientists & Technologists	19-2099.01	Apply remote sensing principles and methods to analyze data and solve problems
Remote Sensing Scientists & Technicians	19-4099.03	Operate sensors/analyze remote sensing data
Surveyors	17-022.00	Provide data relevant to the shape, contour, gravitation, location, elevation, or dimension of land or land features
Surveying & Mapping Technicians	17-3031.00	Collect data for construction, mapmaking
Survey Researchers	19-3022.00	Plan, develop, or conduct surveys

Appendix Figure 3b: 93 Keywords for Geospatial-Specialized Segment



ArcGIS

Bathymetry
- bathymetric
- bathymetrist
- seafloor mapping
- depth sounding

Cadastral Mapping
- cadastral
- cadastre
- parcel mapping
- land registry mapping

Cartography
- cartographic
- cartographer
- cartogram

Data fusion
- fused data
- fuse (data)
- sensor fusion

Elevation Model
- elevation raster

ESRI

GeoAI
- geographic AI
- geospatial AI
- AI-assisted mapping

Geocode
- geocoding

Geodatabase

Geofence
- geofencing
- location-based fence

Geodesy
- geodetic
- geodesist
- reference ellipsoid
- terrestrial reference frame
- coordinate reference system

Geographic Information Systems
- GIS

Geoinformatic
- geodata informatics

Geomatic

Geoprocessing

Georeference
- georeferencing
- control points
- georectification
- orthorectification

Geospatial

Geostatistics
- geostatistical
- geostatistician
- variogram
- kriging
- Interpolation

Global Navigation Satellite Systems
- GNSS
- precise positioning
- satellite positioning

Hyperspectral
- imaging spectroscopy
- spectral signature
- spectral unmixing

LIDAR (*all capitalization combinations)*

Photogrammetric
- photogrammetry
- photogrammetrist
- orthomosaic
- orthoimage
- structure-from-motion

Remote sensing
- remotely sensed
- Earth observation
- EO data
- sensor data
- mage classification

Satellite Image
- satellite-derived
- satellite-based
- imagery analyst
- imagery analysis
- image interpretation
- EO imagery
- imagery exploitation

Spatial

Spatial Analysis
- proximity analysis
- hotspot analysis

Surveying

Topography
- topographic
- topographer

Triangulated Irregular Network
- surface triangulation

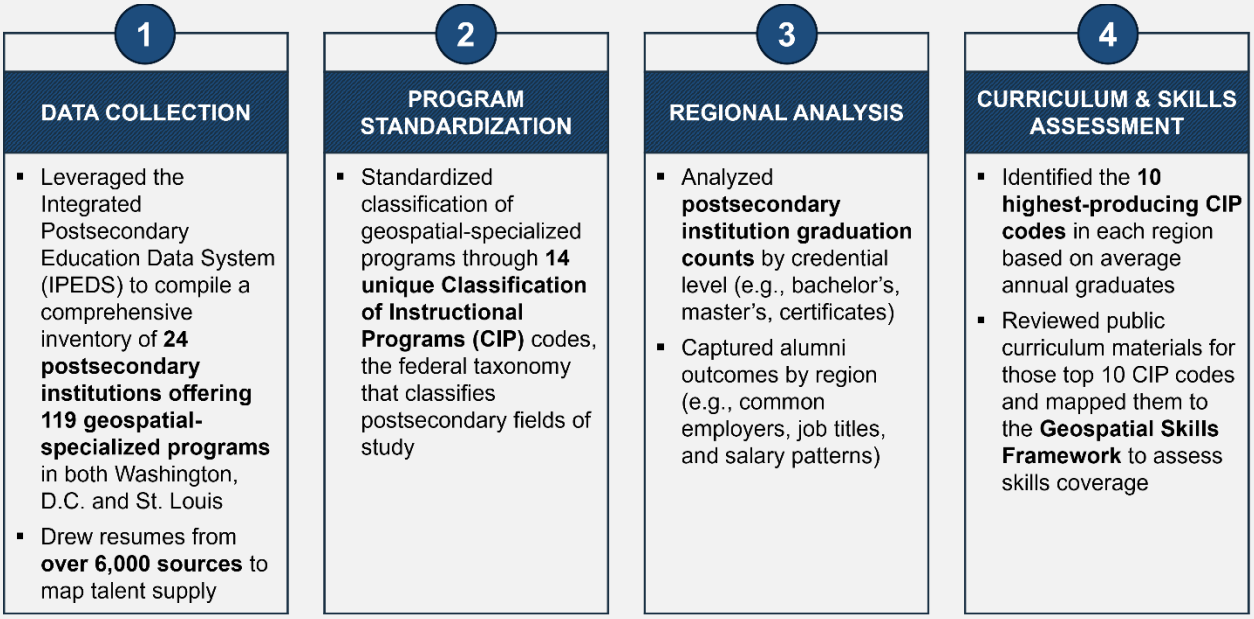
Appendix Figure 4: 32 ONET Codes for Geospatial-Related Segment

Title	ONET	Description
Aerospace Engineering and Operations Technologists and Technicians	17-3021.00	Operate, install, adjust, and maintain equipment used to track, position, and evaluate air and space vehicles
Aerospace Engineers	17-2011.00	Perform engineering duties in testing aircraft, missiles, and spacecraft
Agricultural Engineers	17-2021.00	Apply engineering technology to problems concerned with power, machinery, structures, social, water conservation
Civil Engineers	17-2051.00	Perform engineering duties in planning, designing, and overseeing construction and maintenance of structures
Computer Hardware Engineers	17-2061.00	Research, design, develop, test computer equipment
Engineers	17-2199.00	N/A
Environmental Engineers	17-2081.00	Research, design, plan engineering duties in the prevention and remediation of environmental hazards
Mining & Geological Engineers	17-2151.00	Conduct subsurface surveys to identify the characteristics of ground support systems, processes and equipment and areas for unsafe geological conditions
Water/Wastewater Engineers	17-2051.02	Prepare environmental documentation for water resources, regulatory program compliance, data management and analysis, and field work. Perform hydraulic modeling
Atmospheric and Space Scientists	19-2021.00	Investigate atmospheric phenomena and interpret meteorological data gathered by surface and air stations, satellites, and radar
Physicists	19-2012.00	Conduct research into physical phenomena, develop theories on the basis of observation and experiments, and devise methods to apply physical laws and theories
Physical Scientists	19-2099.00	N/A

Title	ONET	Description
Urban and Regional Planners	19-3051.00	Develop comprehensive plans and programs for land use
Business Intelligence Analysts	15-2051.01	Research/design geospatial tech solutions
Data Scientists	15-2051.00	Apply data mining, data modeling, natural language processing, and machine learning to extract and analyze information from large structured and unstructured data sets
Database Administrators	15-1242.00	Administer, test, and implement computer databases, applying knowledge of database management systems
Database Architects	15-1243.00	Design strategies for enterprise databases, data warehouse systems, and multidimensional networks
Data Warehousing Specialists	15-1243.01	Design, model, or implement corporate data warehousing activities
Statisticians	15-2041.00	Develop or apply mathematical or statistical theory and methods to collect, organize, interpret, and summarize numerical data to provide usable information
Mathematicians	15-2021.00	Conduct research in fundamental mathematics or in application of mathematical techniques to science, management, and other fields
Mathematical Science Occupations	15-2099.00	N/A
Computer and Information Research Scientists	15-1221.00	Develop solutions to problems in the field of computer hardware and software
Computer Network Architects	15-1241.00	Perform network modeling, analysis, and planning, including analysis of capacity needs for network infrastructures
Computer Network Support Specialists	15-1231.00	Analyze, test, troubleshoot, and evaluate existing network systems

Title	ONET	Description
Computer Programmers	15-1251.00	Create, modify, and test the code and scripts that allow computer applications to run
Computer Systems Analyst	15-1211.00	Analyze science, engineering, business, and other data processing problems to develop and implement solutions to complex application problems
Computer Systems Engineers and Architects	15-1299.08	Design and develop solutions to complex applications problems
Information Security Analysts	15-1212.00	Plan, implement, upgrade, or monitor security measures for the protection of computer networks and information
Information Security Engineers	15-1299.05	Develop and oversee the implementation of information security procedures and policies. Build, maintain, and upgrade security technology
Operations Research Analysts	15-2031.00	Collect and analyze data and develop decision support software, services, or products
Network and Computer Systems Administrators	15-1244.00	Install, configure, and maintain an organization's local area network, wide area network, data communications network, operating systems, and physical and virtual servers
Software Developers	15-1252.00	Research, design, and develop computer and network software, or specialized utility programs

Appendix Figure 5: Postsecondary Institution Landscape Analysis Methodology



Appendix Figure 6: 24 Postsecondary Institutions with Geospatial-Specialized CIP codes

Region	Postsecondary Institution
Washington, D.C.	Community College of Baltimore County
Washington, D.C.	Coppin State University
Washington, D.C.	George Mason University
Washington, D.C.	George Washington University
Washington, D.C.	Harford Community College
Washington, D.C.	James Madison University
Washington, D.C.	Johns Hopkins University
Washington, D.C.	Montgomery College
Washington, D.C.	Northern Virginia Community College
Washington, D.C.	Towson University
Washington, D.C.	United States Naval Academy
Washington, D.C.	University of Mary Washington
Washington, D.C.	University of Maryland, Baltimore County

Region	Postsecondary Institution
Washington, D.C.	University of Maryland, College Park
Washington, D.C.	Virginia Polytechnic Institute and State University
St. Louis	Lindenwood University
St. Louis	Missouri University of Science and Technology
St. Louis	Principia College
St. Louis	Saint Louis University
St. Louis	Southern Illinois University Edwardsville
St. Louis	University of Illinois at Urbana-Champaign
St. Louis	University of Missouri
St. Louis	University of Missouri–St. Louis
St. Louis	Washington University in St. Louis

Appendix Figure 7: Geospatial-Specialized CIP codes

CIP Title	CIP Code	Description
Geographic Information Science and Cartography	45.0702	A program that focuses on the systematic study of map-making and the application of mathematical, computer, and other techniques to the analysis of large amounts of geographic data and the science of mapping geographic information. Includes instruction in cartographic theory and map projections, computer-assisted cartography, geographic information systems, map design and layout, photogrammetry, air photo interpretation, remote sensing, spatial analysis, geodesy, cartographic editing, and applications to specific industrial, commercial, research, and governmental mapping problems
Geography	45.0701	A program that focuses on the systematic study of the spatial distribution and interrelationships of people, natural resources, plant and animal life. Includes instruction in historical and political geography, cultural geography, economic and physical geography, regional science, cartographic methods, remote sensing, spatial analysis, and applications to areas such as land-use planning, development studies, and analyses of specific countries, regions, and resources
Geography and Environmental Studies	30.4401	A program that focuses on interactions between people and the natural and built environments. Includes instruction in climate science, sustainability, environmental science and policy, research methods, geographic information systems (GIS), human geography, physical geography, remote sensing, and public policy
Geography, Other	45.0799	Any instructional program in geography not listed in 45.07 parent category
Geological and Earth Sciences/ Geosciences, Other	40.0699	Any instructional program in geological and related sciences not listed in 40.06 parent category
Geological/ Geophysical Engineering	14.3901	A program that prepares individuals to apply mathematical and geological principles to the analysis and evaluation of engineering problems, including the geological evaluation of construction sites, the analysis of geological forces acting on structures and systems, the analysis of potential natural resource

CIP Title	CIP Code	Description
		recovery sites, and applied research on geological phenomena
Geology/Earth Science, General	40.0601	A program that focuses on the scientific study of the earth; the forces acting upon it; and the behavior of the solids, liquids and gases comprising it. Includes instruction in historical geology, geomorphology, and sedimentology, the chemistry of rocks and soils, stratigraphy, mineralogy, petrology, geostatistics, volcanology, glaciology, geophysical principles, and applications to research and industrial problems
Geophysics and Seismology	40.0603	A program that focuses on the scientific study of the physics of solids and its application to the study of the earth and other planets. Includes instruction in gravimetric, seismology, earthquake forecasting, magnetrometry, electrical properties of solid bodies, plate tectonics, active deformation, thermodynamics, remote sensing, geodesy, and laboratory simulations of geological processes
Geotechnical and Geoenvironmental Engineering	14.0802	A program that prepares individuals to apply geotechnical engineering methods, which deal with the analysis, design and construction of earth and earth supported structures, to the application of environmental problems, such as waste containment, waste disposal, construction of land fills, soil permeation, soil analysis, and soil improvement. Includes instruction in soil mechanics, soil dynamics, soil behavior, waste management and containment systems, geosynthetics, geochemistry, earth structures, geoenvironmental engineering, geotechnical engineering, earthquake engineering, and foundation engineering
Hydrology and Water Resources Science	40.0605	A program that focuses on the scientific study of the occurrence, circulation, distribution, chemical and physical properties, and environmental interaction of surface and subsurface waters, including groundwater. Includes instruction in geophysics, thermodynamics, fluid mechanics, chemical physics, geomorphology, mathematical modeling, hydrologic analysis, continental water processes, global water balance, and environmental science
Oceanography, Chemical and Physical	40.0607	A program that focuses on the scientific study of the chemical components, mechanisms, structure, and movement of ocean waters and their interaction with

CIP Title	CIP Code	Description
		terrestrial and atmospheric phenomena. Includes instruction in material inputs and outputs, chemical and biochemical transformations in marine systems, equilibria studies, inorganic and organic ocean chemistry, oceanographic processes, sediment transport, zone processes, circulation, mixing, tidal movements, wave properties, and seawater properties
Signal/Geospatial Intelligence	29.0203	A program that focuses on the theory, technology and operational aspects of collecting, processing and exploiting remote-sensed, radar, acoustic and other forms of signals intelligence. Includes instruction in applied physics, wave propagation and capture, radar systems, acoustics and underwater systems, infrared systems, synthetic aperture systems, collection and processing systems, signal phenomenology, signal analysis and exploitation, and applications to specific intelligence problems
Surveying Engineering	14.3801	A program that prepares individuals to apply scientific and mathematical principles to the determination of the location, elevations, and alignment of natural and manmade topographic features. Includes instruction in property line location, surveying, surface measurement, aerial and terrestrial photogrammetry, remote sensing, satellite imagery, global positioning systems, computer applications, and photographic data processing
Surveying Technology/ Surveying	15.1102	A program that prepares individuals to apply mathematical and scientific principles to the delineation, determination, planning and positioning of land tracts, land and water boundaries, land contours and features; and the preparation of related maps, charts and reports. Includes instruction in applied geodesy, computer graphics, photointerpretation, plane and geodetic surveying, mensuration, traversing, survey equipment operation and maintenance, instrument calibration, and basic cartography

Appendix Figure 8: 16 Industry Certifications

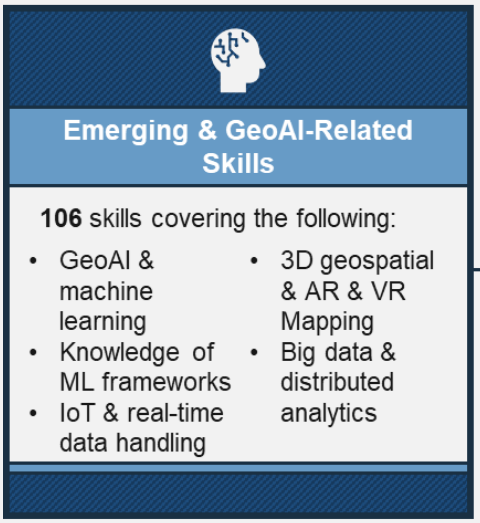
Industry Certification	Description
American Society for Photogrammetry and Remote Sensing (ASPRS) Certified Mapping Scientist (GIS/LIS)	GIS/LIS program and system design, data management, and GIS application of mapping standards; exam-based with an experience requirement
ASPRS Certified Mapping Scientist (LiDAR)	LiDAR data acquisition concepts, point cloud processing/classification, accuracy/quality management, deliverable generation; exam-based with an experience requirement
ASPRS Certified (Photogrammetry)	Photogrammetric project workflows (e.g., control, aerotriangulation, stereocompilation), accuracy standards, production management; exam-based with an experience requirement
ASPRS Certified Mapping Scientist (Remote Sensing)	Remote sensing principles (e.g., sensor/data characteristics, image preprocessing/analysis, production workflows); exam-based with an experience requirement
ASPRS Certified Technologist (GIS/LIS)	Applied GIS/LIS operations (e.g., editing, geoprocessing, data QA, map production), practical workflow execution; exam-based with an experience requirement
ASPRS Certified Technologist (LiDAR)	Applied LiDAR production tasks (e.g., processing, classification, derivative products), operational workflow execution; exam-based with an experience requirement
ASPRS Certified Technologist (Photogrammetry)	Applied photogrammetry production tasks (e.g., control usage, measurement/compilation, orthorectification workflows), operational workflow execution; exam-based with an experience requirement
ASPRS Certified Technologist (Remote Sensing)	Applied remote sensing workflows (e.g., classification, feature extraction, map products), operational execution; exam-based with an experience requirement
Environmental Systems Research Institute (Esri) Technical Certifications	ArcGIS platform capability by role (e.g., user workflows, administration, solution implementation); typically proctored, exam-based per certification
Federal Aviation Administration (FAA) Part 107 Remote Pilot Certificate	Required for commercial drone operations, commonly used in mapping programs; knowledge test for initial certification with recurrent knowledge requirement

Industry Certification	Description
GIS Certification Institute (GISCI) Professional (GISP)	Professional GIS practice and core knowledge; exam-based with requirements for a full portfolio and four years of experience
GISCI PreGISP	Foundational GIS knowledge; exam-based with lighter professional documentation than GISP
NGA GEOINT Professional Certification Fundamentals (GPC-F)	GEOINT fundamentals; exam-based and applies to all cleared DOD personnel in GEOINT-related work roles
NGA GEOINT Professional Certifications (specialties)	Specialty credentials (e.g., geospatial analysis, imagery analysis, cartography); typically requiring clearance and prerequisite conditions
National Society of Professional Surveyors (NSPS) Certified Survey Technician (CST)	Surveying technician competencies by level (e.g., field procedures, computations, drafting/CAD, records, QA/QC); exam-based, multiple levels
United States Geospatial-Intelligence Foundation (USGIF) Certified GEOINT Professional (CGP) (*Suspended*)	*As of March 2024, USGIF continues to temporarily and voluntarily suspend the CGP program and is currently reviewing the future of the CGP program*[57] GEOINT knowledge and competency by professional level; exam-based and program availability status-dependent

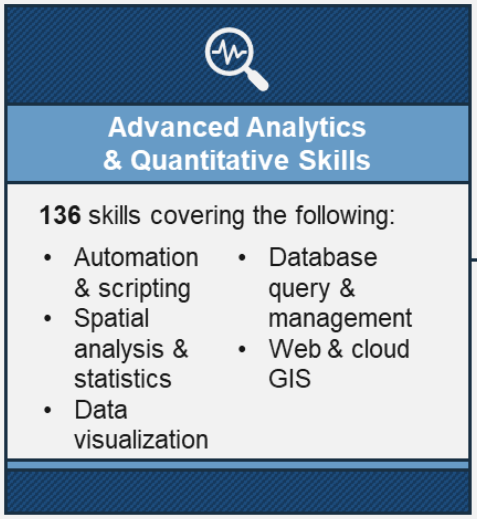
[57] https://usgif.org/certification/

Appendix Figure 9: Skills Alignment by Skills Group





Artificial Intelligence | Machine Learning | Algorithms | Natural Language Processing | Large Language Modeling | Language Model | PyTorch (Machine Learning Library) | Deep Learning | Hugging Face (NLP Framework) | MLOps (Machine Learning Operations) | Sentiment Analysis | Model Tuning | Foundation Models | Computer Vision | Tensorflow | Generative Artificial Intelligence | Machine Learning Algorithms | Neural Networks | Unsupervised Learning | AI Research | Supervised Learning | Dask (Software) | Tokenization | Agentic AI | Text Mining | AWS SageMaker | AIOps (Artificial Intelligence For IT Operations) | Data Classification | Knowledge Graph | Graph Neural Networks (GNNs) | LangChain | Feature Selection | MLflow | Kubeflow | Object Detection | AI Safety | Retrieval Augmented Generation | Mxnet | Feature Extraction | Chatbot | Language Translation | Computational Linguistics | Support Vector Machine | AI Security | Feature Engineering | Recommendation Engine | Machine Translation | Semantic Search | Reinforcement Learning | Vector Database | Recurrent Neural Network (RNN) | AI Innovation | Topic Modeling | LlamaIndex | Data Storage Technologies | Mathematical Optimization | Vertex AI | Image Generation | AI Agents | Database Cluster | Long Short-Term Memory (LSTM) | Artificial Intelligence Markup Language (AIML) | Hierarchical Clustering | Azure OpenAI | Data Preprocessing | Caffe | SpaCy (NLP Software) | Dimensionality Reduction | Text Processing | Text Classification | Image Recognition | Microsoft Cluster Server | CrewAI | BERT (NLP Model) | Artificial Intelligence Systems | Computer Clusters | AI Testing | K-Means Clustering | Amazon Lex | Document Classification | Generative AI Agents | Diffusion Models | Azure AI Studio | Embedded AI | Recommender Systems | AI Alignment | Speech Recognition | Natural Language Understanding | Information Extraction | Data Annotations | Conversational AI | GPT-3 (NLP Model) | Gradient Boosting | Dialogflow (Google Service) | Seaborn | GPT-4 (NLP Model) | Natural Language Toolkits | NLTK (NLP Analysis) | Xgboost | Pattern Recognition | ChatGPT | Cluster Analysis | Scikit-learn (Machine Learning Library) | Prompt Engineering | OpenCV | Artificial Neural Networks



Python (Programming Language) | Bash (Scripting Language) | Shell Script | R (Programming Language) | Geospatial Data Abstraction Library (GDAL) | Arcpy | MapR (Big Data) | Fiona | Visual Design | Digital Dashboards | Visual Modeling | Visual Modeler | Visual Odometry | Dashdb | Data Visualization | Power BI | NoSQL | SQL Server Oracle | Sql Manager | Structured Query Language Procedural Language (SQL PL) | SQL Server Agent | Sql Mode | SQL Services | DB2 SQL | SQL Server Analysis Services | Ansi Sql | SQL Injection | Sqlmap | SAP Sybase SQL | NewSQL | MySQL Workbench | Native SQL | U Sql | SQL Common Language Runtime (SQL CLR) | Embedded SQL | Sql Optimization | Sql View | SQL And Java (SQLJ) | SQL Anywhere | Mini SQL (MSQL) | Standard Sql | SQL-2003 | Spatialite | Tsqlt | SQL Server Express | PostgreSQL | SQL Azure | SQLAlchemy | Transact-SQL | Teradata SQL | SQLite | SQL Server Integration Services (SSIS) | SQL Tuning | Oracle SQL Developer | SQL (Programming Language) | MySQL | Microsoft SQL Servers | Data Modeling | Spatial Intelligence | Geospatial Intelligence | Statistical Modeling | Predictive Modeling | Geospatial Analysis | Atmospheric Modeling | Quantitative Modeling | Systematic Organization Of Spatial Information (SOSI) | Geometric Modeling | Environmental Modeling | Correlation Analysis | Conceptual Data Modeling | Spatial Planning | Spatial Design | Structural Equation Modeling | Weather Modeling | Mplus (Structural Equation Modeling) | Climate Modeling | 4D Modeling (Construction) | Groundwater Modeling | Autocorrelator | Spatial Data Infrastructures | Digital Image Correlation | Atmospheric Dispersion Modeling | Computational Modeling | Thermal Modeling | Econometric Modeling | Spatial Analysis | Microsoft Azure | Google Cloud | Azure Cloud Services | Azure DevOps | Google Cloud Platform (GCP) | AWS CLI (Command Line Interface) | AWS CodeBuild | AWS Lambda | Azure Security | AWS Networking | AWS SDK | AWS Kinesis | AWS Auto Scaling | AWS SageMaker | Azure Monitor | Azure Kubernetes Service | AWS Serverless | AWS Amplify | GeoServer | Azure Policy | AWS Bedrock | OpenLayers | Azure Logic Apps | AWS Fargate | Azure Automation | Azure Pipelines | Azure Event Hubs | AWS AppSync | Azure Synapse Analytics | Azure Web Apps | Azure Sentinel | Google Cloud Security | Azure Service Fabric | AWS Systems Manager | Azure Blob Storage | Azure Service Bus | AWS Elastic MapReduce (EMR) | Google Cloud Messaging | Azure API Apps | Azure API Management | Mapbox | Azure Cosmos DB | Google Earth | AWS CodePipeline | AWS Glue | Azure Data Lake | Azure Data Factory | AWS CloudFormation | Azure Active Directory