The Value of STEM Skills In Every Career

A.I. Skills
SKILLSTORM

Georgia AIM Day

STEM Education Crossroads

STEM Skills are the Future of Our Economy

STEM (Science, Technology, Engineering, and Mathematics) is the foundation of many of the world's most important industries. As Georgia's economy becomes increasingly driven by technology and innovation, students must have a compelling foundation in STEM subjects to be competitive in the job market when they enter the workforce. In fact, Georgia is forecasted to create another 100,000 tech jobs by 2033, bringing the total to more than 450,000 tech jobs in the state.

It is important to note that STEM skills are no longer for STEM careers exclusively. Most professions will require some of the skills traditionally associated with scientists, engineers, and medical professionals. The World Economic Forum now recognizes scientific literacy and ICT (Information and Computer Technology) literacy as two of the six foundational literacies for 21st-century workers.

Employers across all sectors are increasingly looking for digital native candidates who possess strong analytical and technical skills, which are key aspects of STEM education. For example, product development requires a deep understanding of engineering principles and the ability to innovate solutions. In product marketing, data analysis skills are crucial for understanding market trends and consumer behavior.

While the STEM field has been historically male dominated, there is a growing emphasis on diversity and inclusion. Diversity, equity, and inclusion (DEI), in STEM or any other field, gives people of different identities and backgrounds an opportunity to participate and contribute their perspectives. Everyone has something of value to contribute, and it's the responsibility of society to make sure that everyone has an equal opportunity to contribute.

Helping students develop STEM skills will be crucial for their long-term employability and professional journeys in the 21st century. The Technology Association of Georgia Education Collaborative (TAG-Ed) helps facilitate STEM education through annual events such as GA STEM Day and Day of Code, and by providing high school students with placements at innovative companies through our High School Summer Internship Program.

Whether you choose a career in a traditional STEM field or not, a STEM education will undoubtedly provide you with the skills needed to succeed in any field. For more information on upcoming events and educational resources, please visit tagedonline.org.

Larry K. Williams
President
TAG / TAG-Ed

Larry K. Williams serves as the President and CEO of the TAG and the TAG Education Collaborative. TAG-Ed's mission is to strengthen Georgia's future workforce by providing students with relevant, hands-on STEM learning opportunities by connecting Technology Association of Georgia (TAG) resources with leading STEM education initiatives.

Georgia AIM projects make plans for inaugural Georgia AIM Day

Members of the 17 projects and organizations associated with Georgia Artificial Intelligence in Manufacturing (Georgia AIM) recently gathered to plan activities and events celebrating Georgia AIM Day on Oct. 4.

Georgia AIM Day aligns with National Manufacturing Day and is an opportunity to highlight the advanced manufacturing technologies that exist across the state. It's also a day to celebrate innovations in K-12 classes and new programs in workforce development. The Technology Association of Georgia, which now offers a registered apprenticeship program for employers, is a partner with Georgia AIM.

The event planning session was part of a larger two-day meeting for the coalition that recapped recent accomplishments and collaborations across the statewide project. The meeting took place at the Georgia Cyber Innovation & Training Center in Augusta, which is also a partner on the project.

Funded by a $65 million grant from the federal Economic Development Administration, Georgia AIM is a network of projects across the state that work to connect the manufacturing community with smart technologies and a ready workforce. Georgia AIM works across all geographies and demographics to bring traditionally

underrepresented participants to manufacturing spaces, specifically rural residents, women, people of color, veterans, and those without a college degree. Georgia AIM projects include K-12 education, Georgia's technical colleges and universities, workforce education, regional partnerships, nonprofits, and support for emerging technologies and manufacturers.

As the coalition focuses on Georgia AIM Day, the conversation turned to projects across the state that include school robotics teams, career centers adopting advanced technologies, partnerships with manufacturers, innovation showcases, hybrid panels with experts and C-suite executives who have implemented AI, and mobile AI studios.

The final list of ideas, which will then be honed to represent the full range of Georgia AIM's projects across the state,

will be released later this summer.

"This is a unique opportunity to showcase all the ways Georgia AIM is working across the state of Georgia," said Donna Ennis, co-director of Georgia AIM through Georgia Institute of Technology's Enterprise Innovation Institute. "Georgia AIM Day is a celebration of manufacturing in Georgia and the advances we have made to stay ahead of the technology curve."

Schools, businesses, nonprofits and community organizations are welcome to join in the planning. For more details on Georgia AIM Day and to sign up for email updates for future events, visit:

georgiaaim.org/georgia-aim-day

Share this issue with your students, peers, parents and industry professionals you know. Make this a new monthly connection for curiosity, interaction, college prep and career development.

Many parents really enjoy this content as they too pursue their personal life-long learning goals.

Industry and government leaders need to know about this resource as their future employees decide and prepare how to spend their careers.

To understand STEM...

...you must DEFINE STEM, but you cannot define an acronym using the words it stands for; you must define the words the acronym represents.

Universities and organizations around the world continue to debate what a STEM career is. There is no doubt that "every career" uses STEM skills and this observation remains the focus of STEM Magazine.

Science: "The systematic accumulation of knowledge" (all subjects and careers fields)

Technology: "The practical application of science" (all subjects and careers)

Engineering: "The engineering method: a step by step process of solving problems and making decisions" (every subject and career)

Math: "The science of numbers and their operations, interrelations, combinations, generalizations, and abstractions" (every career will use some form[s])

For a moment, set aside any preconceived notions of what you think a STEM career is and use the above dictionary definitions to determine the skills used in any career field you choose.

These definitions are the "real" meaning of STEM and STEM careers.

The *Value* of STEM Skills In Every Career Field

By Wayne Carley

From secretary to scientist, STEM Skills are necessary and used daily in any career you can name. The level and frequency of these skills varies day to day, but the skills remain in tack based on the definition of this acronym. Let's review the definition of the STEM acronym and apply them to several career fields to clarify its importance. There is no doubt that "every career" uses STEM skills and this observation remains the focus of effective STEM education.

Science is defined as - "The systematic accumulation of knowledge". Within every career field, the need to continually "learn" or accumulate knowledge about your employers products,

services, inventory, expansion plans, marketing efforts, policies, new tech and more remains important. To be the most effective employee, the amount of company knowledge you gather in an ongoing manner, makes you a valuable asset.

One example is the largest employer category in the United States – retail sales.

More Americans work in retail sales than any other work category. Using this example, the systematic accumulation of knowledge about your inventory, products, manufacturers you sell, cost changes, styles, trends, marketing campaigns, service and so on, require

this STEM Skill daily and will continue to be necessary as the company changes, grows or shifts focus.

Library science has always been interesting, as the vast amount of knowledge to accumulate requires this strong STEM Skill. Literary works continue to grow in the over 110,000 U.S. libraries in addition to the huge amount of books already in existence that also require familiarity from the library employee. Although computer software has made the search for book topics easier to find, the value of your ability to know your library or bookstore inventory is generally rewarded.

Considering a more traditional science career such as medical research or aerospace technology, the same definition and STEM Skill applies. The need to learn continually within your job responsibilities remains and is vital to your personal success as well as that of your employer.

Technology is defined as - "The practical application of science". The practical applications within any industry often involve the use of existing and new software applications, development and creation of machinery, robotics and assembly procedures to facilitate the production of your products for use in industry.

Taking all of the knowledge you've obtained and continue to accumulate must be translated into ways of producing your product or service effectively for sales, marketing and distribution.

Computers and their various languages are a good example of the application (technology) of your knowledge efforts. Software must be written and rewritten constantly to reflect the knowledge you've acquired to make the software effective, applicable and flexible to serve its purpose.

Artificial Intelligence and ChatGPT use this approach continually as the computer algorithms that decide how the application works, must be rewritten by humans to improve app response, speed, effectiveness and popularity. Yes, A.I. and Chat software are written by employees; software engineers and coding programmers.

"Alexa" is another example of this process. There is a lengthy list of words, phrases, topics and information that Alexa is not allowed to verbalize. Humans make decisions on what to allow based on the accumulated knowledge of what is currently acceptable or not. As acceptability changes, so will the software code to allow or forbid content programmed by software engineers.

The most recent example is the crackdown within social media platforms to block harmful or unacceptable posts that are intercepted by computer code written by company staff. This occurs hourly and continues indefinitely due to the vast amount of information flowing through social media platforms. Thus, a growing need for more software engineers in this growing global STEM career field across hundreds of industries.

Engineering is - "The engineering method: a step by step process of solving problems and making decisions". Depending on the University you ask, there are

4 to 6 general branches of engineering; Mechanical, Chemical, Civil, Electrical, Management, and Geotechnical, and literally hundreds of different subcategories of engineering under each branch. Regardless of the specific field, problems need to be solved and decisions need to be made. The Engineering Method varies slightly depending on the industry or University you ask, but they are very similar and effective.

"Name one career that does not have problems that need solving."

There are usually two different approaches to solving problems based on the industry or circumstance of the problem: The Engineering Method and The Engineering Design Process.

These are different approaches to different problems and vary in their steps. Within our daily lives and most career fields, the Engineering Method is used. As a reminder, here is the general structure of the engineering method: a STEM Skill:

Step 1: Identify the problem

In this step, engineers or you personally will formulate what the problem is. Problem-solving starts with problem-finding.

Step 2: Ask
The next step in the Engineering

Method is to ask questions about the problem. The type of problem will determine how you approach possible solutions in step 3 of the process. The more clearly you identify the problem, the greater the possibility of success quickly.

Step 3: Create possible solutions

Look at solutions for similar problems that already exist. By looking at existing solutions, new ideas based on them and steering clear of mistakes made in the past improves results. This step develops creativity and research skills. The point is not to come up with one right answer but to create a list of answers.

List possible solutions to the problem and narrow down the options. You can start by simply thinking through the possible ideas and considering how they would work. Many of the ideas will be rejected during this step. If more than one idea still seems viable after talking through the solution, sketch out a few designs to make them more realistic and narrow down the list even further.

Step 4: Design a test to evaluate the possible solution

This step will probably be simply a decision to test, rather than a physical creation. Various sources suggest that the average adult makes 33,000 to 35,000 total decisions each day, including what we will eat, what we will wear, what we will do, what we will say, and how we'll say it, according to the Harvard Business Review.

The amazing part of these decision numbers are that we actually use the

Engineering Method steps "instantly", often without a thought and perhaps without realizing it's the Engineering Method. When it come to "big" problems or decisions, likely we will slow down and consider these steps with much more thought.

Step 5: Test a solution

Once a solution is decided upon, it's time to test it. This step allows for the practical application of your solution and will provide end results when the test is complete.

Step 6: Evaluate

It's time to examine the results of your test and decide if the problem is solved. If it is not solved or has a glitch, you may need to modify the test or choose a completely different "possible solution" to compare results. This process continues until you are satisfied with the solution and consider the problem solved.

A common or practical example of this method we can relate to is simply getting from one place to another. Let's say you want to attend a concert across town and you cannot personally drive. This is your problem to solve. Here are several step 4 possibilities to test. You could:

- walk / but it's too far and unsafe

- ride your bike / the tire is flat and you'll be all sweaty

- hitchhike / "a hard no" on this one

- take the bus or public transportation / routes and convenience are a challenge

- call an UBER / you may not have the funds to use this service, but it's a good possible solution

- call a friend who is attending and ask for a ride / a good possibility

- ask a family member to drive you / another good possibility

Step 7: Test results

○ your family member is not available at that time / no solution

○ cannot afford an UBER / no solution

○ found a friend to ride with / SOLUTION – problem solved.

In a work environment, the problem may be how to ask the boss for a day off. The steps still apply, but the possible solutions are different.

> when should I ask? (time of day, how far in advance…)
> what reason should I give? (to lie or

be truthful is a decision of ethics – what are the possible consequences?)

> how should I word it? (using professional communications skills is a plus)

> what if the answer is no to that day – should I be prepared to ask for a different day?

Engineers solve problems and make decisions. By definition, you're already an engineer in daily practice.

For those who cook, math is a huge factor in successful outcomes, as recipes require exact measurements, often in metrics. Conversions for recipe portions can vary and need to be calculated based on how many you're cooking for. Temperature variations, unique ingredients and time to serve calculations are everyday math. For more complex careers in banking, aerospace, medicine, chemistry and statistics, higher levels of math may be required, but the STEM Skill of math remains necessary and common to all fields.

Math is defined as- "The science of numbers and their operations, interrelations, combinations, generalizations, and abstractions". From balancing your personal finances to calculating the best rocket trajectory for a flight to Mars, math is part of your everyday life.

As you consider possible career fields, there is no doubt that these STEM Skills and slight variations will be vital to your success in your chosen path. From sous chef to software engineer, clothing designer to robotics repair, STEM Skills are necessary, and you're already more equipped that you realize.
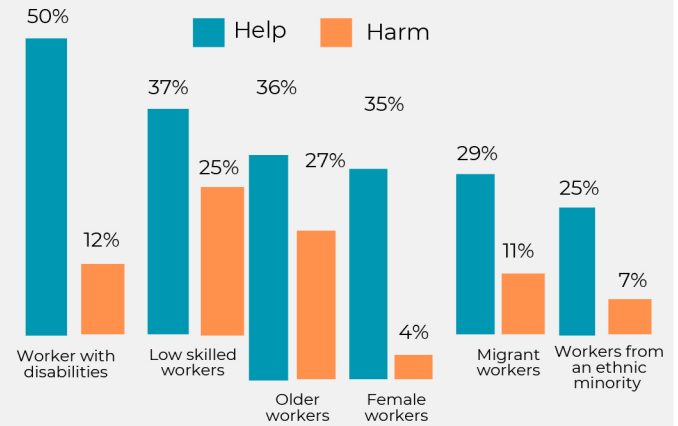
The manufacturing industry has a rich history of undergoing digital transformation and revolution. Sectors such as automotive, aerospace and defense, food and beverage, and pharmaceutical manufacturing have experienced such transformation. The integration of AI technology has brought about a competitive advantage by reducing operational expenses and increasing overall customer satisfaction. Concerns about job losses have emerged as AI integration in the manufacturing industry.

Many manufacturing workers believe that AI system integration will positively impact the manufacturing sector as a whole. The question of who will benefit or be harmed by AI in the manufacturing industry has been raised. According to a 2023 OECD Employment Outlook survey, more workers will benefit than will be hindered by AI.

Share of respondents who say that the following workers will be helped or hindered by AI

Help ▇ Harm ▇

- Worker with disabilities: 50% / 12%
- Low skilled workers: 37% / 25%
- Older workers: 36% / 27%
- Female workers: 35% / 4%
- Migrant workers: 29% / 11%
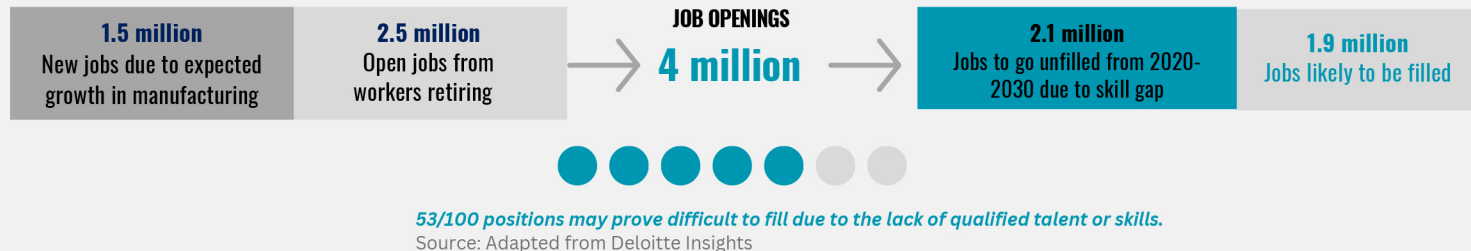- Workers from an ethnic minority: 25% / 7%

Figures do not total 100 percent since Neither/Don't know" responses not shown. 1.400 manufacturing employers surveyed in selected OECD countries Jan.-Feb. 2022.

Source: Adapted from OECD Employment Outlook 2023

Jobs Eliminated

According to recent data, the integration of AI in manufacturing will not lead to the elimination of jobs. However, the industry is facing a labor shortage due to the difficulty in finding qualified talent to fill future automated roles. By 2030, more than 2 million manufacturing jobs are projected to remain unfilled. This shortage has a negative impact on the nation's capacity to produce essential materials, such as electronics, textiles, metal production, and nuclear submarines. The problem is compounded by lackluster economic development, outsourcing, lost growth prospects, and decreased productivity.

An estimated 2.1 million open positions may prove difficult to fill by 2030

1.5 million New jobs due to expected growth in manufacturing

2.5 million Open jobs from workers retiring

JOB OPENINGS → **4 million** →

Manufacturing Jobs to Fill From 2020 - 2030
JOBS

2.1 million Jobs to go unfilled from 2020-2030 due to skill gap

1.9 million Jobs likely to be filled

53/100 positions may prove difficult to fill due to the lack of qualified talent or skills.
Source: Adapted from Deloitte Insights

Job Creation Projections

High-demand middle-skill careers such as computer numerical control (CNC) machinists, welders, and maintenance technicians require some level of technical training and/or applied skills. (Deloitte). Although some manufacturing workers may be well equipped to run certain mechanics on the floor, many do not possess the digital savvy needed to properly use specific computer systems and analyze data.

Manufacturing middle-skill occupations with the highest projected job opening during 2019-2029

- Miscellaneous assemblers and fabricators: 113,200
- First-line supervisors of production and operating workers: 56,900
- Inspectors, testers, sorters, samples, and weighers: 48,300
- Helpers - production workers: 44,100
- Welders, cutters, solderers, and brazers: 43,400
- Packaging and filling machine operators and tenders: 40,600
- Industrial machinery mechanics: 40,500
- Machinists: 38,000

Note: Only those jobs considered where at least 50% are employed by manufacturing industry.

Source: Adapted from Deloitte of data from O*Net.

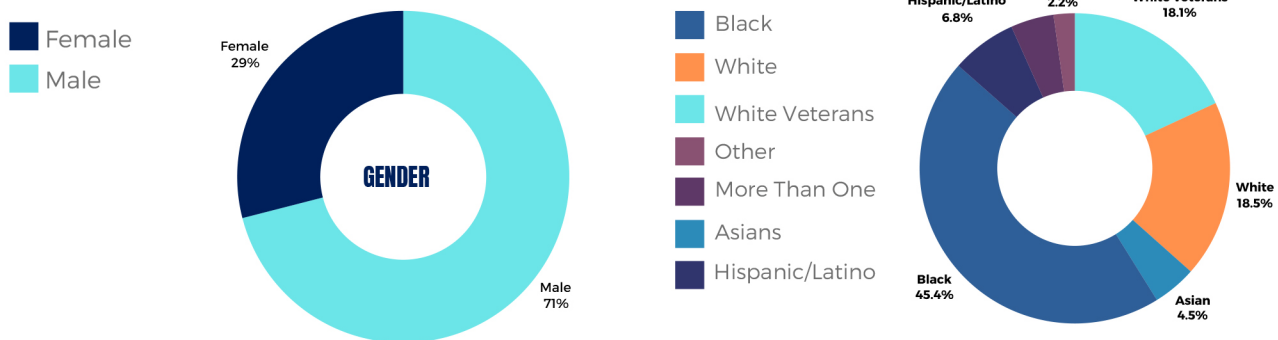# THE TAG SOLUTION: BRIDGING THE GAP TO SUCCESSFUL WORKFORCE SOLUTIONS

In partnership with the Georgia community and corporate partners, the Technology Association of Georgia's foundation, TAG Education Collaborative, a 501c3 (TAG Ed) is working to help bridge the workforce gaps created by the onset of AI. As recipients of the Georgia AI Manufacturing (GA-AIM) Grant, TAG Ed contributed by accelerating the adoption of artificial intelligence across Georgia's legacy industrial sectors. GA-AIM works to drive AI adoption to lead the next revolution in U.S. manufacturing across all sectors, geographies, communities, and underrepresented constituencies. Our mission is to serve all Georgia residents, including rural residents, women, Black, Indigenous, People of Color (BIPOC), those living with disabilities, and veterans. Historically, these groups have been underrepresented in manufacturing.

TAG Ed provides solutions to the technology workforce by taking a proactive approach through predictive analysis. Our approach includes creating pathways to the tech workforce for upper-level high school students, transitioning career professionals, and mid-level to senior-level tech leaders. One featured program is the Registered Tech Apprenticeship Program, which creates pathways for underrepresented candidates (minorities, women, and veterans) to secure in-demand tech positions through training and job placement.
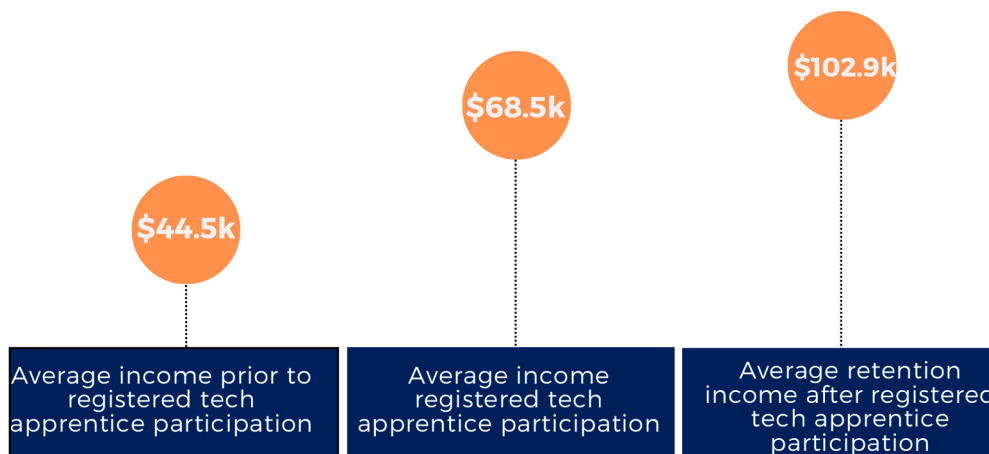
TAG Filling Tech Talent Pipeline with Diversity in Georgia

Georgia has a vital workforce development ecosystem eligible for tech apprenticeship opportunities.

DIVERSITY AND EQUITY

GENDER
- Female 29%
- Male 71%

Legend:
- Black
- White
- White Veterans
- Other
- More Than One
- Asians
- Hispanic/Latino

- Other 2.2%
- White Veterans 18.1%
- Hispanic/Latino 6.8%
- White 18.5%
- Asian 4.5%
- Black 45.4%

WAGE DATA

$44.5k — Average income prior to registered tech apprentice participation

$68.5k — Average income registered tech apprentice participation

$102.9k — Average retention income after registered tech apprentice participation

$3.1M*

Average lifetime earnings increase due to registered **tech apprenticeship** in Georgia

*Based on a 25-year work projection

Source: Adapted from Apprent.org

Inaugural Regents' Award

By Jeremy Craig
Communications Manager / Office of the Provost

The University System of Georgia (USG) has awarded its inaugural Regents' Award for Excellence in High-Impact Practices and Experiential Learning to Georgia State University's Experiential, Project-based and Interdisciplinary Curriculum (EPIC) Program.

The Regents' Awards represent the system's highest recognition for excellence in teaching and advising among the state's 26 public colleges and universities governed by the USG.

"As higher education undergoes shifts in a complex, evolving technological landscape and job market, the fundamentals of problem-solving and experiential learning will always remain at the core of student success," said Nicolle Parsons-Pollard, Provost and Executive Vice President for Academic Affairs. "I am delighted for Georgia State and our team to receive this

recognition for our continuing work and dedication so that our students are prepared for success in college and in their careers."

EPIC was launched in fall 2019 to provide GSU students with a curriculum to help them become adaptable problem-solvers. The program offers opportunities to learn by doing in long-term projects and seeks to develop a more meaningful general education experience by showing students how their courses connect to one another.

"We've worked with over 100 Georgia State instructors over the past four years, so this is a group effort," said Brennan Collins, Director of EPIC and Associate Director of the Center for Excellence in Teaching, Learning and Online Education. "EPIC demonstrates that faculty development around high-impact practices in the classroom can play a significant role in improving

The University System of Georgia recognized the EPIC Program May. From left to right: Ashwani Monga, Executive Vice Chancellor and Chief Academic Officer for the University System of Georgia; Nicolle Parsons-Pollard, Provost and Executive Vice President for Academic Affairs; Ashley Holmes, Interim Executive Director, Center for Excellence in Teaching, Learning & Online Education (CETLOE); Keyonna Sutton, Manager, Project Management Office at Georgia State's Department of Instructional Innovation and Technology; Ryan Carlin, Professor of Political Science and Director of the Pollitik EPIC project lab; Kathryn Crowther, Associate Professor of English and CETLOE Faculty Associate; Brennan Collins, EPIC Director and Faculty Associate, CETLOE; Chancellor Sonny Perdue, University System of Georgia.

student success."

The system's award recognizes the high-impact practices of the EPIC program such as EPIC's Wicked Problems Project, engaging students in complex, real-world issues with no clear or easy solutions. With "wicked problems," students must apply skills and knowledge from different fields to bring about different and sometimes contradictory points of view.

The system also noted EPIC's work in engaging students through project labs that build connections to Atlanta. Additionally, the USG recognized EPIC's support for faculty development

and learning communities to nurture and support the project. Further, the system noted the use of data to adjust and refine EPIC's work.

The data indeed demonstrate EPIC's positive impact upon the undergraduate learning experience, one of Georgia State's nationally recognized strengths as the university has proven that students can succeed regardless of their background.

By the end of the program's fourth year in 2022-23, EPIC's retention rate was over 30 percent higher than the 2019 incoming class as a whole. Compared to the average incoming student in 2019, EPIC students were dispropor-

tionately eligible for Pell Grants, with slightly more first-generation college students compared to the university as a whole.

Additionally, this success came despite the disruptions to the higher education experience during the acute part of the COVID-19 pandemic.

Some of the projects within EPIC of note include, but are not limited to:

• Pollitik: A public opinion lab where students working with Professor Ryan Carlin found fascinating results in analyzing public opinion surveys regarding international leaders and whether the public in their respective countries rally around leaders who contracted COVID-19. Other work in the Pollitik lab has included research on executive approval ratings in response to the Russia-Ukraine conflict.

• Krog Street Codex: The ever-changing artwork inside and alongside Atlanta's Krog Street Tunnel may be ephemeral, but the Krog Street Codex project lab documents the changing nature of the tunnel, the hot spots for painting and messaging, and the ways that current events in society change the look and feel of this quintessential Atlanta landmark.

• CDC Virtual Exhibitions: Students have collaborated with the museum of the Centers for Disease Control and Prevention to share the history recent outbreaks, contributing to the development of virtual exhibits and educational resources.

• Mapping Atlanta: Aimed at public-facing mapping projects, including a mapping project of a UNESCO World Heritage Civil Rights Trail and an oral history map for the Centers for Disease Control and Prevention Museum.

• The Phoenix Project: Using the MARTA Archaeological Collection of the Anthropology Department that contains artifacts and material remains found by university archaeologists during the transit system's initial rail line construction in the 1970s. Students learn about photography, 3D modeling, curation, geographic information systems and more.

EPIC is supported by the Georgia State Office of the Provost and The Teagle Foundation, in addition to recent grants from the National Endowment for the Humanities (NEH).

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- Exam voucher included
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Once you have the fundamentals or programming experience, you can be eligible for the Microsoft Azure AI Solutions course. This is where you'll gain a comprehensive understanding of the of the responsibilities encompassing the design, deployment and maintenance of AI solutions.

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- 100% Online, Instructor led
- Equipped to pass Azure AI Associate AI-102 exam
- Exam voucher included
- Price: $2,400

Ask About Bridge Builders Scholarship: TAG Bridge Builders and SkillStorm are committed to promoting equity and diversity in the workforce. Apply for a scholarship tailored to serve minorities in Georgia who are looking to advance their tech careers.

Sign up for a course today!

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AI Skills: The New Currency in Today's Job Market

The AI revolution is here. Ever since ChatGPT arrived on the scene in late 2022, artificial intelligence has been reshaping the way we live and work. What does that mean for tech professionals looking to compete in a changing labor market?

TV pundits and talking heads love to get riled up about whether robots are coming for our jobs — but the truth is that AI will probably create more jobs than it eliminates. And one thing's for sure: understanding how AI works, and mastering AI skills, will be the key to success in tomorrow's ever-changing world of work.

New research shows that a growing number of companies are asking for AI skills in job descriptions — including non-tech roles. And a survey of HR professionals released last month shows that job candidates with AI skills ask for more money during the interview process — and tend to get it once they're hired. Simply put, AI is going to be underpinning nearly every job out there. That's why staying ahead of the latest in AI development is so important.

Building AI skills doesn't just mean learning how to engineer prompts for ChatGPT. It's everything from programming to data modeling and analysis to mastering concepts like machine learning and natural language processing. And if there's anything certain in our fast-paced economy, it's that building AI fundamentals today will translate to career opportunities tomorrow and beyond.

That's where SkillStorm comes in. In partnership with TAG, we offer Microsoft Azure AI courses that are instructor-led, career-aligned tech certification courses and will help you build the AI skills that employers need. From the basics of AI and machine learning to a comprehensive understanding of how to design, deploy, and maintain AI solutions, you'll learn everything you need to accelerate a career in the economy's hottest fields.

It won't be long before all kinds of jobs, all across the economy, require AI skills. And starting now is the best way to accelerate your ascent up the career ladder. Build those skills today and you'll lay the foundation for opportunity for years to come — and set yourself up for success in an AI-driven future of work. Register today to get started with a career in tech.

Breaking Barriers:
NASA's Quesst Mission and the X-59

By Anya Shah

It's real, and it's here.

Have you ever wished you could cross between North America's east and west coasts in a few hours instead of a whole day? Imagine getting on a plane in New York after breakfast time and getting off in San Francisco in time for a mid-morning coffee. The X-59, pioneered by NASA and Lockheed Martin for the Quesst mission, is bringing this vision of the future closer than it might seem. The goal of the Quesst mission is to take on one of the key challenges to supersonic flight over land - the sonic boom.

Crewed supersonic flight has been around since 1947, starting with the first designated experimental aircraft, the Bell X-1. Today, military fighters routinely fly at speeds over twice the speed of sound. This creates an issue for people on the ground, however. When aircraft fly faster than the speed of sound, they create shockwaves that make a loud, startling "boom" sound when they reach the ground.

These sonic booms were disruptive enough to people that, in 1973, the United States and other countries banned commercial supersonic flights over land. As a result, in the 77 years since the X-1's historic flight, commercial supersonic flights over land have been banned for 51 of them.

To solve this issue, new technology needed to be created that would dampen the sonic boom so that it sounds more like a soft thump instead of a loud boom. This is the goal of the Quesst mission: to show that it is possible to build a supersonic airplane that doesn't disturb people on the ground, and to gather data that could lead to a change in the rules. The X-59 is the product of these efforts.

The Quesst mission stands as one of NASA's most important aeronautical research endeavors, featuring the design and build of NASA's brand new supersonic X-plane. In 2018, the

agency contracted Lockheed Martin to build the X-59, a unique airframe designed to demonstrate with quiet supersonic flight. This aircraft is engineered to significantly diminish the noise associated with flying faster than the speed of sound, reducing it from a resounding boom to a gentle thump. If successful, this endeavor could facilitate commercial adoption of quiet supersonic technology in the future.

The X-59's design represents a substantial leap forward in airframe design, all of it aimed at making supersonic aircraft quieter. Its elongated nose and meticulously designed wings and body are tailored to mitigate the shockwaves responsible for sonic booms. Through its unique shape, the X-59 seeks to markedly reduce the noise generated by supersonic planes, rendering them less disruptive to people on the ground. Researchers also harnessed state-of-the-art technologies in materials and aerodynamics to develop the aircraft, which will fly as fast as Mach 1.4, or 1.4 times the speed of sound; equivalent to around 925 mph.

NASA has multifaceted objectives for the Quesst mission. The primary aim is to showcase the feasibility of quiet supersonic flight over land, laying the groundwork for regulators to consider changing rules on overland-based supersonic air travel.

Currently, with rules prohibiting commercial airplanes to go faster than the speed of sound, there is a "speed limit" on commercial flight. The Quesst mission is helping to see if that could be changed to an actual "sound limit", so that if an airplane's sonic boom, or "thump", during supersonic flight is quieter than the limit, it would be allowed to fly faster than Mach 1 over land. This could potentially enable companies to build commercial airliners that can fly at greater speeds, substantially reducing travel times and enhancing long-distance travel accessibility. Ultimately, Quesst is one of the ways in which NASA aspires to redefine 21st-century air travel.

The Quesst mission unfolds in three phases. The first phase encompasses the aircraft's development by Lockheed Martin, focusing on initial design steps, including computer simulations, wind tunnel tests, and engineering. Computer simulations have been employed to predict shockwave behavior and optimize the aircraft's shape to minimize shockwave magnitude. Wind tunnel tests, meanwhile, assessed aerodynamics by subjecting models of the X-59 to high-speed airflows, gauging the aerodynamic performance and studying how the shockwaves would come off of the actual aircraft.

Additionally, the X-59 incorporates components from different aircraft, such as the F-16 and T-38. Due to this, engineering efforts are required to integrate these different parts into a cohesive, novel aircraft in preparation of the final part of Phase 1 – initial flight tests, which will ensure the aircraft's safety and operability.

Quesst's second phase transitions the focus to acoustic validation, which entails extensive measurements to confirm the X-plane is producing sonic thumps as quiet as they're predicted to be. This will include numerous flight tests to evaluate the emitted shockwaves and ground noise levels. These assessments ascertain the aircraft's actual supersonic sound and compares that data to what the airplane was designed to produce.

During this phase, accompanying aircraft will fly with the X-59, equipped with instruments to record data of the shockwaves coming off the X-59, while strategically placed microphones on the ground capture the aircraft's noise profile, helping acquire vital acoustic data.

In the final phase of the Quesst mission, the focus extends to include involvement by the public and community feedback. This phase incorporates comprehensive assessments of sound, coupled with public perception surveys,
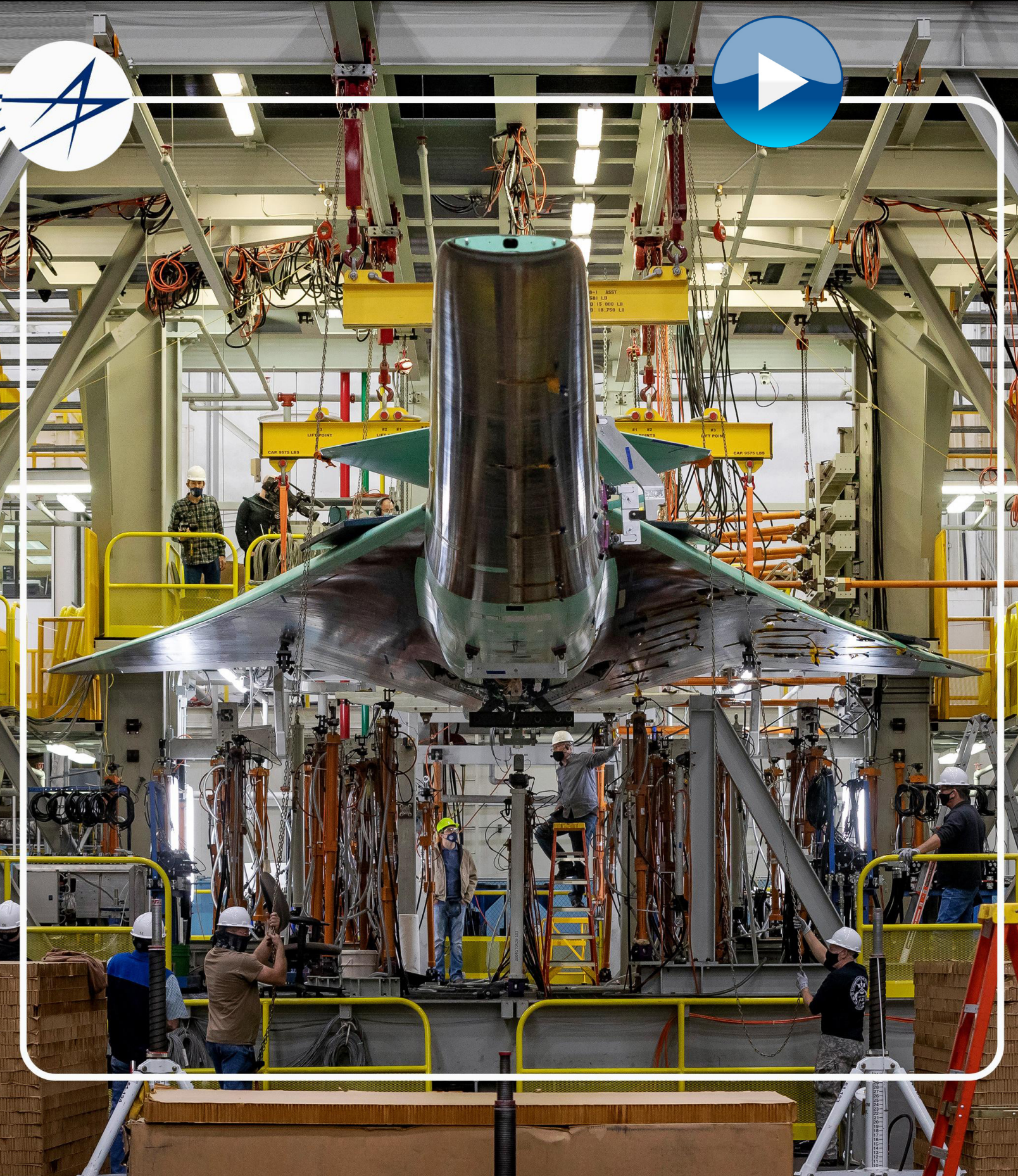
to correlate subjective perceptions of noise exposure with objective measurements. Employing sophisticated statistical methodologies, Phase 3 endeavors to relate these perceptions and feedback to actual noise levels.

To gauge public assessment regarding noise, NASA will fly the X-59 over various regions of the country, collecting feedback on noise acceptability. This feedback will then be compared to ground-based sound readings. The resulting insights will inform regulatory bodies, aiding in potential revisions to aviation regulations ("the sound limit").

Two of NASA's test pilots have been training to fly the X-59 and will be critical in all three phases of the Quesst mission. This X-plane is a different kind of plane to fly; due to the unique design of the aircraft and its long nose, the pilot can't see out a standard from window. To address this, the airplane uses a new technology called the External Vision System (XVS). XVS can be described as a virtual augmented reality screen. Cameras looking out in front of the airplane will display that environmental imagery on screens in front of the pilots, with crisp precision, as though they were looking out a window.

The road to building the X-59, presented with technical challenges, led to an

official rollout ceremony of the painted aircraft in January 2024 in Palmdale, California. This rollout celebrated all the work that went into building the airplane and allowed the world to see the X-59 in its final form for the very first time. Following the rollout, the X-59 immediately began additional systems checks and ground tests. The aircraft is currently scheduled to fly in 2024.

The Quesst mission's aspirations transcend technological innovation. Ultimately, NASA seeks to foster global connectivity by enabling supersonic flight over land. Journeys that currently might take close to a day may be able to be completed in half the time. It's one big piece is the puzzle to rejuvenating commercial supersonic flight and making it practical. NASA's collaborative efforts in broader supersonic research aim not only to mitigate noise but also lower fuel consumption and emissions, thereby fostering a more environmentally conscious aviation industry.

The strides made in developing the X-59 and advancing the Quesst mission underscore the dynamism of the aviation sector and the remarkable technological achievements within reach. This initiative has the potential to revolutionize commercial aviation, with benefits that can range from

redefining business or personal travel to fostering stronger international relations, cultivating a future where the world feels more interconnected and accessible.

The X-59 aircraft and NASA's Quesst mission stand at the forefront of an aviation revolution. Challenging conventional norms, they strive towards a future where swift, efficient, and quiet supersonic travel is not just a possibility, but a reality.

The global community eagerly anticipates these groundbreaking developments, poised for a new era of air travel that promises to enable connections beyond imagination.

Anya Shah
NASA Langley Research Center
Communications

American STEM Education at a Crossroads

By Jeff Weld, Ph.D.

*W*hat's on the horizon for American STEM education? I posed the question to ChatGPT – more technology integrated in learning, it stole from somewhere. Project-based learning too. Online learning, coding, soft skills, diversity, and inclusion. All obvious harvests from the web.

Jeff Weld is former White House Senior Policy Advisor for STEM Education – architect of the 2018-2023 Federal five-year STEM education strategic plan Charting a Course for Success: America's Strategy for STEM Education

Executive Director, Iowa Governor's STEM Council 2011-2023

Author of Charting a Course for American Education from out on a limb at the executive branch (Torchflame Books, 2021), Creating a STEM Culture for Teaching and Learning (NSTA Press, 2017), and The Game of Science Education (Pearson, 2004).

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It included a caution: "As of my last knowledge update in January 2022. Check more recent sources to get the latest updates and insights into the current state of STEM education." Now that's intelligence, artificially. Because recent years have been momentous for STEM education, trending in directions that evade or maybe defy the predictive analytics of AI. It has not yet picked up on STEM at a crossroads. Let's feed it.

That crossroads is this. The 21st century road for STEM so far has been to infuse preK-12 and college education with resources, training, and funding to fuel greater student interest and capability in STEM studies, college majors, and ultimately jobs. Investments from industry and government have poured in to support school partnerships with business, the integration of computing and project-based learning into math and science classes, and to reach those most needy and least represented.

That's been the goal of STEM in many states like mine for the last decade plus, accumulating evidence that wins un-

wavering annual support by the legislature. Those same priorities became the core of the Federal five-year STEM education strategic plan for 2018 to 2023, Charting a Course for Success: America's Strategy for STEM Education.

In the process, STEM has become much more, ushering education reforms that are revving up relevance for all learners in all subject areas. The STEM brand – partnering with business, localizing coursework to communities, and blurring the borders between the disciplines – equips Generations Z and Alpha to ask and answer the complex questions ahead. The model is ripe for adoption in every school but we're far from it. Here at a crossroads, will STEM education continue to expand or whither? Or maybe just morph? For the answer, follow the money.

Local manufacturers, tech companies, health providers, and builders wanted STEM-ready hires too. Like, now though, not later. They were strategically impatient. But the three-pronged STEM brand of education – partnerships, community context, and melded coursework boundaries takes time.

To understand and anticipate the STEM horizon means understanding its genesis. The 1957 threat to American security and economic vitality

posed by U.S.S.R. satellite Sputnik drove an unprecedented STEM response in the U.S. led by the National Defense Education Act of 1958 that created NASA and rallied aerospace behemoths Raytheon, GE, Boeing, Lockheed Martin, Northrop Grumman and countless others to a STEM imperative.

Four decades later terrorists attacked the United States and Congress responded by creating the Department of Homeland Security, and the STEM-heavy America COMPETES Act of 2007. In both instances, significant investments boosted the economy and bolstered national security in part by

producing more STEM workers. By 2010 states and regions were launching their own STEM programs, all urged on by influential business and policy organizations.

Local manufacturers, tech companies, health providers, and builders wanted STEM-ready hires too. Like, now though, not later. They were strategically impatient. But the three-pronged STEM brand of education – partnerships, community context, and melded coursework boundaries takes time.
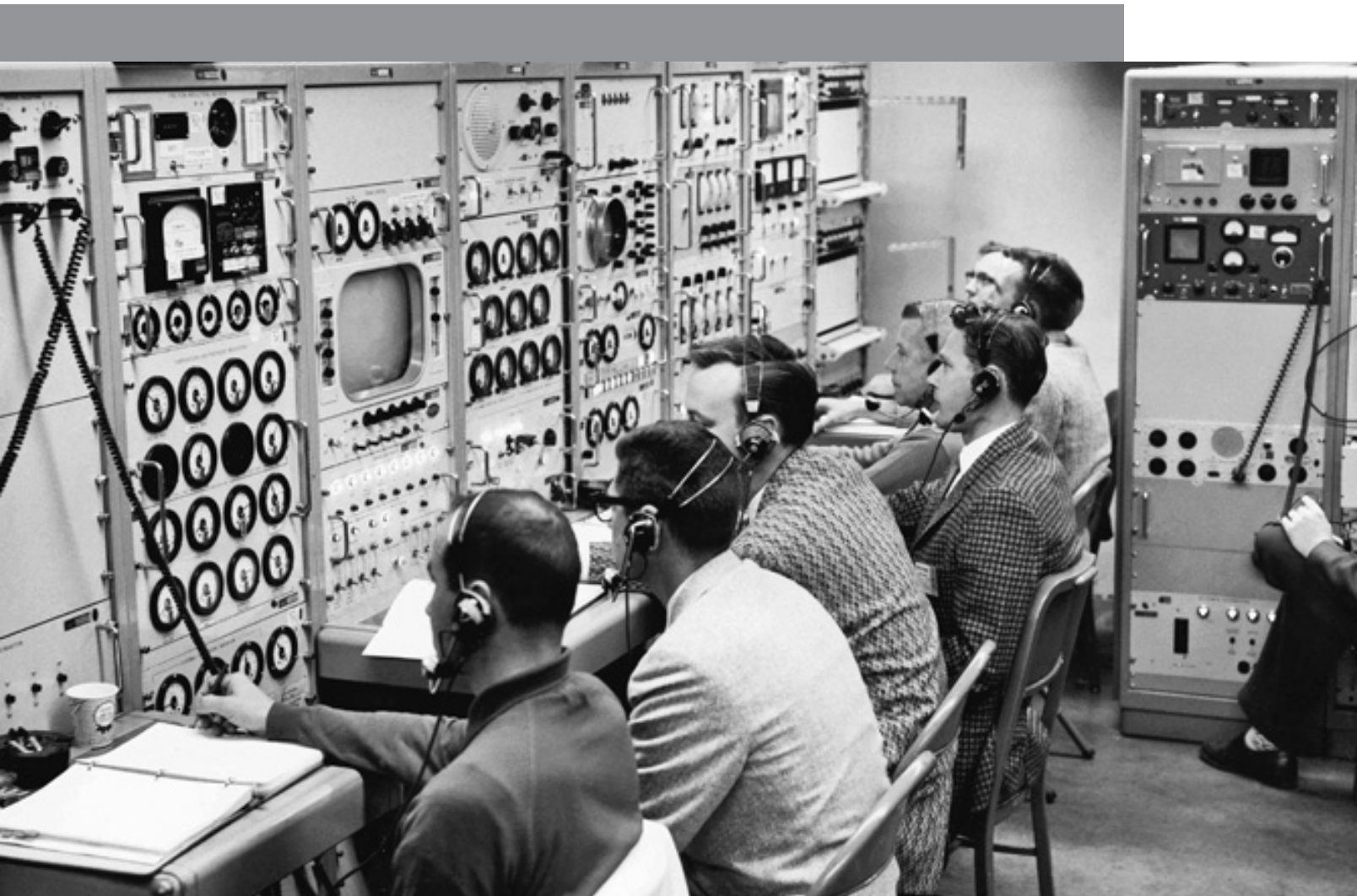
Competition for public and private dollars is intensifying between slow-

cooking STEM programs and front-burner career-tech job training.

Apprentices, on the other hand, can start right now. So too can interns. And coding bootcamp alums. They learn job-ready skills with learn-as-you-go credential accumulation perhaps more marketable than a diploma. In many states today, including mine, competition for public and private dollars is intensifying between slow-cooking STEM programs and front-burner career-tech job training.

These are the forces behind STEM education at a crossroads. Elected officials need quick wins, and business leaders need quick hires. While STEM is a long game, it enjoys a swelling fan base. A recent nationwide survey by Research!America found 84 percent of respondents agree that the federal government should assign higher priority to improving STEM education, up from 69% in 2017. The reason is compelling: participants in K-12 STEM programs are better prepared for, and twice as likely to enter STEM college and careers pathways than their peers.

Americans are fortunate to enjoy both a talent incubation system in and out of K-12 school as well as a rapid delivery pathway to skilled STEM trades.

We have a win-win rather than an either/or. Undue impatience on the part of policymakers and investors would result in unsustainability, while on the other hand prioritizing the distant horizon over immediate need risks economic and national security vulnerability.

STEM should be able to continue to hold the attention of elected officials and industry leaders. The key for funders behind America's STEM workforce is to balance the long game and short game. Pin the pendulum at mid-swing.

Ask ChatGPT about sustaining educational innovation and you will get a recipe: Focus on goals, collect evidence, involve stakeholders, and make data-driven decisions. For two-year-old advice, that's timely. At this crossroads in STEM education, it's a homework checklist for advocates to steer where STEM goes next.

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