UNIVERSITY OF MARYLAND
GLENN L. MARTIN INSTITUTE OF TECHNOLOGY
A. JAMES CLARK SCHOOL OF ENGINEERING
DEPARTMENT OF MECHANICAL ENGINEERING

2181 Glenn L. Martin Hall
College Park, MD 20742
TEL: 301-405-2410
FAX: 301-314-9477
www.enme.umd.edu

CECD
Center for Engineering Concepts Development
www.cecd.umd.edu

MEMO

To: File

Letter of Transmittal
July 30, 2024

As we were working on our revised version of the Engineering for Social Change Revisited book there was some discussion of including a chapter dealing with the paucity of Black engineers in our community. After a good bit of study, I prepared this paper and realized that even though it is a very important issue it didn't easily fit into the ESC book that we were writing. I decided instead to document it separately on file for the larger community.

Having come to the United States in 1956 at the age of 17, I have mostly been engrossed in engineering and even though I saw a lot of the things that I mention in my paper, I never put them down in a cohesive manner. So this paper represents my perspective, which is meant to be factual and not judgmental. My sincere hope is that collectively as a community we will resolve this complex problem on a continuous basis.

Davinder K. Anand
Professor Emeritus of Mechanical Engineering
Director, Center for Engineering Concepts Development
University of Maryland, College Park
dkanand@umd.edu
(301) 405-5294

cc: dka

Opportunity Denied

Davinder K. Anand

Center for Engineering Concepts Development

CECD

University of Maryland, College Park, Maryland

Preface

After a considerable amount of discussion, I decided to touch on a topic mostly ignored in the engineering curriculum. That is the participation of Black people in the areas of engineering and technology. The issue of Black Lives Matter and the widespread protests in 2020 have forced us to examine the long-standing opportunities in technology denied to this community. In this paper I review a brief history of how we got to this point and the challenges inherent in the educational system. At the end I discuss some deeply ingrained and difficult-to-change issues and present some final thoughts on this very complex situation.

Davinder K. Anand
College Park, MD
August 2024

Author Biography

Davinder K. Anand is Professor Emeritus of mechanical engineering and Director of the Center of Engineering Concepts Development (CECD) at the University of Maryland, College Park (UMCP). He received his B.M.E., M.S., and D.Sc. degrees in mechanical engineering from the George Washington University. His career has spanned the past six decades in helping to make the State a recognized leader in research and engineering. He previously served as senior staff at the Johns Hopkins University Applied Physics Laboratory (APL), as Program Director of Mechanical Systems at the National Science Foundation (NSF), and as the chairman of the Department of Mechanical Engineering at UMCP. He also founded two successful technology consulting companies. His research and consulting work was in satellite systems, control systems, solar energy, magnetic bearings, and manufacturing systems. His personal scholarly contributions include authoring/coauthoring 22 books and more than 200 journal papers, and he guided and nurtured a generation of students who have gone on to successful careers in government, industry and academia. In 2013, he founded The Neilom Foundation, a growing nonprofit organization providing opportunities for young people to use their technical skills to create positive social impact. In July 2023 he established the Neilom Foundation Maryland Promise Scholarships in collaboration with the Clark Foundation in the School of Engineering at the University of Maryland College Park. He is a member of the Cosmos Club, where he established the Neilom Foundation Meritorious Award in Technology and Society to be given to a Cosmos Scholar. He also developed a successful new program in engineering for social change in partnership with the School of Public Policy at UMCP. He was honored by Maryland Senate resolution, naming April 4, 2009 as Dr. Davinder K. Anand Day in Maryland. He has received the NSF Sustained Superior

Performance Award, the UMCP Outstanding Accomplishment Award, and the Outstanding George Washington University Alumni Award. He is a Fellow of the American Society of Mechanical Engineers, and a registered professional engineer in the State of Maryland. He is a member of Tau Beta Pi, Sigma Xi, Pi Tau Sigma, and Omicron Delta Kappa, and was inducted into the George Washington University Engineering Hall of Fame in 2019.

Opportunity Denied

In our earlier work, we had concluded that:

> *The future is now,*
> *Engineering is more than just Engineering, and*
> *The global engineer should be inspired to practice social entrepreneurship and pursue ideas that make a difference.*

An obvious question that must be asked is this: Why are there not more Black people working in engineering and technology fields? The answer is not simple, due to a complex tapestry of historical events that is often forgotten for the sake of expediency. The intersection of race and technology has had a very important role in American history. To understand how our society grew in response to historical conditions and technological opportunities, we need to go back to the beginning of the formation of the British colonies in North America.

The first slaves from Africa were sent to Jamestown, Virginia in 1619. They were used for labor on tobacco plantations there, then throughout the Chesapeake colonies of Virginia and Maryland, and then, primarily though not exclusively, in all the southern colonies. But later, the claim in the *Declaration of Independence* that "all men are created equal," and the subsequent American Revolution, led many in both the north and south to challenge the legitimacy of slavery.

However, shortly thereafter, a new technology reversed that course. In 1794, Eli Whitney invented the cotton gin, a mechanical device to separate seeds from cotton fiber. While the machine cleaned cotton it could not plant or pick it, so the number of slaves in the south increased dramatically (from 700,000 in 1790 to 3 million by 1850), as did the wealth of the plantation owners who benefitted from their labor. By 1800, cotton had become America's

leading export.

The cotton gin was one of the first unintended consequences of technology, and historically the most damaging.

Equally important was the fact that education was reserved for white people only, and in fact, after Nat Turner's Rebellion in 1831, virtually every southern state made it illegal to educate slaves. This resulted in generation after generation of undereducated Black youth who had no opportunity other than working in the fields.

At the same time, our nation was involved in acquiring technology patents and machinery to establish manufacturing mills to weave this cotton into cloth. Colonial leaders believed that a strong manufacturing base was vital to the survival of the largely agrarian economy. And the quickest way to achieve the necessary technology was to steal it. In 1791, Secretary of the Treasury Alexander Hamilton's *Report on Manufactures* called for making rewards and privileges available "in regard to improvements and secrets of extraordinary value, to be able to extend the same benefit to Introducers, as well as Authors and Inventors."[1] This subsequently enabled the country to benefit from industrial spies. The Patent Act of 1793 allowed Americans with stolen ideas to receive a US patent, but at the same time barred foreign-owned companies from doing so.[2]

Alexander Hamilton's encouragement of "Introducers" in the *Report on Manufactures* appears to have been in part due to his knowledge of a particularly successful industrial spy of the time, Samuel Slater. Slater had worked in the British textile industry for many years with inventor Richard Arkwright's innovative water-powered spinning machine. With a desire to strike it rich in America, he committed the plans for the machine to memory, and surreptitiously emigrated, against British rules, to the US in late 1789. After a year of prototyping, he successfully used his extraordinary memory of Arkwright's technology to build a functional water-powered textile mill in Rhode Island. He would later build a successful manufacturing village, and created the successful Rhode Island System of Manufacturing for greater rural

industrialization. President Andrew Jackson praised his work, calling him the "Father of American Manufactures," but the British were not as fond of "Slater the Traitor." [3]

To establish a world class cotton cloth industry, the US needed improved loom technology. Francis Cabot Lowell, having entered Harvard at 14 and graduated with honors, rose to the challenge. As a successful international merchant operating out of Boston's Long Wharf, Lowell was well connected both in the United States and England. Using his status in 1811 he undertook reconnaissance tours of British textile mills where he carefully observed state of the art manufacturing technologies.[4] The power loom, or "Lancashire Loom," had helped make Great Britain the world's leading industrial power, and this machine was of particular interest to Lowell. After unsuccessfully attempting to procure plans for the loom, he did as Samuel Slater had done before him, and committed the design to memory.

After returning to the US Lowell raised significant capital, and in 1814 he and his partners in the Boston Manufacturing Company constructed the first water-powered integrated textile manufacturing mill (both spinning and weaving) to turn cotton into woven cloth. Lowell was granted a United States patent for his power loom in 1815.[5]

Slater and Lowell are just two examples of the many Americans through the 18th and 19th centuries who brought cutting-edge technological capabilities and the necessary skilled workers to the country through industrial espionage. Built upon a foundation of technologies primarily stolen from England, the US grew over the next two centuries into a leading industrial power.

In 1862 President Abraham Lincoln signed the first of a series of laws known as the Homestead Acts.[6] In total, these laws gave 270 million acres of free land, (almost 10% of the US), to the citizens who had never taken up arms against the Federal Government. This was almost half a million square miles! Although some Black settlers took advantage of the offer, most of the land went to white settlers. The number of farms grew from an estimated two million to around six million by the end of the century.

By the late 19th century, many state and local laws, referred to as "Jim Crow" laws, had been passed to enforce post-slavery racial

segregation and discrimination. During the same period, many technological advances spawned small factories creating low-level jobs for Black people, who were seen at the time as only capable of low-skilled labor.

As the US entered World War I in 1917, 700,000 Black men registered to fight for the country to prove their patriotism and with the hope that they would get full citizenship rights,[1] which included the necessary education for advancement. Even though 380,000 ultimately served, more than half of them had menial roles.[7] They received no special training or education, and lived under segregated conditions. At the end of the war, the US was not yet ready to give these Black soldiers any additional rights. In fact, some 26 race riots occurred during the "Red Summer" of 1919, as returning Black veterans and others who had migrated north during the war were targeted by white citizens. Such acts would codify a system that denied Black people any real prospects for receiving the technical education necessary for sharing in the wealth of the nation.

Technological advances in machinery and manufacturing had spawned various small cottage industries that created many jobs. And even though they were filled by Black labor, they were mostly menial or maintenance level jobs. There were no Black engineers or managers. Technology had helped those who would practice racial prejudice by redefining the qualifications of a worker. Screening for hiring often left out female and Black candidates due to social biases. Stakeholders and stockholders were forcing corporations to focus only on the bottom line, making it more important than race issues.

Before long, these industries became factories of mass production, and home to many Black laborers, who had little hope of moving up the economic ladder. And, when factories moved overseas due to companies seeking economic advantage, Black workers were the first to lose their jobs. This created cities of poverty, desperation, and crime. It was easier and cheaper for American companies to move their factories and production facilities overseas, rather than invest in educating and training Black

[1] According to the constitution, slaves were considered as 3/5ths of a citizen. Even after they became free, they did not enjoy the same privileges as White citizens.

youth at home. Intentional or not, this form of racism was devastating.

Overall, after the Civil War, the largest, most debilitating, and far-reaching impact of this trifecta of no wealth, no opportunity, and racism was the poor education that Black people endured at every level. By the time the Civil Rights Act of 1964 had outlawed segregation and discrimination in various forms, racism had extremely deep roots, and Black people had not received a proportionate share of the benefits from advanced technology.

As white people left the cities to move to the suburbs in the 1960's and 1970's, inner cities began developing poor majority Black neighborhoods. Children raised in this environment received a substandard public education due to poor quality schools. This inequality provided less information, poor healthcare, and poor nutrition – unavoidably resulting in poor learning outcomes. As a result, many Black students in these areas were left ill-prepared for a technical college education, let alone a college education.

In 1956, when I was an engineering freshman student at the George Washington University in Washington D.C., there were no Black students in engineering. This was unsurprising, as there were no engineering schools that were accredited for Black students when many land grant universities appeared in the latter half of the 1800's. Most of these were agricultural schools, but some had engineering programs. A good example was our home institution, the University of Maryland at College Park. The engineering school was established in 1894 for white students, and it was not until decades later in 1936 that "Mechanic Arts" was finally offered at a separate campus established for Black students on Maryland's eastern shore.[8] Even as late as 1965, there was no visible Black student body at the traditionally white campus. So as technology grew, adding wealth to the nation, there were no Black engineers that participated either in education, or in wealth generation for themselves through technology.

Today the situation is still bleak. The Black population is 13.4% in America.[9] Yet the percentage of undergraduate engineering degrees awarded to Black students in the US was just 4.2% in 2018, and the percentage of engineering doctoral degrees awarded was the same.[10]

In 2019 1,033 engineering students at the University of Maryland College Park received an undergraduate degree. 612 received a Master's degree, and 160 a Ph.D.

Black engineering students received 83 undergraduate degrees (8%), 34 Masters degrees (5.6%) and just 4 Ph.Ds (2.5%).[11]

Not only must our elected officials strengthen laws that will reduce systemic racism, but other institutions, particularly institutions of higher learning, need to pursue and encourage Black student enrollment far more actively.

An alternative way for universities such as MIT to change the course of arguments about diversity, equity and inclusion and actually to have a dramatic impact on higher education might be for them to share $1 billion of their endowments with a historically Black college or university. Harvard has an endowment worth $50.7 billion, Yale has $40.7 billion, and Princeton has $34.1 billion socked away. In fiscal 2023, MIT's endowment stood at $23.5 billion. By contrast, Morehouse College's endowment stood at just $275 million at the start of the school's most recent capital campaign, despite its 157 years of excellence. Howard University has the largest endowment of all the HBCUs with $865.3 million, followed by Spelman College, which reported an endowment of $570.8 million in 2021, and earlier this year received a $100 million donation, the largest gift ever to an HBCU. A number of these historically Black schools are in the middle of fundraising efforts aimed at growing their endowments to $1 billion. If the Ivy League schools want to level the playing field, perhaps they could start by sharing their wealth to help these colleges

and universities not simply reach that goal but surpass it.[12]

A cursory glance at engineering and computer science enrollment numbers at our home institution, the University of Maryland, however, shows a deteriorating situation over the past two decades. Black undergraduate students in the engineering school in 1999 were 13.2% of the total student body. By 2019, this had dropped to just 7%. The situation has been no better in computer science. In 1999, 10.9% of enrolled computer science undergraduate students were Black. By 2019, their numbers had dwindled to just 7.2%.[13]

Why, as technology grew exponentially over the past two decades, has Black student enrollment in engineering and computer science not grown, or even held steady? There are two principal reasons. The first is that many Black students have not received adequate preparation in their high schools. The second is that colleges and universities have, in general, not established aggressive programs to support Black students.

The Pell Institute for the Study of Opportunity in Higher Education and the University of Pennsylvania's Alliance for Higher Education and Democracy, both advocates for improved college access, released a report on higher education equity indicators in 2021. They found that "students from groups historically underrepresented at colleges are continuing to be left out at higher rates than their peers."[14] *Although the report tracked data from 2018-19, COVID-19 was expected to further contribute to factors leading to underrepresentation.*

Not surprisingly, a lack of educational preparation in these fields is reflected in the numbers of Black employees at major technology companies. A mere 2% of Google and Facebook's employees were Black in 2019,[15] with just 3% at Microsoft, and 6% at Apple. In Fortune 500 firms in 2018, just 3 CEOs were Black. A joint study by MaC Venture Capital and the Kauffman Fellows found that only

2.1% of 260,000 technology startup executives were ethnically perceived to be Black, compared to the 79.2% who were identified as white.[16]

With so little representation in technology fields, Black entrepreneurs also find it extremely challenging to attract funding for their startup ideas. At capital investment firms 80% of the partners were white, versus 3% Black.[17] Given that successful people tend to invest in other people who they see as similar to themselves, this is a significant challenge for Black entrepreneurs. A lack of Ivy-league college connections also puts many Black entrepreneurs at a disadvantage when dealing with these tight-knit venture capital communities. According to *Fortune*, as of 2018 only 34 Black, female founders in the United States had *ever* raised more than $1 million in venture capital funding. Banks are also less forthcoming with loans for new business ventures for Black clients, as they require significant collateral that their families are less likely to have. Even when Black entrepreneurs do have these resources, banks still turn them away at a higher rate than similar white customers.[18]

We have seen how Black people have been locked out both politically and socially, and therefore find it difficult to enter the world of technology development. Due to educational gaps, many may lack the opportunities necessary for technological ambitions. There simply are not as many role models in technology for Black youth as there are in sports or music. While successful role models do exist, there are no "Michael Jordans" of the technology world, who have totally dominated their industry at a level beyond all others. Not only have Black people not engaged in technological activity proportional to their population, but we see that technology itself has been unjust to them.

> *New technologies are being created with both programming and data that are racially biased. The AI behind the image recognition system in Google Photos incorrectly labelled Black people's faces back in 2015. Nearly three years later Google had fixed the issue not by correcting the technology, but rather by blocking the incorrect image categories.*[19]

In partial recognition of the systemic problems with facial recognition that have an outsized effect on Black people, IBM discontinued its facial recognition business, announced during the Black Lives Matter (BLM) protests of June 2020. [20]

The Correctional Offender Management Profiling for Alternative Sanctions (COMPAS) AI-based software tool, developed for US courts to use in re-offense risk assessment, was found to be heavily biased. White defendants were flagged incorrectly as reoffenders 24% of the time, versus 45% for Black defendants.[21]

A study of high-cost patients in a large academic hospital's risk assessment system over three years found that Black patients who were equally as sick as white patients were much less likely to be enrolled in a program to help them. The bias was found to be significant yet entirely correctable within the algorithm, which was widely used in the health industry and applied to millions of people to determine who receives special care and who does not.[22]

Many Black people do directly participate in technology and have significant value to our economy, but primarily as consumers! This is driven home by the media and profit-driven corporations. Technology is a wealth generator, but typically not for the Black community.

This systemic inequality not only has deep roots, as we have shown, but it is also supported by deeply ingrained conscious and unconscious bias. This bias would have stayed there, and history tells us that it likely would have changed very slowly. But a new administration in the United States rapidly brought systemic problems to the surface, resulting in widespread unrest and calls for equality. Social media assisted in the rapid dissemination of the various triggers for unrest. Most importantly, the Internet created a culture of doubt, and many of our own citizens questioned the direction of our nation. Technology had given wealth and great

power to the government and corporate worlds. Improved technology put surveillance and deadly weapons in the hands of police. And for historical reasons, Black people faced the intensity of structural racism and inequality as never before.

A new trifecta of inter-related problems of American justice in crisis, a deadly pandemic, and economic collapse, became a national issue in 2020. Suddenly, 40 million people were out of work. The pandemic had caused widespread illness and death, and an economic crisis with the highest unemployment rate in a generation. The toll of both has been borne disproportionately by communities of color in America, as well as the most disadvantaged. Congressional aid of trillions of dollars resulted in enormous handouts to major corporations, small change to a few taxpayers, and no significant bailouts for many Black families. There would be no social and racial justice or equal protection under the law absent public pressure. So, the public went out to the streets to reclaim what was theirs.

Technology showed its power in the early summer of 2020 when police, using advanced weapons, attacked our country's own Black and white citizens at the focal point of protesters for social and racial justice: Lafayette Square in Washington DC, in front of the White House. The scene was repeated many times throughout the nation, with the largest and most sustained mass protests in half a century against anti-Black racism. Justice was neither fair nor equal.

Today, polls show that most Americans believe that law-enforcement is discriminatory. We can see this every day by observing what the police do. They enforce the laws in ways that disproportionately impact Black people. They shoot to death about 250 Black people every year in our nation, twice the rate of white people.[23] During the writing of this chapter it was found that the Atlanta police had shot yet another Black man who was running away from the police. He was seven parking spaces away when he was shot in the back, and this was the 48th officer-involved shooting investigated by the Georgia Bureau of Investigation that year.[24]

Complicating our discussion is the emergence of Critical Race Theory (CRT) in our political discourse. This idea emerged more than 40 years ago, primarily from the work of civil rights attorney Derrick Bell, who spent the second half of his career as an

academic.[25] One of the key ideas of CRT is that racism is not merely due to individual bias or prejudice, but that it is also embedded in our legal systems and national policies. Laws that appear colorblind at first glance may be applied in such a way as to actually increase racial discrimination. Because persistent racial inequalities deny a good education to Black, Hispanic, and other underserved populations, this theory should be an integral part of our educational system.[26]

Finally, the economic capability of a family significantly impacts their quality of life, and the ability of their children to pursue and receive high quality education. A significant impediment to this is the significant wealth gap between Black and white households, which persists to this day. Therefore, "narrowing the U.S. wealth gap in general is important; narrowing the racial wealth gap is urgent. As a country we have already wasted too many opportunities to tackle it head-on."[27] Today, this is complicated in part by a bitter irony; the Supreme Court has decided to limit the government's authority to consider race-specific economic measures in order to correct economic disadvantages in Black communities.[28]

On the positive side, we must note, however, that according to the editorial board of the *Washington Post* "the Black-White wealth gap is narrower than it was three decades ago: Median Black household wealth was 12 percent of white households in 2019, but an even lower 6 percent in 1989. The lesson is that the United States has proved capable of reducing racial wealth inequality – even during a time when it was not consciously trying to do so, and, in some respects, was raising new obstacles. Think how much more progress can be achieved if the country actively pursues it."[29]

Although Black people have been locked out educationally, politically, and socially, and therefore have found it extraordinarily difficult to enter the world of technology development, in recent years there have been some very successful role models who have emerged. Robert F. Smith, a chemical engineer, entrepreneur, and philanthropist, has a current worth of $6.7 billion. He founded private equity firm Vista Equity Partners in 2000. With $92 billion in total assets, the firm focuses exclusively on investing in software companies. [30] David Steward, with a net worth of $5.8 billion, is the

founder and chairman of IT provider World Wide Technology, a $14.5 billion company.[31]

Jay-Z (Sean Carter) and Dr. Dre (Andre Young) have been very successful in the music, business, and technology worlds as musicians who used their talent and audience to become extremely successful entrepreneurs. Dr. Dre's Beats audio technology company was acquired by Apple in 2014 for $3 billion, the company's largest acquisition to date. Jay-Z, among many other ventures, acquired a music technology company and built Tidal, a major music streaming service, and a technology venture capital firm. Jay-Z became a billionaire in 2019, and Dr. Dre is worth $800 million. We mentioned earlier that the number of Black women who had raised $1 million in investor backing was just 34 in 2018, this number had risen to 93 in 2020.[32] The situation appears to be slowly improving with a newly increased focus on racial equity.

Apple CEO Tim Cook (right) with Andre Young (Dr. Dre) (left) after he sold his Beats technology company for $3 billion to Apple.[33]

At the same time, it is worth noting that Jeffrey Bezos, CEO of Amazon, is worth almost $200 billion.[34] There is still very much catching up to do.

Final Thoughts

Even though my interest is primarily engineering education, I am totally aware of the fact that what we have today is based on some fundamental and faulty beginnings.

The first has to do with our constitution. As noted by Simon Schama, "True history is the enemy of reverence. We do the authors of American independence no favors by embalming them in infallibility, by treating the constitution like a quasi-biblical revelation instead of the product of contention and cobbled-together compromise that it actually was …. as one of Jefferson's favorite books, Gibbon's *Decline and Fall of the Roman Empire*, so luminously argued, "there is no surer sign of a country's cultural and political decay than an obtuse blindness to its unmistakable beginnings.""[35]

The second problem is American hate. United States Representative Ilhan Omar stated that "American hate is not new – and is not scarce. While November 8, 2016 acted as a wake-up call for many Americans, to most people of color and indigenous people, the election of President Trump served as an affirmation of our nation's divisions. We have never truly defeated hate. We merely allow it to take new forms …. We need to recognize that racism has never been subtle, though it has gone underreported …. This is the same fight as the civil rights movement, the civil war – we are fighting over human rights. So the solution is not compromise. The solution is to educate."[36]

It is with that thought that I conclude, speaking from a strictly technology viewpoint, is that Black people have not participated proportionately. For historical and other systemic reasons, they neither have the power, technical education, nor the wealth that technology has brought others.

Will the Black community participate in and benefit fully from future technologies? Will the educational system improve sufficiently in time? Do we as a nation have the humanity to

recognize what has been denied to a key part of our society, and find a way to make up for it? The answers to these questions are difficult and complex, but hope is eternal.

References

[1] Hamilton, A., "Alexander Hamilton's Final Version of the Report on the Subject of Manufactures", *National Archives*, December 5, 1791, accessed at https://founders.archives.gov/documents/Hamilton/01-10-02-0001-0007

[2] Klein, C., "The Spies Who Launched America's Industrial Revolution", *History*, January 10, 2019, accessed at https://www.history.com/news/industrial-revolution-spies-europe

[3] Public Broadcasting System (PBS), "Samuel Slater: American Factory System", *PBS*, accessed at http://www.pbs.org/wgbh/theymadeamerica/whomade/slater_hi.html

[4] Bellis, M., "Francis Cabot Lowell and the Power Loom", *ThoughtCo*, July 25, 2019, accessed at https://www.thoughtco.com/francis-cabot-lowell-the-textile-revolution-1991932

[5] Yaeger, D., "Francis Cabot Lowell", *Harvard Magazine*, September 2010, accessed at https://www.harvardmagazine.com/2010/09/vita-francis-cabot-lowell

[6] United States Congress, "The Homestead Act of 1862", *National Archives*, June 2, 2021, accessed at https://www.archives.gov/education/lessons/homestead-act

[7] Goldenberg, R., "African-American Troops Fought to Fight in World War I," US Department of Defense, Feb 1, 2018, accessed at https://www.defense.gov/News/News-Stories/Article/Article/1429624/african-american-troops-fought-to-fight-in-world-war-i/

[8] "History of Technology and Engineering Education," University of Maryland Eastern Shore, 2022, accessed at https://wwwcp.umes.edu/tech/history-of-technology-and-engineering-education

[9] U.S. Census Bureau, "Quickfacts: United States", *United States Census Bureau*, November 2021, accessed at https://www.census.gov/quickfacts/fact/table/US/IPE120218

[10] Roy, J., "Engineering by the numbers", *American Society for Engineering Education*, July 15, 2019, accessed at https://ira.asee.org/wp-content/uploads/2019/07/2018-Engineering-by-Numbers-Engineering-Statistics-UPDATED-15-July-2019.pdf

[11] All data generated from records available at http://reports.umd.edu, University of Maryland College Park, November 2021.

[12] Letters to the Editor, "Opinion: How to create a coherent American community", *The Washington Post,* May 2024, accessed at https://www.washingtonpost.com/opinions/2024/05/27/america-immigration-mit-dei-diversity/

[13] All data generated from records available at http://reports.umd.edu, University of Maryland College Park, November 2021.

[14] *Indicators of Higher Education Equity in the United States*, The Pell Institute

for the Study of Opportunity in Higher Education, PennAhead Alliance for Higher Education and Democracy, 2021, accessed at http://pellinstitute.org/downloads/publications-Indicators_of_Higher_Education_Equity_in_the_US_2021_Historical_Trend_Report.pdf

[15] Harrison, S., "Five Years of Tech Diversity Reports – and Little Progress", *Wired*, October 2019, accessed at https://www.wired.com/story/five-years-tech-diversity-reports-little-progress/

[16] West, C., Sundaramurthy, G., Nichols, M., "Deconstructing the Pipeline Myth and the Case for More Diverse Fund Managers", Kaufman Fellows, February 4, 2020, accessed at https://www.kauffmanfellows.org/journal_posts/the-pipeline-myth-ethnicity-fund-managers

[17] West, C., Sundaramurthy, G., Nichols, M., "Deconstructing the Pipeline Myth and the Case for More Diverse Fund Managers", Kaufman Fellows, February 4, 2020, accessed at https://www.kauffmanfellows.org/journal_posts/the-pipeline-myth-ethnicity-fund-managers

[18] McKee, M., Sutherland, B., Johnston, P., "A Challenging Road", *The Margins*, Northeastern University, 2017, accessed at https://web.northeastern.edu/themargins/tech-was-supposed-to-be-the-great-equalizer/

[19] Simonite, T., "When It Comes to Gorillas, Google Photos Remains Blind", *Wired*, January 11, 2018, accessed at https://www.wired.com/story/when-it-comes-to-gorillas-google-photos-remains-blind/

[20] Krishna, A., "IBM CEO's Letter to Congress on Racial Justice Reform", *IBM*, June 8, 2020, accessed at https://www.ibm.com/blogs/policy/facial-recognition-susset-racial-justice-reforms/

[21] Angwin, J., Larson, J., Kirchner, L., "Machine Bias", *ProPublica*, May 23, 2016, accessed at https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing

[22] Obermeyer, Z., Powers, B., Vogeli, C., Mullainathan, S., "Dissecting racial bias in an algorithm used to manage the health of populations", *Science*, Vol. 366, No. 6464, pp. 447-453, Oct 25, 2019.

[23] Various, "Fatal Force", *The Washington Post*, October 30, 2021, accessed at https://www.washingtonpost.com/graphics/investigations/police-shootings-database/

[24] "GBI Investigates Officer Involved Shooting in Atlanta," Georgia Bureau of Investigation, June 13, 2020, accessed at https://gbi.georgia.gov/press-releases/2020-06-13/gbi-investigates-officer-involved-shooting-atlanta

[25] Cobb, J., "The Man Behind Critical Race Theory", *The New Yorker*, September 13, 2021, accessed at https://www.newyorker.com/magazine/2021/09/20/the-man-behind-critical-race-theory

[26] Sawchuk, S., "What Is Critical Race Theory, and Why Is It Under Attack?," *Education Week*, May 18, 2021, accessed at

https://www.edweek.org/leadership/what-is-critical-race-theory-and-why-is-it-under-attack/2021/05

[27] Editorial Board, "Opinion: Narrowing the U.S. wealth gap is important. Narrowing the racial wealth gap is urgent," *The Washington Post*, July 30, 2021, accessed at https://www.washingtonpost.com/opinions/2021/07/30/us-wealth-gap-race/

[28] Lane, C., "Opinion: Would reparation for slavery be constitutional?", *The Washington Post*, August 12, 2019, accessed at https://www.washingtonpost.com/opinions/would-reparations-for-slavery-be-constitutional/2019/08/12/76677182-ba10-11e9-b3b4-2bb69e8c4e39_story.html

[29] Editorial Board, "Opinion: Narrowing the U.S. wealth gap is important. Narrowing the racial wealth gap is urgent," *The Washington Post*, July 30, 2021, accessed at https://www.washingtonpost.com/opinions/2021/07/30/us-wealth-gap-race/

[30] "Robert F. Smith," Vista Equity Partners, May 31, 2022, accessed at https://www.vistaequitypartners.com/about/team/robert-f-smith/

[31] Dolan, K.A., Peterson-Withorn, C., Mille, R., "Forbes World's Billionaires List," *Forbes*, May 2022, accessed at https://www.forbes.com/billionaires/

[32] Hinchcliffe, E., "The number of Black female founders who have raised more than $1 million has nearly tripled since 2018," *Fortune*, December 2, 2020, accessed at https://fortune.com/2020/12/02/black-women-female-founders-venture-capital-funding-vc-2020-project-diane/

[33] "Selling Beats to Apple made Dr. Dre 2014's highest-paid musician," The Verge, December 12, 2014, accessed https://www.theverge.com/2014/12/12/7382813/selling-beats-to-apple-made-dre-highest-paid-musician-2014

[34] Wiles, K., "Jeff Bezos is no longer the richest person on the planet after his net worth drops $13.9 billion in one day," *MarketWatch*, August 2, 2021, accessed at https://www.marketwatch.com/story/jeff-bezos-is-no-longer-the-richest-person-on-the-planet-after-he-loses-13-9-billion-in-one-day-11627926841

[35] Schama, Simon., "The Founding Fathers, Unzipped," *Newsweek*, July 4-11, p. 4, 2011.

[36] Omar, Ilhan., "Ilhan Omar: Unity will take Generations," *Time*, August 2017, accessed at https://time.com/4904295/ilhan-omar-unity-will-take-generations