Using ‘Real-Time’ Labor Market Information to examine the National Geospatial-Intelligence Agency’s staffing needs in St. Louis

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Executive Summary

The National Geospatial-Intelligence Agency (NGA) anchors St. Louis' emerging geospatial technologies and applications cluster. It employs roughly 3,700 workers (3,150 in St. Louis and 550 in Arnold) in many skilled, high-paying jobs. Attracting and developing a workforce with the specialized skills required to staff this agency will be critical to NGA's current and future success. It is also necessary to establish St. Louis as a leading center for geospatial technology. This white paper uses information drawn from NGA's online job advertisements to provide insights about the agency's workforce needs. It also examines the extent to which other employers, both in St. Louis and in other US metro areas, have similar workforce needs.

Between September 1, 2018 and August 31, 2020 there were 263 job postings at NGA's St. Louis facilities—220 in St. Louis and 43 in Arnold. During this period, the majority of NGA job advertisements displayed a preference for applicants with three common characteristics. These characteristics include a 4-year degree (at minimum), more than 3 years of experience, and—importantly—an ability to acquire and maintain a security clearance.

Overall NGA seeks to fill a wide variety of positions ranging from those requiring deep subject matter expertise (e.g., maritime cartographers) to managerial or administrative positions (e.g., contract administrators) to facilities support jobs (e.g., security guards). However, during the study period the most common job postings were for computer-related occupations. Specifically, NGA most frequently advertised for occupations such as geographer/GIS specialists, User Interface/User Experience designers and developers, software developers and engineers, computer systems engineers, and data scientists.

Many other St. Louis area employers seek these kinds of workers, particularly software developers and computer systems engineers. Nonetheless, the need to fill positions in secure environments makes NGA's workforce needs somewhat more unique. As a result, NGA draws from a similar labor pool as other employers—such as Boeing, Leidos, General Dynamics, Booz Allen Hamilton, or federal agencies like the Department of Veterans Affairs—that also often require security clearances as a condition of employment. Therefore, these employers represent both a source of competition, and a source of potential workers.

The local labor market provides NGA with most of its workforce, but the relative quality of jobs and the required degree of specialization means that it may also draw from a broader labor pool. Both larger (e.g., Washington, DC) and smaller (e.g., Huntsville) metro areas provide similar job opportunities and need similar workers. These other metro areas represent potential competitors for, and sources of, talent. Moreover they also face similar challenges in meeting the demand for these kinds of workers. As a result, St. Louis area stakeholders can learn from these peer metro areas in order to maintain a competitive place in the competition for talent.

Introduction

The National Geospatial-Intelligence Agency (NGA) anchors St. Louis' emerging geospatial technologies and applications cluster.[1] NGA is both an intelligence and combat support agency that provides policymakers, warfighters and intelligence professionals with timely, accurate and actionable geospatial-intelligence.[2] Headquartered in Springfield, VA, NGA has a significant presence in the St. Louis, MO-IL Metropolitan Statistical Area (MSA). It employs roughly 3,700 workers (3,150 in St. Louis and 550 in Arnold) in many relatively high-paying jobs, making it one of the St. Louis metro area's leading employers. Moreover, NGA is expanding its St. Louis footprint with the construction of the $1.7 billion NGA West facility north of downtown St. Louis.[3] Attracting and developing a workforce with the specialized skills required to staff this agency will be critical to NGA's success, but it is also necessary for establishing St. Louis as a center for geospatial technology.

Given the nature of NGA's mission and activities, many of their operational needs are not made public. However, examining NGA job advertisements can provide some insights about the agency's workforce needs. The analysis presented here uses Burning Glass Technologies' *Labor Insight* tool to identify the types of workers NGA seeks to hire.[4] This tool extracts information from online job advertisements to determine the skills, certifications and experience valued by specific industries and employers. It is important to note that these data are about job postings, not actual jobs. One posting might lead to multiple jobs, or employers may run multiple advertisements for hard to fill positions. Nevertheless, the information drawn from these job postings does offer some indication about the workforce needs of employers, industries and regions.

This white paper will use these data to answer several key questions about NGA's staffing needs. As a result, this analysis will identify:

- The most common occupations, experience and skills sought by NGA's St. Louis-based operations,
- Other industries and employers within the St. Louis MSA that hire workers for similar jobs and with similar skills, and
- Other metro areas that exhibit significant demand for workers with similar qualifications.

The information derived from these job postings data will help the region better understand NGA's workforce needs, and the types of employers that draw from the same labor pool. The identification of peer metros can help St. Louis determine potential external sources of labor, as well as identify cities from which St. Louis might learn.

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[1] https://alliancestl.com/work-smarter-in-stl/key-industries/geospatial/

[2] https://www.nga.mil/about/1595956020452_About_Us.html

[3] *GeoFutures: A Strategic Roadmap for Advancing the Geospatial and Location Technology Cluster in the St. Louis Region.* Prepared by Teconomy Partners, LLC. June 2020.

[4] More information about this tool and these data are available in Appendix A.

NGA prefers workers with several common characteristics

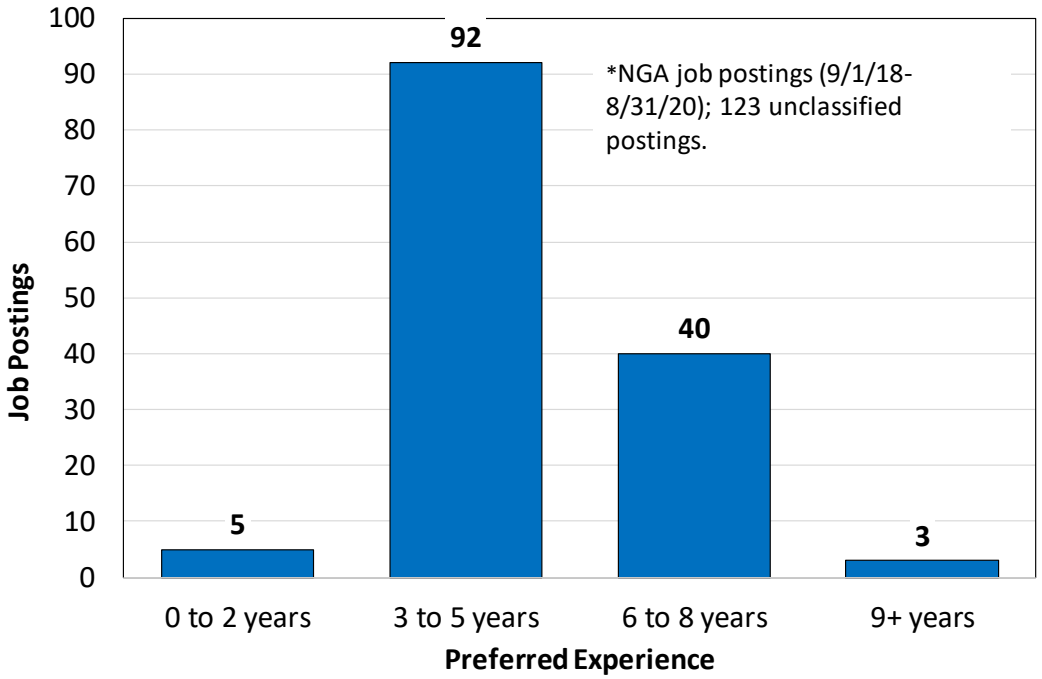
We examined job advertisements for positions specific to NGA's St. Louis and Arnold facilities in the two-year period between September 1, 2018 and August 31, 2020. Once again recognizing that job advertisements are the not the same as jobs, but during that two year period there were 263 job postings at NGA's St. Louis facilities—220 in St. Louis and 43 in Arnold. The pace of NGA's hiring has increased, as 200 of these job advertisements (76 percent) were posted between September 1, 2019 and August 31, 2020.

During this period the majority of NGA job advertisements displayed a preference for applicants with three common characteristics, including:

- **A 4-year degree (at minimum):** 241 of the 263 NGA job postings required applicants to have at least a bachelor's degree (5 postings noted greater education, 5 less, and 17 postings were unspecified). As a result, NGA primarily advertises for positions that require skilled and trained professionals.

- **Experienced workers:** 140 of the 263 NGA job postings provided experience requirements; all but 5 of those job postings sought applicants with at least 3 years of experience (***Figure 1***). Among the postings that listed experience requirements, 65.7 percent wanted applicants with at least 3 to 5 years of experience and 28.6 percent with 6 to 8 years of experience. This is not to say that NGA does not hire workers straight out of university, but we can infer from the job posting data that NGA prefers experienced workers.

Figure 1: Preferred experience level identified in NGA job postings



Source: Burning Glass Technologies LaborInsight

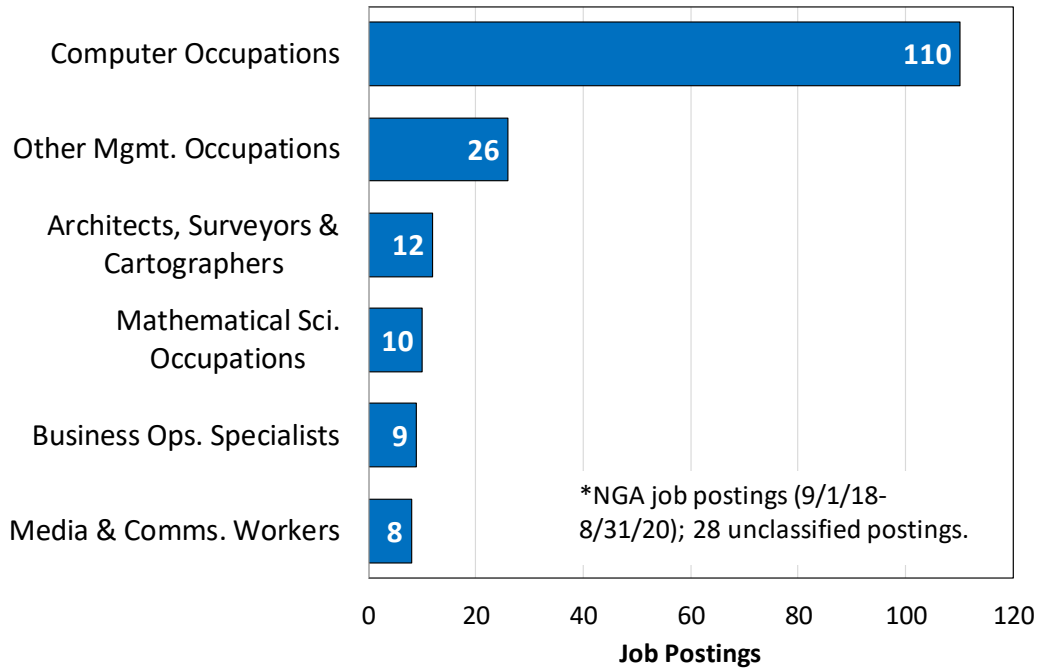
- **An ability to acquire and maintain a security clearance**: Almost every job posting (239/263; 20 unspecified) indicated that the successful candidate must obtain and retain a security clearance as a condition of their employment. This requirement can somewhat limit the applicant pool as people with a criminal record or excessive debt may not be able to meet this requirement. Nevertheless, this requirement also likely draws applicants who currently possess a security clearance or have held one in the past. These applicants may include, for instance, veterans or exiting military, or workers currently employed by other federal agencies or contractors.

These common trends indicate the NGA values highly educated workers with some experience in their field. Moreover, the security clearance requirement indicates that NGA views experience in government broadly, or in defense or intelligence-related activities more specifically, favorably.

NGA seeks workers to fill a variety of jobs, but especially for IT-related positions

NGA seeks to fill a wide variety of positions. These jobs might range from those requiring deep subject matter expertise (e.g., maritime cartographers) to managerial or administrative positions (e.g., contract administrators) to facilities support jobs (e.g., security guards). ***Figure 2*** shows that NGA's most common job postings were for computer-related occupations (SOC 15-1000). Of the 263 job postings advertised between September 2018 and August 2020, 110 were for computer occupations (e.g., software developers). Managerial occupations (SOC 11-9000) and architects, surveyors and cartographers (SOC 17-1000) were the next common types of occupations with 26 and 12 job postings, respectively.

Figure 2: NGA job postings by 3-digit SOC codes



Source: Burning Glass Technologies LaborInsight; 3-Digit Standard Occupational Classification (SOC) codes

These broad occupational groups provide a rough sense of the demand exhibited by the job postings. However, Burning Glass Technologies provides a more detailed and granular set of occupations.[5] Whereas NGA hires for a wide variety of positions, the job postings data show us the positions that NGA most frequently advertised for during the study period. These occupations include:

- **Geographer/GIS specialists** gather, produce and analyze data that can be used in maps or products derived from geographic information systems (GIS).

- **User Interface (UI)/User Experience (EX) designers and developers** design technology that make products easier for people to use. This may involve examining user needs, so that the layout, design and technological features of products or websites improve user accessibility and value.

- **Software developers and engineers** design software programs, write code and/or test, maintain and document programs. Workers in these occupations may specialize in the design of computer applications or computer systems.

- **Computer systems engineers** create computer and data communication networks for companies and organizations.

- **Data scientists** utilize advanced statistical analysis and machine learning techniques to systematically answer questions in order to provide actionable recommendations.

Combined, these five occupations account for over 30 percent of NGA's total job postings during the study period. As noted above, most jobs at NGA seek workers with at least a 4-year degree, some experience, and the ability to receive and maintain a security clearance; those demands apply to each of these occupations. ***Figure 3*** shows the desired experience, common job titles and software and programming skills associated with these select occupations. Within these occupations the job postings show variance, in terms of skills or experience. In some instances, this may indicate different jobs within a given occupation (e.g., photogrammetrist v. cartographer) or different levels of experience sought (e.g., senior v. mid-level). In other instances, however, this may just simply reflect that some job advertisements provide more details than others.

[5] The Burning Glass occupational classifications are based on job function and actual work performed, they provide more detailed information than the US Bureau of Labor Statistics' Standard Occupational Classification (SOC) codes. They are also updated more regularly so as to capture new occupations (e.g., data scientist) that may not yet appear in the BLS SOC codes.

Figure 3: Key occupations identified in St. Louis-based NGA job postings (9/1/18 to 8/31/20)

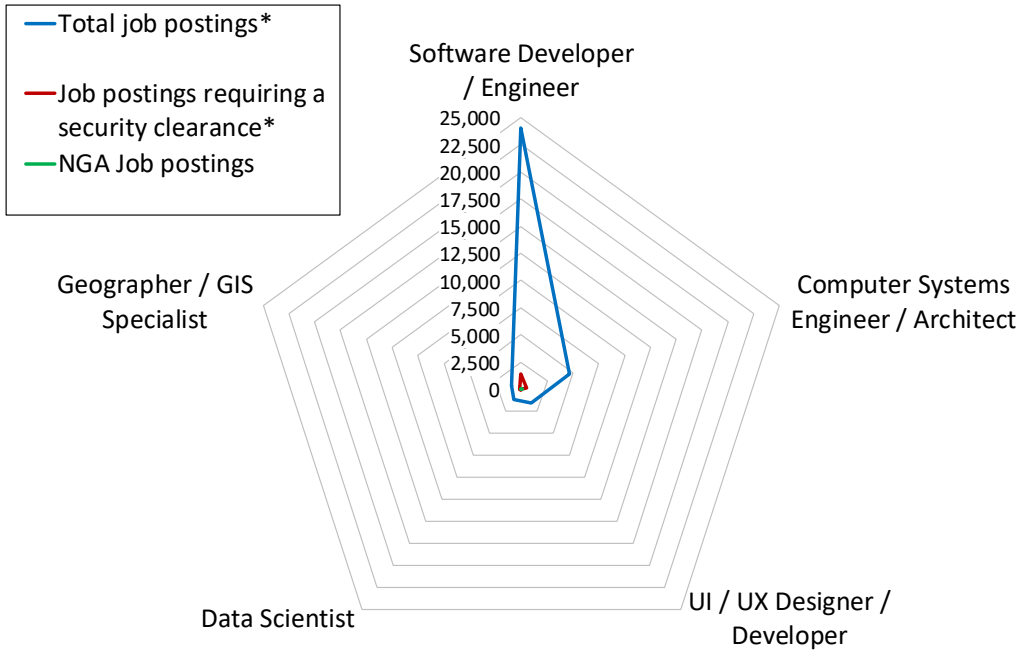
Occupation	Job postings	Desired experience	Common job titles	Selected software & programming skills
GIS analyst	19	• 3-5 years: 7 • 6-8 years: 6 • Unspecified: 6	• Photogrammetrist (5) • Imagery analyst (3) • US military imagery analyst (3) • Cartographer (2)	• ArcGIS (6) • Erdas Imagine (5) • GIS (4)
User experience (UX) designer-developer	18	• 3-5 years: 4 • 6-8 years: 3 • Unspecified: 7	• Mid-level UX architect (9) • UX experience architect (4) • UX experience engineer (1)	• Java (8) • Visual design (7) • Microsoft SharePoint (7) • HTML5 (7) • User Interface (UI) Design (5) • Graphical User Interface (GUI) (3)
Software developer	15	• 0-2 years: 1 • 3-5 years: 4 • 6-8 years: 3 • Unspecified: 4	• IT software developer (3) • Mid-level data analyst (3)	• Python (8) • Javascript (8) • Software engineering (5) • MySQL (4) • Matplotlib (3) • ggplot2 (3) • Tableau (3) • R (3) • MatLAB (3)
Computer systems engineer	15	• 3-5 years: 4 • 6-8 years: 5 • Unspecified: 6	• Systems engineer (14) • Systems architect (1)	• Computer engineering (4) • Agile development (4)
Data scientist	14	• 3-5 years: 4 • 6-8 years: 5 • Unspecified: 5	• Data scientist, mid-level (9) • Data scientist (5)	• Tableau (9) • SQL (9) • Python (9) • Java (9) • ESRI (9) • Matplotlib (8)

Source: Burning Glass Technologies LaborInsight

Other St. Louis area employers advertise for similar employees

NGA is one of many St. Louis area employers seeking IT-related workers. During the study period, there were over 32,000 job postings within the St. Louis, MO-IL MSA for each of the five key occupations mentioned earlier; NGA had a combined 81 job postings for these five occupations. Figure 4 shows that much of this demand was for occupations such as software developers or engineers, and more limited demand for more specialized occupations such as GIS specialists, data scientists and UI/UX Designers. Figure 4 also shows that workers needed to fill positions in secure environments represents an even more specialized segment of the labor force.

Figure 4: Job postings by BGT occupations within the St. Louis, MO-IL MSA



Source: Burning Glass Technologies LaborInsight, 9/1/18 to 8/31/20
**Does not include NGA job postings*

Within these five key occupations, almost 2,300 job postings (7 percent) indicated the need for a security clearance. Overall there were over 11,300 job postings from other firms within the St. Louis, MO-IL MSA (excluding NGA) that identified the need for workers to have, or secure and maintain, a security clearance. This includes companies like Boeing, Leidos, General Dynamics, Booz Allen Hamilton, or federal agencies like the Department of Veterans Affairs. The majority of these job postings were for jobs in either in St. Louis, MO or at Scott Air Force Base in Illinois. Almost 6,175 of these job postings (54 percent) were in computer-related occupations.

These employers all draw from a very similar labor pool as NGA and therefore represent both a source of competition, and a source of potential workers. That said, the nature of this demand (in the St. Louis, MO-IL metro area and during the study period) varies by occupation.

- Excluding NGA, there were over 980 job postings for ***geographers/GIS specialists*** from employers such as Leidos (96 job postings), BAE Systems (41), Booz Allen Hamilton (35), General

Dynamics (27), and H2M Group (26). As with NGA many of these job postings sought to attract candidates with 4-year degrees and experience, but almost 20 percent indicated that workers with less than a 4-year degree and less than two years of experience could apply. Almost 19 percent of the job postings noted the need for a security clearance to maintain employment; most of those job postings came from Booz Allen Hamilton and the majority indicated a preference for applicants with at least three years of experience.

- During the study period, St. Louis area employers posted almost 1,600 job advertisements for ***user experience designers and developers***. Very few of these required a security clearance as a condition of employment. Rather, these job postings come from a wide variety of employers such as professional, scientific and technical services firms like IBM, or finance and insurance companies like Edward Jones or Anthem Blue Cross. Therefore NGA is likely to find candidates with technical experience, but is less likely to find UX designers and developers with experience working in secure environments.

- S***oftware developers and engineers*** are commonly sought throughout the St. Louis economy. This demand comes firms of all sizes, including prominent St. Louis area employers such as Boeing, IBM, MasterCard, Enterprise Rent-a-car, Centene Corporation, Wells Fargo, and World Wide Technology among others. During the study period, there were almost 24,000 job postings for software developers In the St. Louis metro area, but only 1,370 of those job postings (5.7 percent) required a security clearance. The most common source of those job postings originated from defense contractors such as Boeing, Leidos and Booz Allen Hamilton, and the workers that apply to these jobs likely overlap with NGA's potential labor pool.

- The demand for ***computer systems engineers*** is smaller in scale than software developers, but it comes from similar industries and large employers. During the study period, St. Louis area employers posted approximately 4,670 job advertisements for computer systems engineers. Relative to software developers, a greater proportion of these jobs (11.5 percent) indicated that a security clearance was a condition of employment; Boeing accounted for almost 1 in 4 of these job postings. Again, NGA likely draws workers from this same labor pool.

- St. Louis area employers posted roughly 1,140 job advertisements for ***data scientists*** between September 2018 and August 2020. These job postings were found in a wide variety of industries such as management, scientific and technical consulting services (e.g., IBM, Booz Allen Hamilton) or pharmaceutical manufacturing (e.g., Bayer Corporation). The minimum advertised education for data scientist positions tend to be greater than some of the other jobs, as 36 percent of those job postings indicated a preference for candidates with master's or doctoral degrees. Approximately 160 job postings (14 percent) indicated the need for a security clearance.

Demand for these occupations is not unique to St. Louis

The local labor market provides NGA with most of its workforce, but the relative quality of jobs and the degree of specialization required means that it may also draw from a broader labor pool. Identifying other metro areas where employers have similar workforce needs as NGA can serve several purposes. These other metro areas potentially represent competitors for, and sources of, talent. Moreover, these other metro areas face similar challenges in meeting the demand for these kinds of workers. St. Louis area stakeholders, therefore, can learn from the experiences of these peer metros.

Advertisements for five key occupations identified in NGA job postings—geographer/GIS specialists, UI/UX designers and developers, software developers and engineers, computer systems engineers, and data scientists—are often most common in the nation's largest metro areas (e.g., New York, Los Angeles, San Francisco, Dallas-Fort Worth, Washington, DC, etc.). Although these metros may represent potential sources of workers, many workers in these regions may not have experience in the kind of secure work environment found at NGA. In order to identify useful peer metro areas, we first limited our analysis to just those job postings that indicated the need for a security clearance. We subsequently identified the metro areas that 1) had more than 2 percent of the remaining US job postings for each key occupation, and 2) a high relative concentration of these job advertisements (as measured by location quotient).[6]

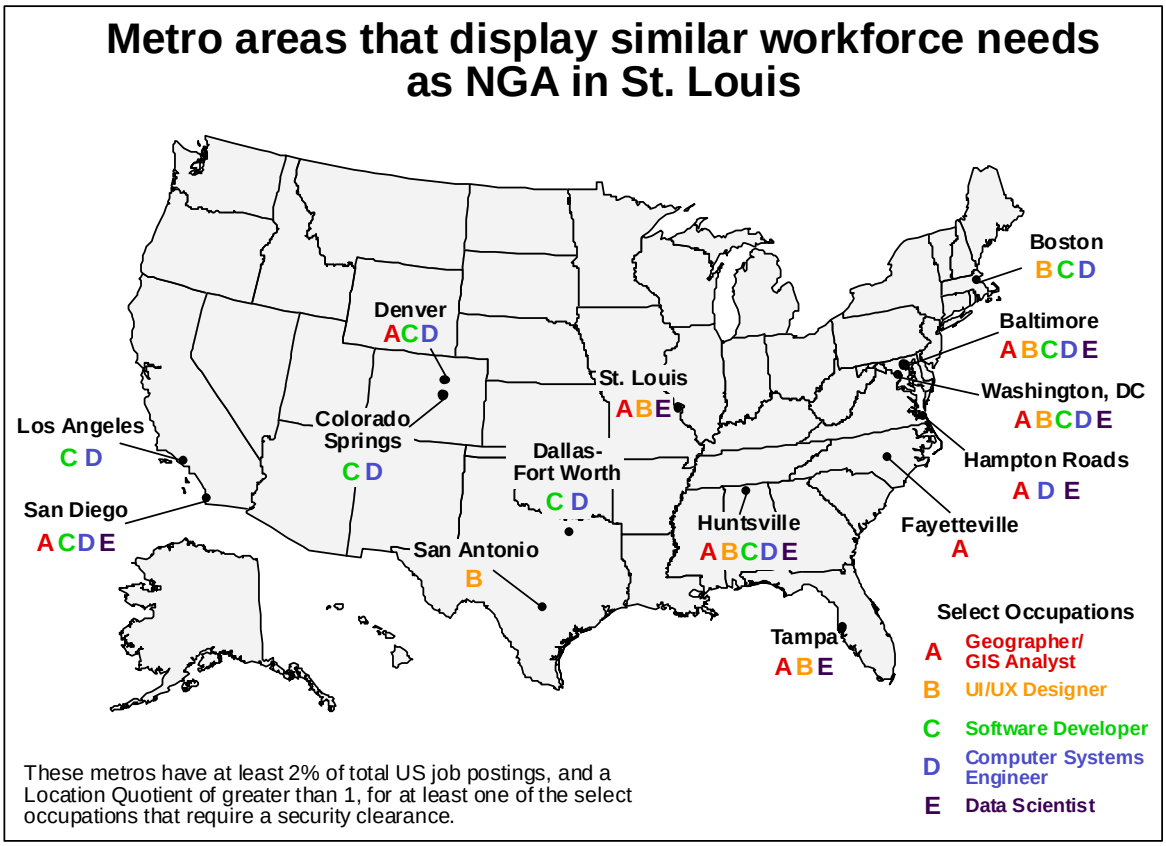
Figure 5 shows the other metro areas that met these criteria for each of the five key occupations. A variety of factors drive the demand for the occupations in each of the different metro areas.

- A large proportion of the nation's defense-related activities and defense contracting (including NGA's headquarters) is found in the ***Washington, DC*** and ***Baltimore, MD***[7] metro areas. Almost 28 percent of all job advertisements requiring a security clearance were from employers in the Washington, DC and Baltimore, MD metro areas. Combined, the National Capital Region is home to large numbers of workers that possess the skills and qualifications that NGA requires. The

[6] Location quotients (LQs) provide a measure of relative concentration. An LQ greater than 1.0 means that the region has a higher share of job postings (among the key occupations that require a security clearance) than the overall national economy. For instance, an LQ of 2.0 means that the relative share of job postings in a given region that met our criteria was two times as great as the national share of job postings. We only included metro areas with LQs greater than 1.

[7] The National Security Agency and prominent government contractors like Leidos are located in the Baltimore metro.

Figure 5:



Source: Burning Glass Technologies, LaborInsight *University of Missouri Extension*

data shows that employers in both Washington, DC and Baltimore posted significant numbers of job advertisements (requiring a security clearance) for all five of the key occupations mentioned above. This region may represent a source of potential workers, not only for NGA but also for St. Louis' broader government contracting community. The Washington, DC metro area has experienced net domestic outmigration since 2013[8], as many residents leave the region for opportunities in regions with lower cost of living.[9]

- Outside of the National Capital Region, ***Huntsville, AL*** is the only other metro that met the criteria described above for all five key occupations. Known as 'Rocket City', Huntsville is home to NASA's Marshall Space Flight Center and US Army's Aviation and Missile Command at the Redstone Arsenal, which in turn are supported by numerous defense contractors. The Huntsville MSA is a relatively smaller metro (population: 455,000; the population of the St. Louis MSA is

[8] As shown by the US Census Bureau's Population and Housing Estimates Program.

[9] The US Bureau of Economic Analysis' Regional Price Parities Index show that in 2018 the relative cost of living in the Washington, DC metro area was almost 18 percent higher than the nation, while the St. Louis metro area was 9 percent lower. The real disparities comes in the cost of housing. Rent in the DC metro area was over 60 percent higher than the nation, while St. Louis rents were almost 20 percent lower than the nation.

approximately 2.8 million), but given its unique workforce needs it likely provides a useful peer metro from which St. Louis might learn.

- Employers in ***San Diego, CA*** posted significant advertisements for jobs requiring security clearances in 4 of the 5 key occupations (all but UI/UX designers). San Diego has a large naval presence and a significant number of defense contractors that helps generate demand for these kinds of positions.

- The ***Hampton Roads*** region (Virginia Beach-Norfolk-Newport News, VA-NC MSA) in Virginia represents another peer region from which St. Louis might learn. It is not only the headquarters of the Atlantic Fleet, but numerous federal facilities (e.g., Langley Air Force Base, Jefferson Labs) are located in the region, and many contractors support those facilities. Employers in this region post significant numbers of advertisements for geographers/GIS analysts, computer systems engineers, and data scientists.

- The ***Tampa-St. Petersburg-Clearwater, FL*** MSA is a similarly sized metro to St. Louis, with relatively similar demand for geographers/GIS analysts, UI/UX designers, and data scientists. As with the other metro areas listed above, the Tampa region has a significant military presence as the US Central Command and US Special Operations Command operate out of MacDill Air Force Base.

- The ***Denver, CO*** metro area is growing much faster, but is another similarly sized city from which St. Louis might learn. The region's employers posted significant numbers of job advertisements (requiring security clearances) for geographers/GIS analysts, software developers, and computer systems engineers. Including demand from employers in the nearby ***Colorado Springs, CO*** metro further adds to the demand for software developers and computer systems engineers.

- Among the five key occupations, software developers and computer systems engineers were most widely sought throughout the economy. Unlike the relatively more specialized occupations (e.g., geographer/GIS analyst), job postings (requiring a security clearance) were less common in St. Louis. Rather postings for these jobs were more commonly found in the nation's larger metro areas such as ***Los Angeles, CA***, ***Dallas-Fort Worth, TX***, and ***Boston, MA***, which tend to have overall deeper pools of tech talent.

Key conclusions

The data presented above provide another way to understand workforce demand. Utilizing information extracted from online job postings, we can begin to identify the types of workers and skills sought by the National Geospatial-Intelligence Agency in St. Louis. The number of NGA job postings have grown over the past year. These job postings show that NGA hires for a wide variety of jobs, but has a particular need for information technology workers. That workers must secure and maintain a security clearance

distinguishes NGA from the broader set of St. Louis employers seeking tech talent. It also somewhat limits the talent pool from which it might potentially draw.

The job postings indicate that NGA seeks to fill some relatively specialized positions (e.g., GIS Analysts, UX designers) as well as some more common needs (e.g., managers), and these needs often overlap with the region's broader defense and government contracting community. These other employers represent both sources of, and competitors for, potential workers. Therefore, growing the St. Louis region's emerging geospatial sector requires much more than just establishing a talent pipeline for NGA. Given the flow of workers between employers in this broader contracting community, the larger goal must be to create an overall deeper talent pool. In fact, the first strategy identified in the *Strategic Roadmap for the St. Louis GeoFutures Initiative*[10] is to scale up talent and workforce development to meet geospatial industry demand. Some of these efforts are already underway. In September 2020, for instance, NGA recently announced that it is collaborating with Harris-Stowe State University to develop the next generation of Science, Technology, Engineering and Math (STEM) educators.[11] These efforts are designed to not only create a deeper talent pool, but a more diverse one as well.

It should also be noted that the kind of workers required to support St. Louis as a geospatial hub are also in-demand from employers in other sectors. In many instances, workers likely possess GIS (e.g., ESRI), programming and database (e.g., Python, R, SGL), and dashboard software (e.g., Tableau) skills. Increasing the number of workers with these combination of skills can generate greater cross-pollination between industries. As a result, concerted efforts to build these skills within the St. Louis labor force will not only benefit firms engage in geospatial-related activities, but also firms in agricultural and life sciences or finance and insurance. Moreover, larger numbers of job opportunities for workers with these skills will not only help keep talent in the region, but also make the region more competitive for mobile workers. As shown above, there are job opportunities for these kinds of workers in larger (e.g., Washington, DC) and smaller (e.g., Huntsville) metro areas across the country. St. Louis must learn from these other metro areas in order to maintain a competitive place in the competition for talent.

[10] *GeoFutures: A Strategic Roadmap for Advancing the Geospatial and Location Technology Cluster in the St. Louis Region.* Prepared by Teconomy Partners, LLC. June 2020.

[11] https://www.nga.mil/news/1600789534821_Future_Press_Release__NGA_Harris-Stowe_State_Unive.html

Appendix A: About the data

This report used 'Real-Time' Labor Market Information (LMI). Real-Time LMI utilizes web technologies to capture and analyze data derived from job postings and resumes available on public websites.[12] Several proprietary vendors produce Real-Time LMI and this study uses data produced by Burning Glass Technologies, one of the more established vendors in this space. The large volumes of data produced by Real-Time LMI vendors can improve our understanding of labor market dynamics. Once aggregated and organized, these data can show which industries are hiring, where jobs are available, and the education, skills, and certifications that employers seek.[13]

These data draw upon information extracted from a variety of public websites including job boards (e.g., Monster, Career Builder), government agencies (e.g. USAjobs.gov), newspaper ads, and corporate websites (large, medium and small). Burning Glass Technologies (the vendor used in this study) pulls job advertisements from 45,000 different sources.[14] Once collected these vendors use text analytics technologies to parse, extract and code data elements such as industries, locations, occupations, job titles, and required education and certifications among others. This information is gathered daily (hence "real-time"), and therefore provides one advantage over more traditional sources of labor market information where there may be lags of months or years between the time the data are collected and when they are subsequently published.

Important caveats when using Real-Time LMI

As with any other data sources, these data come with some caveats. First, it is important to understand what these data say and what they do not say. By looking at online job advertisements, these data reflect employer needs and demands; they do not measure jobs. One job advertisement may lead to multiple jobs or no jobs, or alternatively an employer may run multiple job advertisements in order to attract applicants for a hard to fill position. In addition, many job advertisements offer different levels of detail, so many fields may be left empty due to a lack of information. Also, not all job openings are posted online. As a result, these data often miss many job opportunities in highly unionized environments, industries where there may be a large informal workforce (e.g., construction, agriculture), many smaller employers, or low-paying, entry-level occupations.[15]

Since private vendors generate these Real-Time LMI data, the methods used to produce these data are more opaque than data produced by public data agencies. Nevertheless, these vendors take several steps to improve to improve their overall data quality. Since the job advertisements are read by machines not people, vendors use text analytics to better contextualize the data extracted from job advertisements. This helps differentiate between, for example, a sales representative at Budget Rent-a-car, and a job advertisement asking someone to set budgets. As with many automated processes, this is

[12] https://www.lmiontheweb.org/wp-content/uploads/2020/02/Summary_Brief_-_Real-Time_LMI.pdf

[13] Dorrer, J. *Using Real-Time Labor Market Information to Achieve Better Labor Market Outcomes*. Lumina Foundation Issue Papers, June 2016.

[14] https://help.burning-glass.com/en/articles/3678618-data-job-posting-aggregation-and-deduplication-process

[15] https://help.burning-glass.com/en/articles/3705134-data-source

imperfect. In this study Burning Glass Technologies' *LaborInsight* tool showed that a majority of NGA's job postings sought workers with knowledge of SAP—an enterprise resource planning software developed by the German company SAP, which is commonly used within the manufacturing sector. However, upon reviewing NGA's individual job advertisements we found that SAP in this context referred to Special Access Programs, which are security protocols for managing access to classified information.

Deduplication is another key step that Real-Time LMI vendors take to improve their overall data quality. A single job advertisement can run in a wide variety of locations, as an employer can post jobs on their corporate website, Monster, and/or CareerBuilder among others. Vendors look to eliminate these redundancies, by writing procedures to identify records that have previously been collected. Moreover, their search engines attempt to deduplicate advertisements that have significant number of redundant variables (employer, job title, job ID, posting date, location, etc.). Burning Glass Technologies states that this process eliminated 80 percent of duplicates. These issues must be taken in account when using these data. For instance, in this study we limited our search for NGA job posting to just those specifically originating from the City of St. Louis and Arnold, MO because searching for NGA jobs in the broader St. Louis metro area led to redundant NGA job postings.