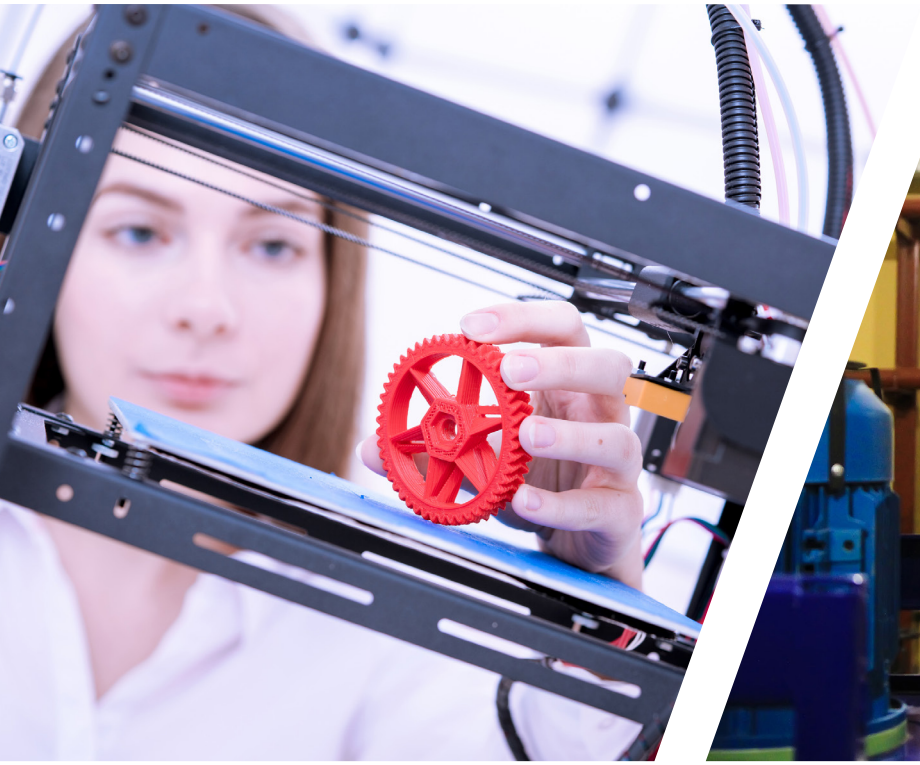
SALARY & CAREER REPORT 2023



A compendium of articles from

ElectronicDesign®

Microwaves&RF®

MachineDesign®

POWER&MOTION

SALARY & CAREER SURVEY 2023

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EDITORIAL

A Thirst For Excellence

BOB VAVRA, Senior Content Director,
Machine Design & Power & Motion

I've often said that it doesn't matter if a glass is half-empty or half-full; what matters is how thirsty you are. As the more than 1,000 engineers who responded to this year's Salary & Career Survey note, that perspective guides their enthusiasm about their craft and their outlook to the future.

These are challenging, turbulent times in design and engineering. A post-pandemic world has realigned our supply chains, our technology is changing the way we work, and we still have a chronic shortage of the engineers needed to navigate the next generation of manufacturing innovation. Yet engineers who are in the eye of this storm find value in their work and see it as a benefit not just to their company, but to society as a whole.

This e-book will take a deeper dive into the trends affecting various aspects of the design and engineering community—from electronics and test equipment to machine design and fluid power. There are several broader truths we've also gained from those engineers who shared their information and opinions with us again this year:

- **Engineering has value as a career:** The engineers who responded to the survey are experienced, with the majority having more than 20 years of experience in the industry. They see a secure career, with 70% saying engineering is as promising a career path as five years ago. Only 17% describe themselves as less than satisfied with their career, and 91.2% would recommend engineering as a career to young people. Still, the engineering shortage remains: 69.3% say it is difficult to hire people for new positions, with companies seeking between 3-5 years of experience for new hires. Software engineers and system engineers are the two most often-mentioned jobs needed, but there are needs for engineers across the board and in design, mechanical, electrics, power and RF experience.
- **Engineering is embracing technology:** We asked about all technologies, but the emergence of artificial intelligence and machine learning in the last two years prompted some specific questions around those areas. While one-third of respondents state their company is not actively using AI or machine learning at all, 52% are evaluating its use for design. Its value is still under discussion—33% see it as a competitive advantage and 32.8% suggest their industry is not yet ready for it.
- **Engineering matters:** The design and engineering professionals who responded to our survey have concerns ranging from finding qualified personnel to professional development. The issues that keep them up at night are specific to their finished work: reliability, quality and the availability of components. Financial concerns come further down the list, although staying current with technology is more of an issue (32.4%) than concerns about the general economy (30%). And they are more concerned with their general economy than they are about the condition of their own company's finances. What matters most to these engineers are company culture and values, job satisfaction, compensation and the change to design products that benefit society.

Despite all the challenges and change, design and engineering professionals are definitely glass half-full people. Even better, they have retained their thirst for their profession, and for excellence.

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Credit: Dreamstime, Zimmytws

CHAPTER 1:

First Takeaways from Our 2023 Career & Salary Survey

WILLIAM WONG, Editor, Senior Content Director, *Electronic Design & Microwave & RF*

Beyond coverage of key elements of your job, this year's Electronic Design Career & Salary Survey takes a deeper look at the impact of AI and its regulation.

We just wrapped up our group-wide salary survey and I have a few tidbits to get things started. A bunch of articles coming up will delve more into the details. Our editors will present different aspects of the results, such as continuing education, how collaboration is changing, and where we're working. An eBook containing all of the articles will be available soon.

In general, things are looking up, with many of the same concerns as last year, such as supply chain and hiring issues. The outlook remains promising, but challenges remain. The technologies impacting your designs include perennial favorites—power management, wireless networks, and test equipment—though areas like security are becoming more important (**Fig. 1**).

We asked a few questions about artificial intelligence (AI) and machine learning (ML). They're having a major impact on the tools and platforms we use regardless of whether we're designing products targeting image processing or motor control.

There's definitely a concern about AI/ML regulation (**Fig. 2**), but the technology is having a positive effect for those who are using it. AI/ML is also acknowledged to offer a competitive advantage in a variety of applications. That's not to say its use is pervasive because engineering and software designs address a wide array of application areas—not all need or can use the current crop of AI/ML tools or middleware.

Moreover, a sizable group still doesn't implement AI/ML anywhere, although it's creeping into search engines whether we like it or not (**Fig. 3**). It's also being added to our office and collaboration tools, but we tend to have more control over what's used and how we take advantage of it.

Our Annual Salary Survey page is where you will be able to find the in-depth articles. Thanks to all those who participated. Also let your voice be heard by leaving a comment or two once you read the articles.

Which of these technologies have a major impact on your designs? *Multiple options were selected.*

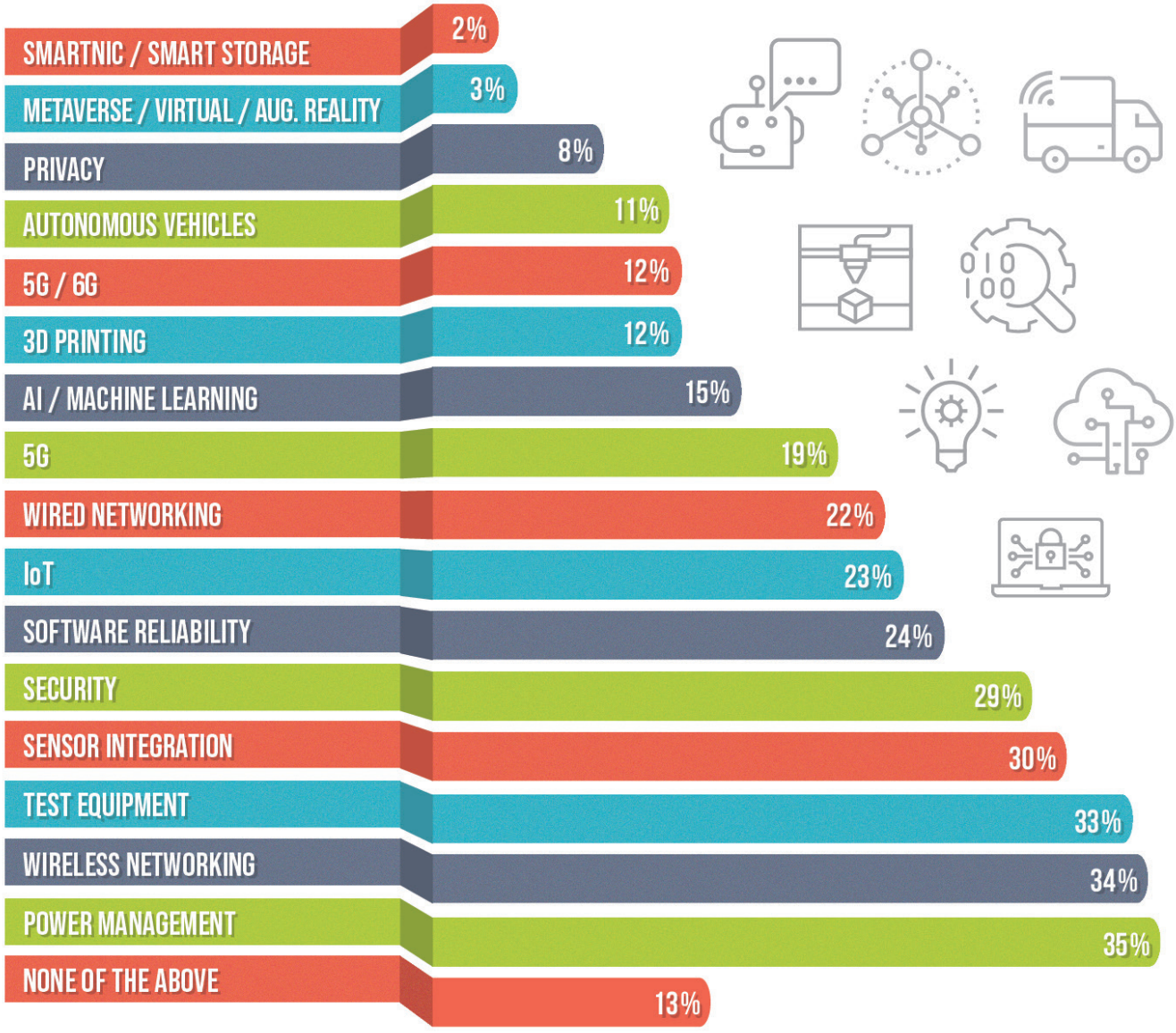
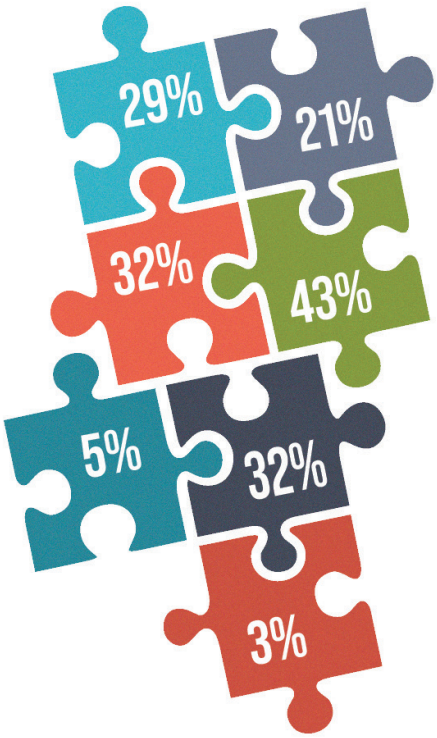


Fig 1. All electronic designs utilize power, and power management is at the top list (or bottom in the chart) in terms of design impact. Security and software reliability are becoming more important.

What do you think about artificial intelligence/machine learning?

Multiple options were selected.



- AI/ML HAS HAD A POSITIVE EFFECT ON OUR TOOLS AND PROCESSES
- AI/ML HAS HAD A POSITIVE EFFECT ON OUR PRODUCT
- AI/ML IS NOT READY FOR USE IN OUR SPACE
- AI/ML NEEDS REGULATION
- AI/ML DOES NOT NEED REGULATION
- IT IS A COMPETITIVE ADVANTAGE
- AI/ML IS CAUSING PROBLEMS FOR US

Fig 2. A significant number of people think that AI/ML isn't ready yet, but not by the majority of who responded. Still, the number of people think the tools and middleware are progressing well.

How has artificial intelligence/ machine learning affected your job?

Multiple options were selected.

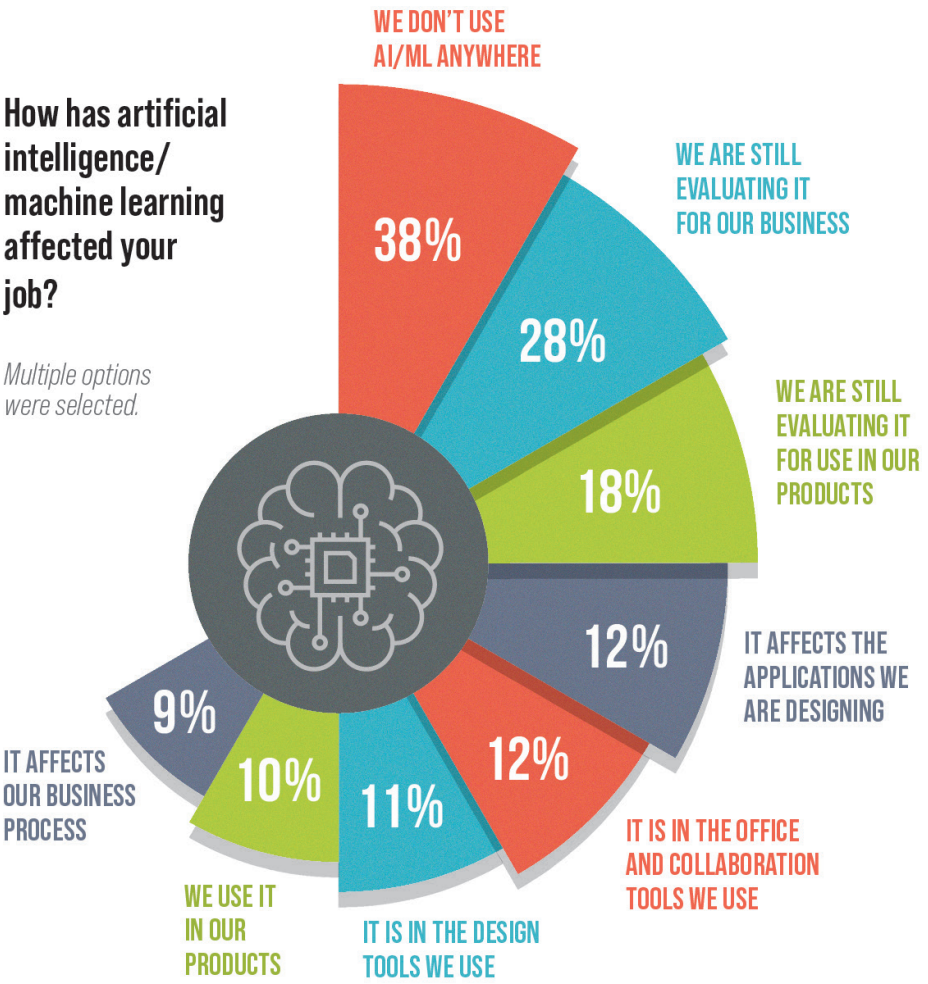
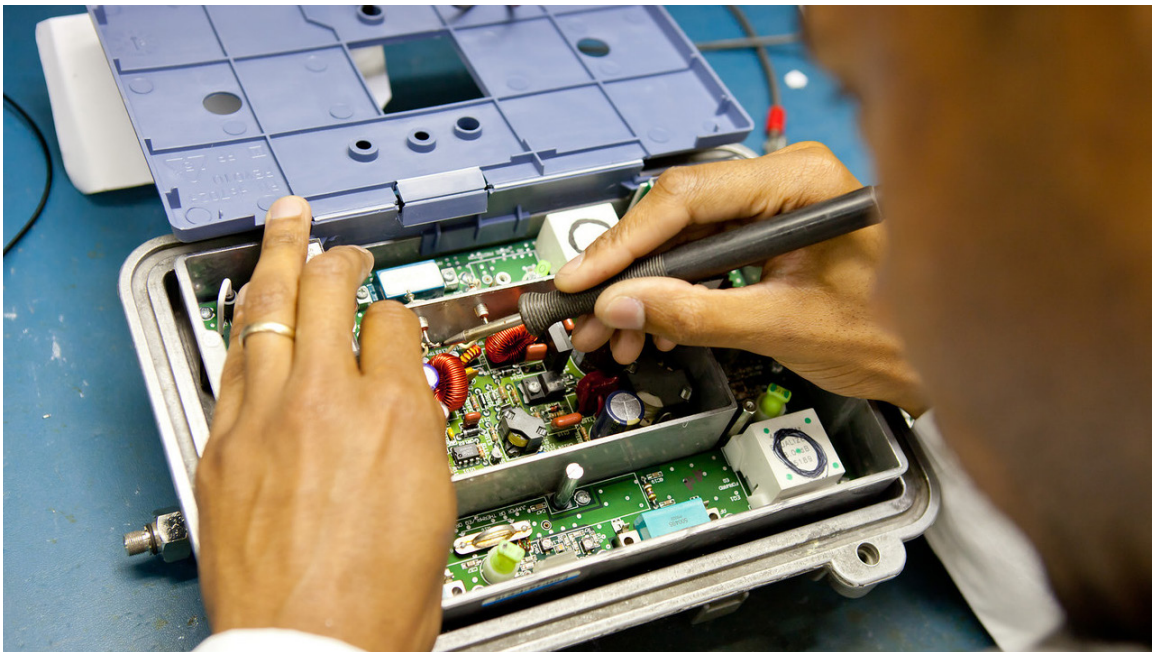


Fig 3. Most respondents either aren't using or evaluating AI/ML at this point. We'll see how this trend changes over the year.



Credit: Avnet

CHAPTER 2:

Employment Prospects for Engineers Are Looking Up

JAMES MORRA, Senior Staff Editor, *Electronic Design*

Are companies starting to realize they need to pay better to retain top engineering talent?

As technology and manufacturing companies seek out scarce talent to stay ahead of the innovation curve, engineers are seeing their stock rise. In such a tight labor market, they are getting more optimistic about their salary potential.

Nearly 70% of the survey's respondents said there are not enough engineers with the necessary skills—to go around, according to *Electronic Design's* annual salary survey, which was conducted in recent months along with the other titles in Endeavor Business Media's Design and Engineering Group. What skills are considered "necessary" are subjective and constantly changing. But as it turns out, 64% expressed their companies are having trouble finding qualified candidates—whether in electrical, mechanical, wireless, power, or other disciplines—to fill open positions.

While they continue to struggle with long hours, tight deadlines, and the pressure to take their work home, most engineers have a favorable outlook on their prospects for pay in the year ahead. Despite the challenges of staying up to date on the latest innovations, they feel confident for the most part about the future of the profession and their place in it. More than 65% of this year's survey respondents earned raises in 2023, and many anticipate further wage growth in 2024. But as inflation—particularly in the U.S.—keeps rising, these paychecks are not stretching as far as they used to.

The engineering profession is reaching a point where a large portion of the workforce is retiring. This is not only creating opportunities for engineers entering the field and those who are in the thick of their careers. But it's also raising red flags about the lack of engineering and technical talent entering the industry. According to a recent report from Oxford Economics, around 1.4 million jobs requiring such skills will remain open by 2030 in the US alone.

While many engineers admit that they need to move into management or executive roles to start seeing significant gains in compensation, the shortage of engineering talent

is paying dividends for those with skills in high demand. Some engineers believe their companies are starting to realize they need to pay better to lock down top talent. About two-thirds say employers are already compensating them sufficiently.

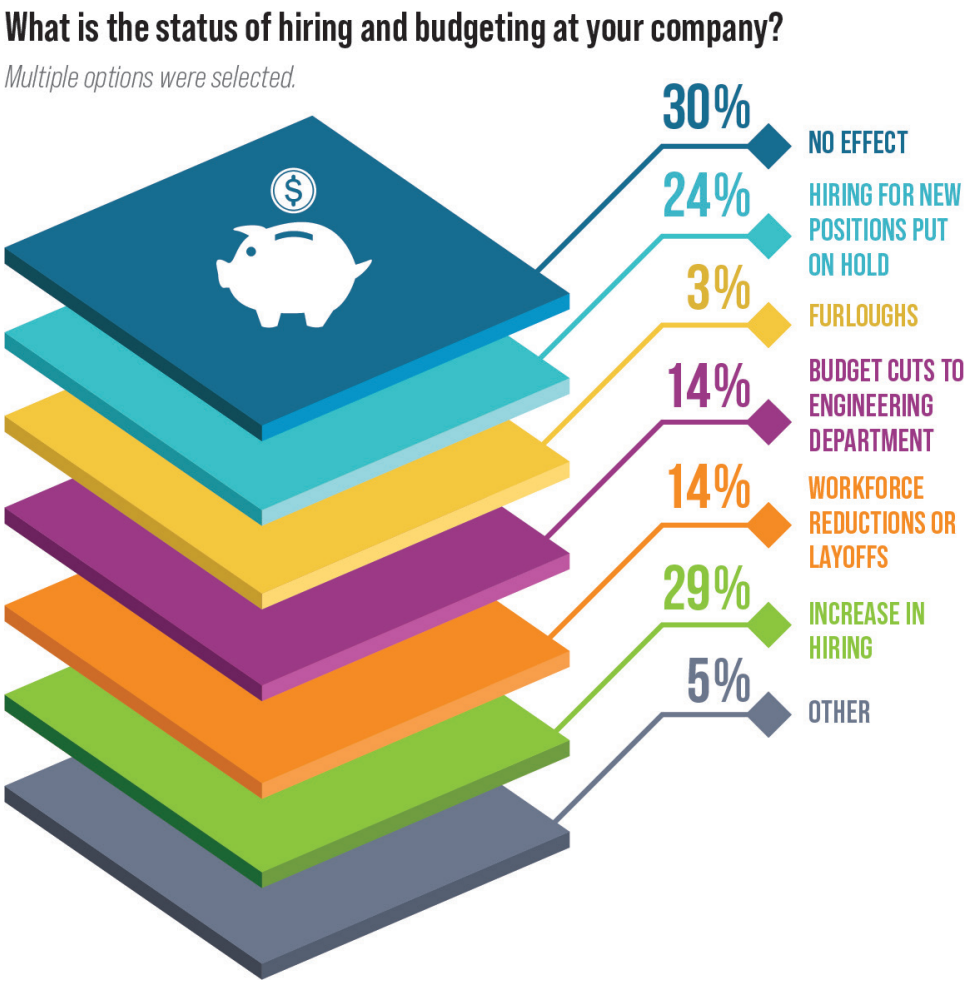
Engineering pros are a motley—and geographically diverse—group. This year's survey polled a sample of 2,660 engineers comprised of *Electronic Design, Machine Design, Microwaves & RF,* and *Power & Motion* readers. They include engineers around the world at varying stages of their careers in various areas of technical competence, including full- and part-time workers with a wide range of job duties and titles.

While we're still reviewing salary figures from the survey, here is what engineers are saying about their employment outlook.

Skilled Engineers See Their Stock Continue to Rise

The consensus from the rank-and-file engineers, managers, and executives on the front lines of the profession is that opportunities abound. Many companies are moving ahead with their hiring plans, undaunted by economic uncertainty.

About 30% say that the status of hiring and budgeting for the engineering department at their company is up in 2023, giving them a degree of stability at a time when—at least in the U.S.—high interest rates threaten to pitch the economy into recession. Less than 25%



of the engineers that participated in this year's survey say their companies have put hiring on pause due to business challenges or broader economic pressures.

On the other hand, only 14% of respondents say they have seen budget cuts to their engineering teams in 2023 and a roughly equal number of engineers say these budget cuts resulted in workforce reductions.

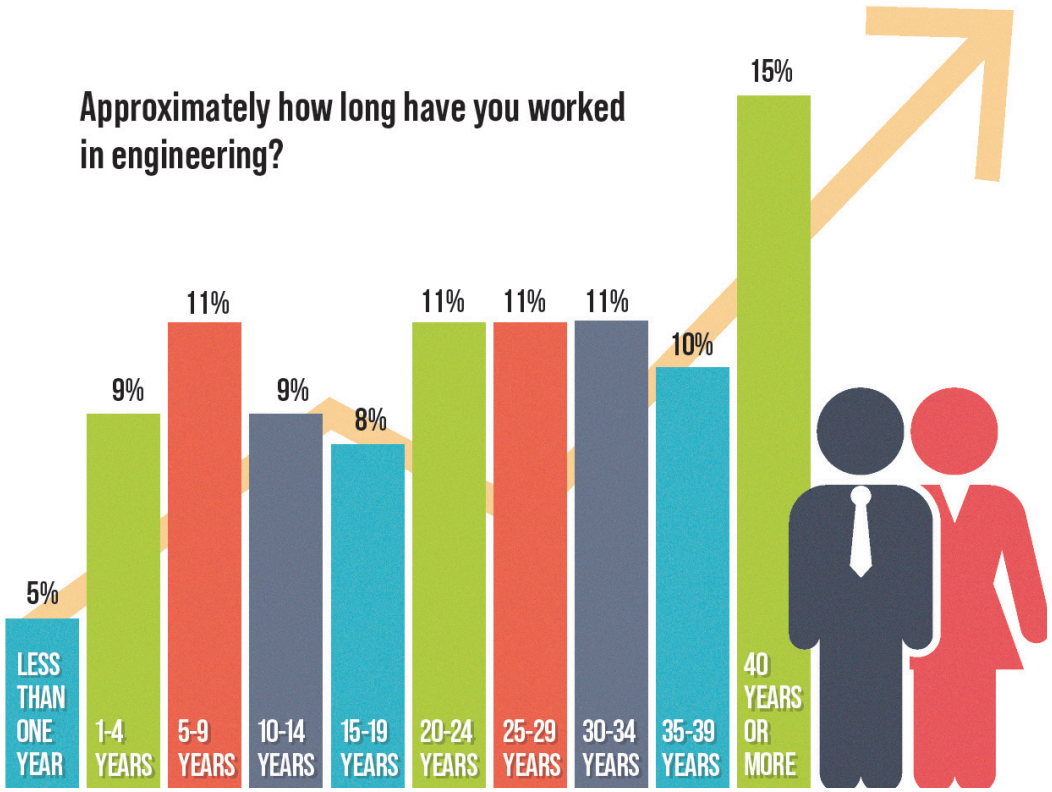
When asked about the employment outlook for engineers at their companies, about 39% of respondents said their employers intend to increase the number of engineering jobs in the coming year. More than 52% said that, to the best of their knowledge, their companies have no plans to expand or cut engineering staff in 2024. In contrast, only 9% are aware of plans to scale back engineering roles at some point next year.

Besides hiring more talent, companies are taking steps to hold onto their existing employers and reduce the productivity drain involved with recruiting and training new hires, including by offering raises or other perks.

About 65% of engineers say their companies are just as focused on employe retention this year as they were in 2022. While salary potential and the rush of researching and designing new products are critical factors, they're not all that matters to engineers considering whether to change jobs. The ability to work in team situations, a company's culture and values, and recognition from others all play into job satisfaction.

While many engineers feel as though they could be making more money in another career (or even at just another company), 90% vouch for engineering as a career path to young people looking for work that is personally fulfilling and comes with good employment prospects.

While the profession has its share of challenges, most respondents are upbeat about the



What is your status regarding new employment?

Multiple options were selected.

ACTIVELY SEEKING A NEW POSITION	15%
NOT ACTIVELY SEEKING, BUT WOULD FOLLOW-UP IF I READ OR HEARD ABOUT AN INTERESTING OPPORTUNITY	32%
NOT ACTIVELY SEEKING, BUT WOULD FOLLOW-UP ONLY IF PERSONALLY APPROACHED WITH AN INTERESTING OPPORTUNITY	35%
CANNOT ENVISION CHANGING JOBS IN THE FORESEEABLE FUTURE	30%
WORK FROM OFFICE REQUIREMENTS DO EFFECT MY DECISION	17%
WORK FROM OFFICE REQUIREMENTS DO NOT EFFECT MY DECISION	14%

salary potential in engineering and manufacturing disciplines, and about 70% feel it's as favorable as it was pre-pandemic.

More Stability, More Mobility in a Tight Job Market

So, what are engineers saying about the areas of technical competence where demand is highest?

The survey cited systems engineering (38%), software (33%), analog (27.5%), radio frequency (29%), mechanical design (27%), and power (23%) as areas where engineers—or their employers—are having the most trouble locating qualified candidates to fill job openings. While many engineers are folding AI into their products or employing it in their tools or processes, 21% say they are struggling to hire experts in the field.

When it pertains to hiring new technical staff, 45.6% warn their companies are requesting three years of experience or less in new hires, and another 39.4% are seeking those with five years of experience. Only about 14% are in the market for engineers with 10 years or more of experience. Of the engineers polled, about 33% said their company offers signing bonuses or other incentives to lure new engineering hires.

At the same time, engineers are changing companies more frequently in pursuit of higher wages or better working conditions. Only 12% say they have been with their employer for more than 25 years, 53% have been at their current employer for less than 10 years, and about 34% have been there for less than five.

Despite the challenges of maintaining an engineering career, most believe their pay is competitive with what other companies are offering workers with the same skills and level of experience. And they are for the most part content with their current jobs. However, many respondents are staying open to new opportunities.

While only about 15% of respondents are actively seeking new positions, another 67% say that they would follow up if they learned—or were personally approached—about a job opportunity that seemed interesting.

In general, engineers are changing jobs (and companies) more frequently than they used to. But most are staying put. Compared to last year, close to 90% said they have the same job this year, and most engineers that changed jobs said they were promoted or reassigned within the same company where they worked the prior year. Additionally, about 30% said they cannot imagine changing jobs in the foreseeable future.

For which engineering specialties are you having difficulty finding qualified candidates?

Multiple options were selected.

ANALOG	27%	MACHINE LEARNING/ARTIFICIAL INTELLIGENCE	21%
RF	29%	SAFETY AND SECURITY	15%
POWER	23%	MECHANICAL DESIGN	27%
DIGITAL	25%	SYSTEMS ENGINEERING	38%
EMBEDDED	26%	PHOTONICS	14%
SOFTWARE	33%	OTHER	12%

New Engineers Step Up Amid Generational Shift

Many engineers point out that the competition for talent is getting more acute given the generational shift taking place in the profession, where the typical engineer currently has 20 to 24 years of experience.

As the survey revealed, there is a severe imbalance between young and veteran engineers. About 25% of respondents have worked in engineering for less than 10 years. In contrast, another 36% have 30 years of experience under their belt, and many workers in this group are considering retirement at some point soon. It's unclear whether there are enough new engineers in the pipeline to replace them when they call it quits.

While younger engineers working today will cover some of the losses, efforts to convince students to pursue a career in engineering as well as recruiting and training young people with technical skills will be critical.

While many say that it was worth it to pursue a career in engineering, some are not sure they want to do it long-term. About a third of respondents say they have considered leaving the profession at some point.

For many of the engineers that have considered leaving (44%), they're interested in trying a different line of work. Others cited the desire for a less stressful career and/or for more freedom and free time after work.

Given the level of education and technical expertise required for the job and the increasingly wide range of responsibilities and technologies they must stay on top of to succeed, other engineers feel their salaries are out of step with what they bring to the table. And so, they have considered re-applying their skills to other industries that pay better. About 51% say they often handle tasks outside their primary area of expertise.

About 20% of the respondents stated that while they don't plan to start another career, they are ready to retire, further highlighting the challenges ahead for companies that are already struggling to recruit talent.

As the engineering shortage drags on, engineers with the right combination of skills and experience are only going to become more valuable assets. And it seems as though they are being rewarded for their efforts.

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Credit: Ai © Leowolfert

CHAPTER 3:

AI's Impact in the Engineering Workplace

CABE ATWELL, Technology Editor, *Electronic Design*

Are companies starting to realize they need to pay better to retain top engineering talent?

We know this: Artificial intelligence (AI) is a useful tool, time-saver, and a crutch in some cases. When some technological breakthrough rolls out, we instinctively gravitate to it and, in turn, becomes a part of our daily lives. Take the iPhone and subsequent touch-based phones that came afterward. They are, without a doubt, essential to our lives, fitting like a glove in how we access the world. And AI is following the same path.

Countless large data projects use AI to, for example, model molecules, detect cancerous cells, and/or enhance CRISPR tools or the production of biomolecules and materials. These are constantly running, constantly producing results that aren't possible with humans. The world of electronics has embraced AI, like machine-learning applications, circuit design, simulation, etc. Take Synopsys DSO.ai, launched in 2020. It has already produced over 100 production tapeouts through increased workflow optimizations and reduced design times.

Such increased productivity and accuracies through AI come at a cost. CNN reported that 212,294 jobs were lost in the tech industry in 2023 due to AI. Goldman Sachs predicts that 300 million jobs will be impacted in the next five years (via Forbes).

This is what humans do, we use technology and displace the old ways. Over 200,000 elevator operator jobs were lost with the use of automatic elevators. It took years to replace all of those workers. AI, on the other hand, is hitting us all fast—11 months and over 200k jobs already gone.

That said, AI will steadily grow in the workplace, which is indicative of the numbers detailed in a 2022 report from Global Market Insights. According to the report, the AIU engineering market is expected to grow by 35% by 2032 with a market value of $180 billion, up from $8 billion in 2022. That number alone is striking, considering it's a base driver for business expansion and long-term research projects in the AI engineering market.

Since ChatGPT launched, more engineers and companies have taken notice of AI's

potential, making it a top conversation across multiple industries and workplaces. From the instances of what ChatGPT has been used for in that time makes it easy to see why AI has been gaining momentum across the engineering fields.

How is AI Leveraged in the Workforce?

AI in the engineering workplace is broken down into hardware and software components. As machines become more sophisticated, they will support not only smart production lines and complex manufacturing tasks, but will also be able to design and improve tasks over time via machine learning (ML).

This is evident in many industries such as automotive and aerospace. However, it's also becoming more beneficial in the design phase of other industries, including using ML to glean insights from other departments to make the design process more efficient with

Which of these technologies have a major impact on your designs? *Multiple options were selected.*

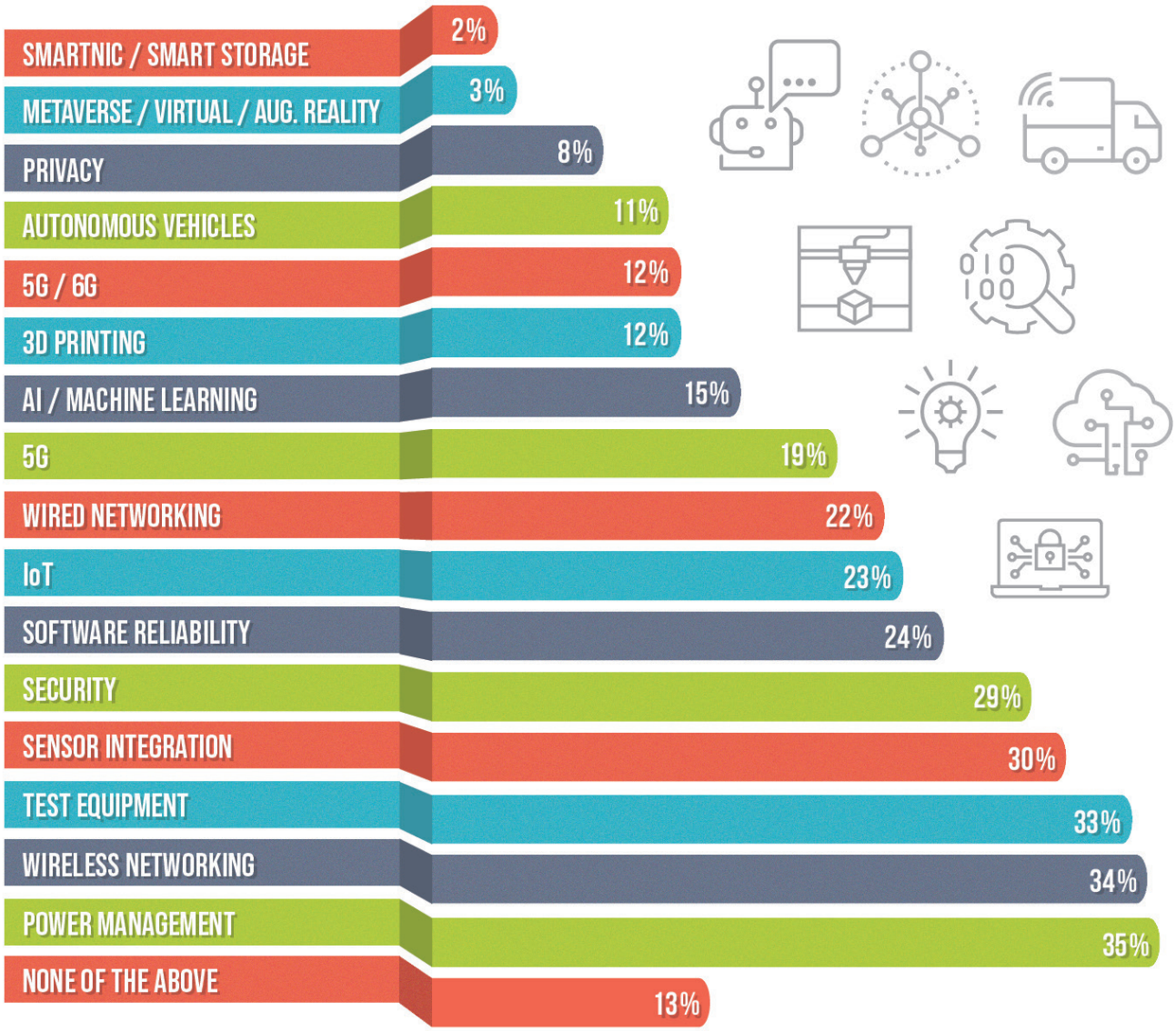

Fig 1. A significant number of engineers utilize AI and ML in their current projects across a number of fields.

increased precision.

AI is also being leveraged in the electrical engineering field, with the most prominent being the automation of routine tasks, including those for circuit design, component selection, and system analysis. It's also being used to provide new tools and techniques to aid in solving complex problems.

For example, engineers can use AI to create models that learn from data to make predictions based on a number of external factors, such as operating environments, temperatures, and power usage via simulations. Software engineers have taken advantage of AI to streamline repetitive coding tasks, including code conversion, converting data maps, and generating working unit tasks.

What Does the Survey Say?

According to a recent survey conducted by Electronic Design and others in the Endeavor Business Media group (**Fig. 1**), which polled engineers from diverse fields and garnered 1,977 responses, 21.25% stated AI and ML technologies have had a major impact on their designs. That's a significant amount, especially for a diverse group, with most employed in the design and development fields.

Another good portion of those engineers polled currently design industrial control systems and equipment, areas where AI tools help streamline everything from component placement to predictive maintenance.

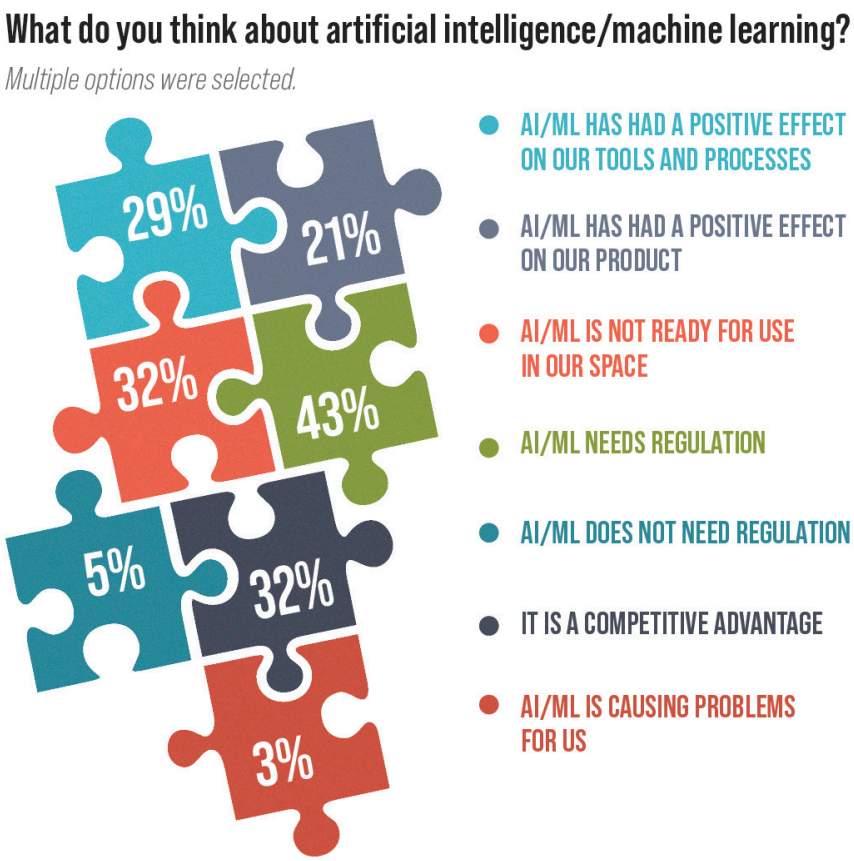

Fig 2. Not all companies and engineers utilize AI in the workplace, as some are in the evaluation process, while others feel it needs regulation before being implemented.

Of course, not all engineers see AI and ML as beneficial in the work environment. Among those polled, 7.46% have considered leaving the profession due to its impingement or the fear of eventually being replaced. These numbers aren't a reflection of engineers on a national scale, but they do represent the notion that some do consider AI to be a detriment to the profession.

For example, the same survey shows that some businesses and companies are still evaluating the use of AI in their practices (**Fig. 2**), while a good portion don't use it at all. Most feel that AI needs to be regulated before being implemented, while others say it provides a competitive advantage. Still, 3.59% feel AI is causing problems in the workplace or job functions.

Revolutionary—with Caveats

The integration of AI in the engineering workplace represents a transformative approach in much the same fashion as the industrial revolution, with its advantages and challenges. AI has provided engineers with powerful tools to automate tasks, optimize designs, and solve complex problems, which have led to increased efficiency and innovation. It has the potential to revolutionize the engineering fields, allowing workers to create complex projects at immense scales.

It also has its drawbacks, as AI raises concerns about privacy, security, and biases within the algorithms themselves. Ethics is also a serious concern, certainly when it pertains to intellectual and proprietary technologies and those who create them. These issues must be addressed—the concerns are valid and legal issues are already being scrutinized.

Ultimately, successful integration of AI in the engineering workplace will hinge on a thoughtful, ethical, and forward-thinking approach to maximize its benefits while mitigating its drawbacks. AI everywhere is an inevitability, but how we see it and use it will decide our fates.

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Credit: Istock, DragonImages

CHAPTER 4:

Engineers Bring Pride, Experience to Their Craft—and it Pays

BOB VAVRA, Senior Content Director, *Machine Design & Power & Motion*

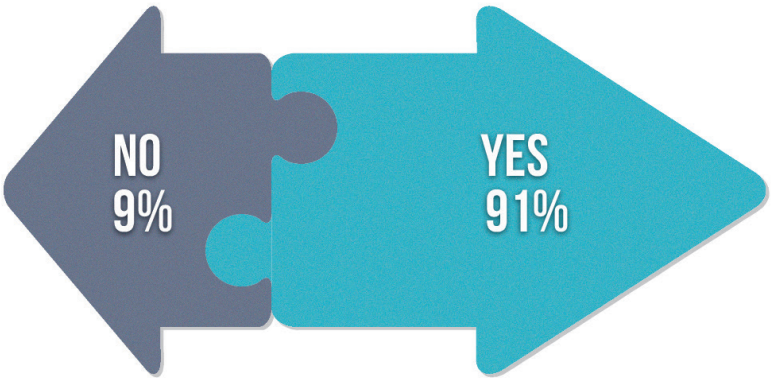
Machine Design's Salary Survey finds compensation grows as the job market remains tight and technology plays a prominent role.

In a time of turmoil, change and uncertainty, design engineers remain confident in the profession they've chosen, optimistic about their personal and financial growth and proud of the value they bring to their craft and to the world.

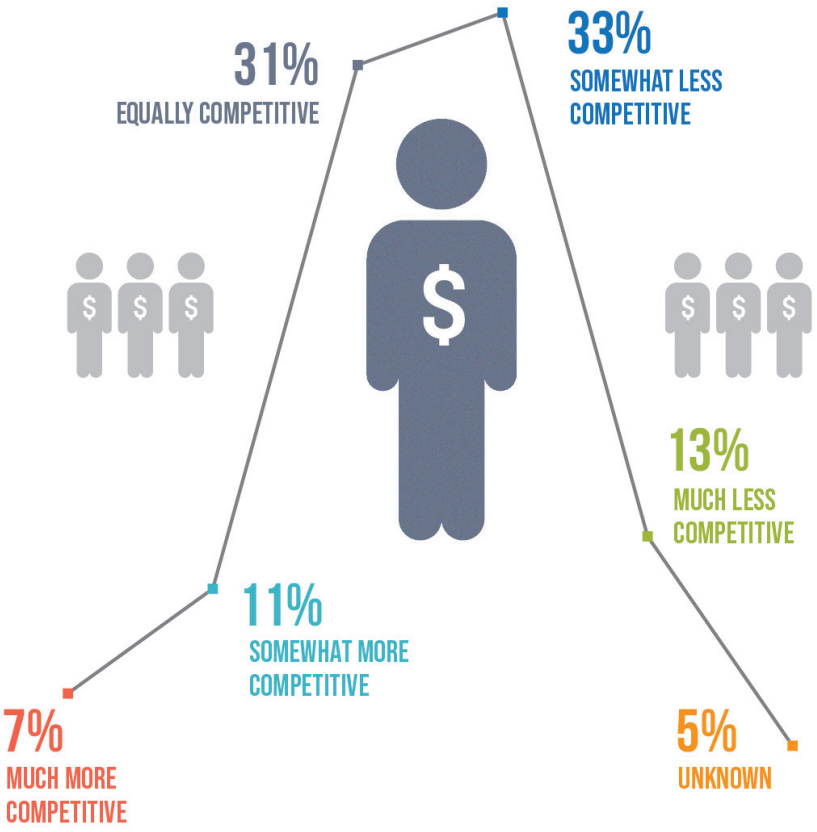
The *2023 Machine Design Salary & Career Survey* polled industry leaders from across the country to gauge their insights into compensation, technology adoption and the challenges they face in an evolving and data-driven age. This survey's data supports the idea that engineers are satisfied with their work and expect their compensation next year will match their skills in a very tight labor market. But it is their enthusiasm for their craft that provides the most telling clue about the future of engineering.

"The economy goes up and down, even major companies go up and down, but there are

Would you recommend engineering as a career path to a young person looking to choose a profession?



Generally speaking, how do you think your compensation package compares with what other engineering employers are paying?



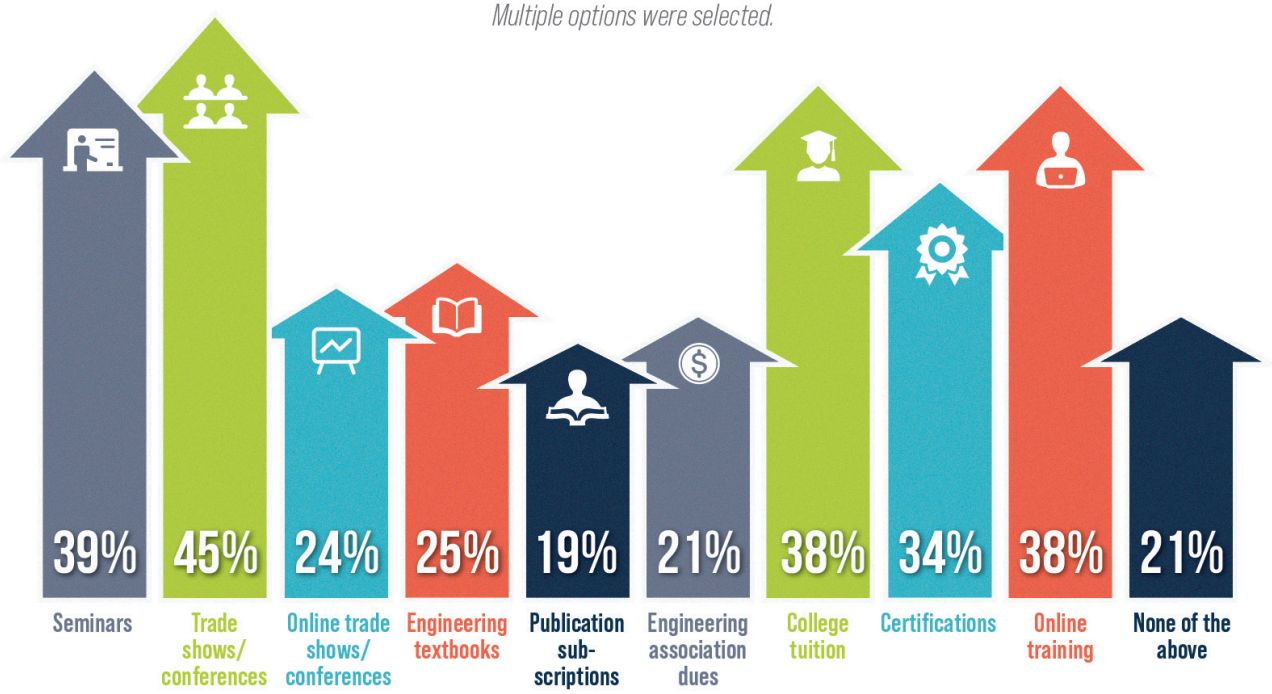
so many places where engineers are needed," wrote one survey respondent. Another wrote, "Overall, engineering has been a fulfilling career as I can see the real-life impact that I and my fellow engineers have had on society. It makes a difference."

The *Machine Design* survey was conducted in conjunction with other titles within Endeavor Business Media's Design & Engineering group. There are common themes across all of these engineering and manufacturing disciplines. When it comes to job satisfaction, for example, 43% of *Machine Design* respondents described themselves as very satisfied with their job, and another 41% said they were satisfied. That compares with 83% of Design & Engineering respondents who expressed their satisfaction with their job.

There is an equal struggle to fill engineering and manufacturing positions. Two-thirds of *Machine Design* respondents expressed there are challenges in filling engineering jobs, compared with 69.3% in the larger group. But respondents also said overwhelmingly that engineering was a career worth pursuing, with 70.3% stating that

For which of these forms of education does your company reimburse costs to engineers?

Multiple options were selected.



engineering was a good career path and 91.2% saying they would recommend engineering as a career.

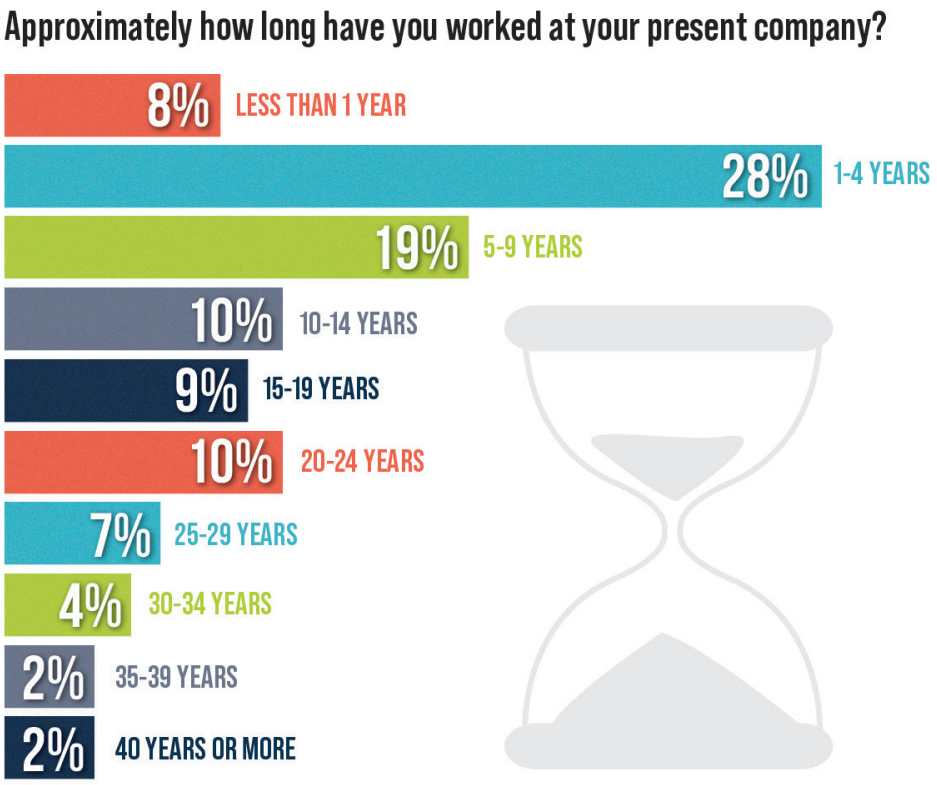
"We as engineers keep all the industries running and need to develop more innovation," one respondent wrote. Another said, "It requires a lot of sacrifice and dedication, but the results end up being worth the effort."

One other reader wrote, "Much of it depends on the individual. If you have a genuine interest in technology (and) how things work (and) solving problems, it will be rewarding. But engineering is hard. If you are looking for just a way to make a good salary, you will likely not like it."

Experience Pays

While there are some encouraging signs that the long-discussed engineering shortage is easing, there remains a large gap between young and veteran engineers. The 2023 Salary & Career Survey found that 29% of engineers who responded have fewer than 10 years of experience, while 46% have more than 25 years of experience. With that older group of workers eying retirement at some point in the near future, the experience pipeline that will follow this group them dries up quickly. It will take a combination of more engineers at the front end of the profession and the rapid maturing of the younger engineers to overcome this age gap.

In an industry that has long prized stability in employment, there also appears to be more mobility in engineering right now. Just 12% of engineers say they've been with their current employer for more than 25 years, while 56% have been at their current company for less than 10 years, and 16% have been there for less than five years.



One area helping bridge the employment gap is technology; another is compensation. In this latter area, engineers who responded to this year's survey are bullish about their prospects for increased pay in 2024. More than half of respondents received pay increases in 2023, and the expectations for 2024 are very high. More than 40% of respondents said their company plans to add engineers next year, and 63% believe there is an engineering shortage. As a result, 67% say their company is having difficulty finding new engineers, with more than half asking for three years of experience or less in their new hires.

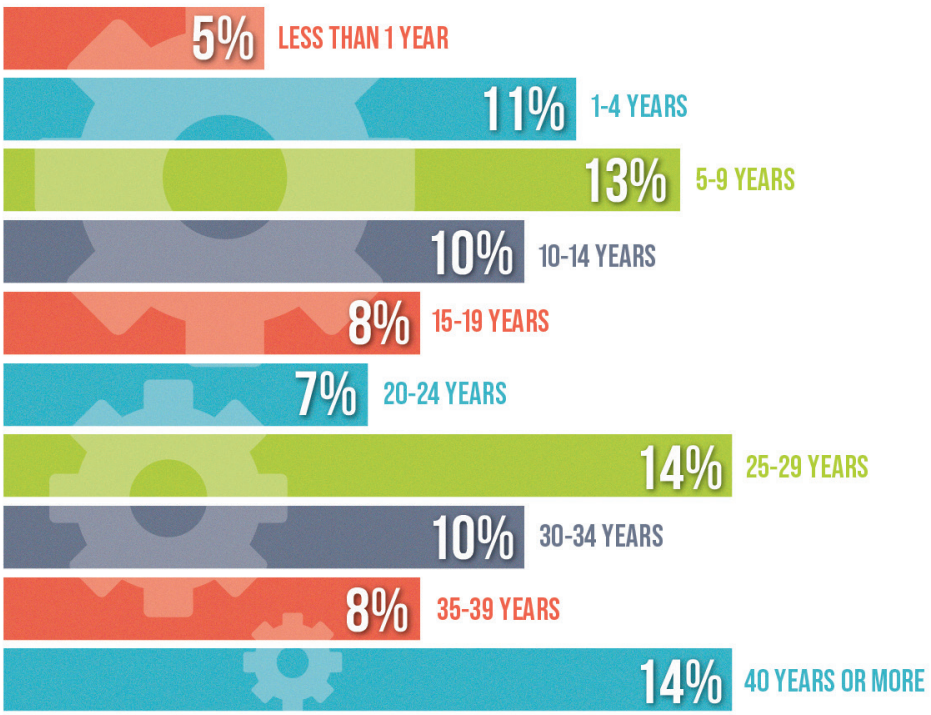
When it comes to direct compensation, 66% of engineers who responded said their current salary is $100,000 or more, with 53% making between $100,000 and $200,000 a year. In terms of other compensation, 72% of engineers earn some kind of bonus, with bonus programs about equally divided between personal performance and organizational performance. For some smaller manufacturers, profit sharing is another avenue of compensation, with 18.3% citing that as part of their pay package.

The combination of engineer shortages and planned expansions for next year make the design engineer a valuable part of the manufacturing team, and the engineers in the survey see that value being rewarded in 2024.

Only 26% of respondents expect their salary to remain the same or decrease next year, with 21% predicting a pay increase of more than 6% and 24.3% seeing an increase of between 4% and 6%. Even so, there is an almost even split among respondents about the competitiveness of their salaries, with 51.5% stating their salary was less competitive than their peers, and 48.5% saying their compensation was equal to or better than their fellow engineers.

One reader summed up the prevailing view by stating, "More and more people are retiring or changing companies. This opens opportunities within the current company. Also,

Approximately how long have you worked in engineering?



companies are in need of good help more than ever, so more is being paid/incentives given to attract and retain the best."

The Technology Factor

The advancement of manufacturing technology—robotics, sensors, data management, artificial intelligence (AI), machine learning and even full enterprise production management systems—have been seen as one way to fill employment gaps and improve operational safety and efficiency. At the same time, engineers need more training and a better understanding of how to use these technology tools to not just design better systems, but to connect that design to the larger operation at the outset.

The post-pandemic era has seen a return to trade shows, with 44.5% of engineers receiving reimbursement for conference attendance. More than one-third of employers also provide compensation for attending seminars (38.5%), college tuition (38.2%), online training (37.4%) and certifications (34.2%). Only 20.6% of respondents said their company does not reimburse for any outside training costs.

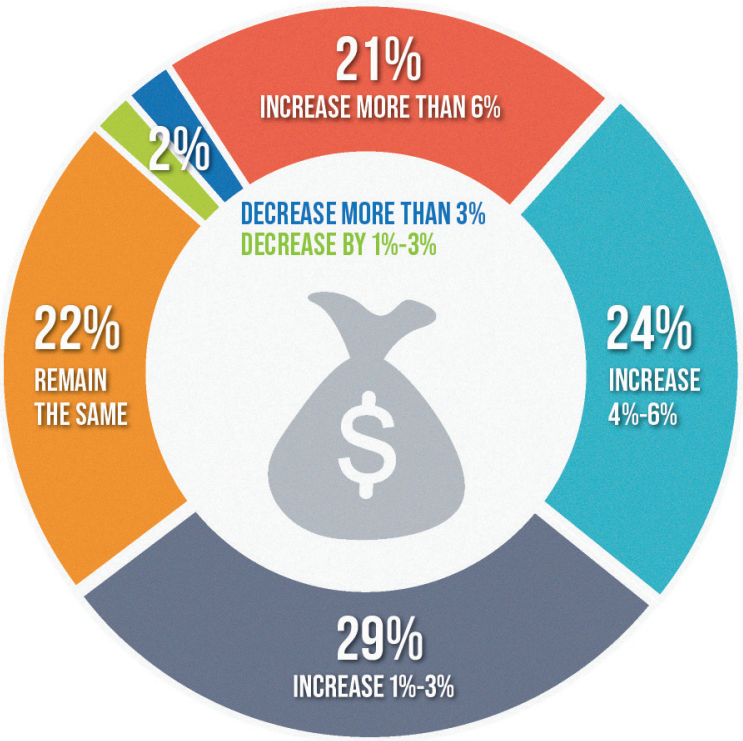
What are some of the ways you continue your engineering education?

Among other channels, the use of engineering videos as a source of information continues to grow, with 61.3% saying they use videos to further their engineering education. Trade publications such as *Machine Design* are next on the trusted resource list, with 54.3% using the publications and 48.3% utilizing the publication website. Seminars, engineering white papers and webinars and engineering textbooks also were cited by more than 40% of respondents as continuing education tools.

While robotics and sensors have become mainstream solutions, especially during the pandemic, the emergence of AI in the past three years has created fascinating possibilities and a discussion on how—or whether—to apply it to manufacturing issues.

There is a sharp division among survey respondents on AI, with 40.1% stating the industry isn't ready for AI and machine learning and 35.4% suggesting the use of AI needs regulation. On the other hand, 33% see AI and machine

How will your total 2023 compensation (salary, bonuses, etc.) compare to what you earned in 2022?



learning as a competitive advantage, 26.9% state it has a positive impact on tools and processes and 17% say it has an impact on products.

All of this led some of our survey respondents to tout the value of basic engineering—and the innate human intelligence it requires. "Engineering is more necessary with the continuing changes in technology and advancement of electronics," one respondent wrote. Another suggested, "Engineering is the backbone of all technological advancement. All disciplines revolve on engineering fields."

Other survey respondents were even more enthusiastic. "It's an amazing world to live in!" one wrote. "The scale of the awesomeness increases… when you get-in-there and apply your curiosity! Go learn about stuff and do amazing things!"

And another challenged the next generation of engineers: "Trained engineers are in high demand. Kids in college, stop playing and pay attention."

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CHAPTER 5:

How Do You Stay On Top of Technology?

DAVID MALINIAK, Executive Editor, *Microwaves & RF*

Technology marches on, but are you lagging in your proficiency? Our 2023 Annual Salary and Career Report survey provides a glimpse into the state of continuing engineering education.

When asked about challenges in staying up to date with evolving technologies, one respondent to our 2023 Salary & Career Report survey answered in a way that may be indicative of industry employment trends. “I’m expected to be current in a wide range of disciplines because of under-resourcing and hiring of junior engineers who need mentoring and bring little to the table initially,” we heard. If this situation sounds familiar—needing to wear multiple hats even as you help new talent—then you’ve got to somehow find time to learn about new technologies. It could be what enables you to prove your value to your organization, both through innovative work of your own and in getting newcomers up to speed.

Needing to scramble to accommodate accelerating change, with precious little time to do so, is a perennial requirement for electronic design engineers. Our survey asked about your current level of education and your preferred means of learning new tricks. We wanted to know whether your employer pays for continuing education, and if so, in what modes? In this article, we’ll look at these topics with facts, figures, and representative anecdotal responses. Bear in mind that for most questions, we asked you to “select all that apply,” so results won’t necessarily add up to 100%.

Education Levels on the Rise

How well are engineers educated, and how do this year’s results compare with the 2022 survey? The largest chunk of respondents holds a master’s degree (33.3% vs. 32% in 2022). Then there’s 25.6% with bachelor’s degrees (22% in 2022). Respondents with a bachelor’s degree plus some graduate studies are at over 14% this year, a slight increase from last year. Doctorates have made a bit of a comeback in 2023 at nearly 13% vs. last year’s 11%. Overall, current education levels are improving year-on-year compared to last year’s survey results.

Educational Options Abound

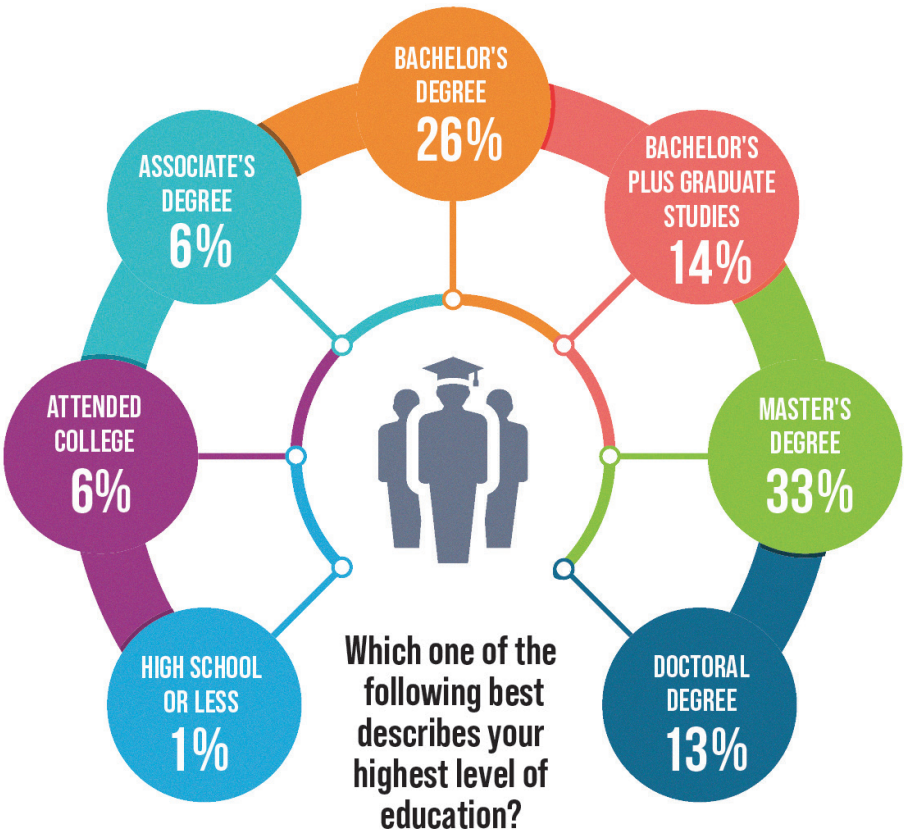
Regardless of whether you graduated from a prestigious technical college or worked your way up from the mailroom, there's no getting around the need to refresh your knowledge and skills. So, as we do each year, we asked, "What are some of the ways in which you continue your engineering education?" While last year was something of an off year for continuing education, this year's results indicate that more of you are taking advantage of opportunities to learn and grow professionally. It's fair to say that coming out from under the pandemic cloud could be the reason.

As usual, we've asked about your usage of various modes of education. You can always count on industry vendors to produce webcasts, videos, and white papers in large volumes. These items are invariably free for the asking (or registering). Most webcast providers make their events available on demand if you've missed the live streams.

In 2023, your most preferred means of getting up to speed on technology is engineering videos (62.4%). That's followed by engineering/technology publications at 62.2%, a significant rebound from 47% in 2022. Last year's #1 option, seminars, has fallen to #3 this year but is still up at 62% from 51% in 2022.

We broke out engineering/technology publications' websites in this year's survey, and 56.4% rely on those for news and information. White papers came in with 59% vs. 48% last year. You're turning to engineering textbooks more this year (48.7% vs. 35% in 2022); the same goes for e-books (41% vs. 35% last year).

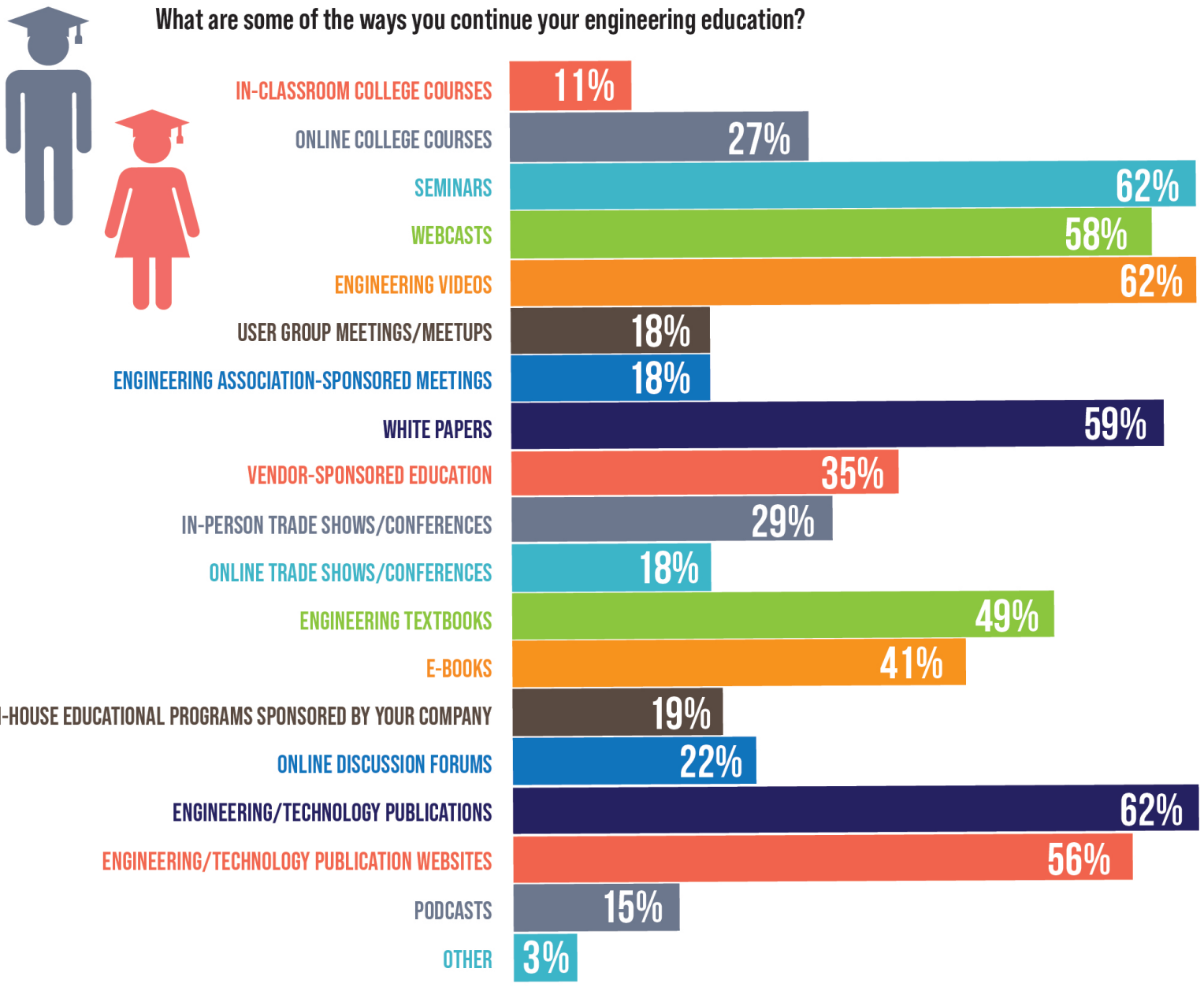
In-person education options are a mixed bag: Fewer of you are attending in-classroom college courses (11.3% vs. 14% in 2022) or showing up at user-group meetings and



meetups (18.3% vs 20% last year). But your tradeshow/conference attendance has risen from 26% last year to 29% in 2023.

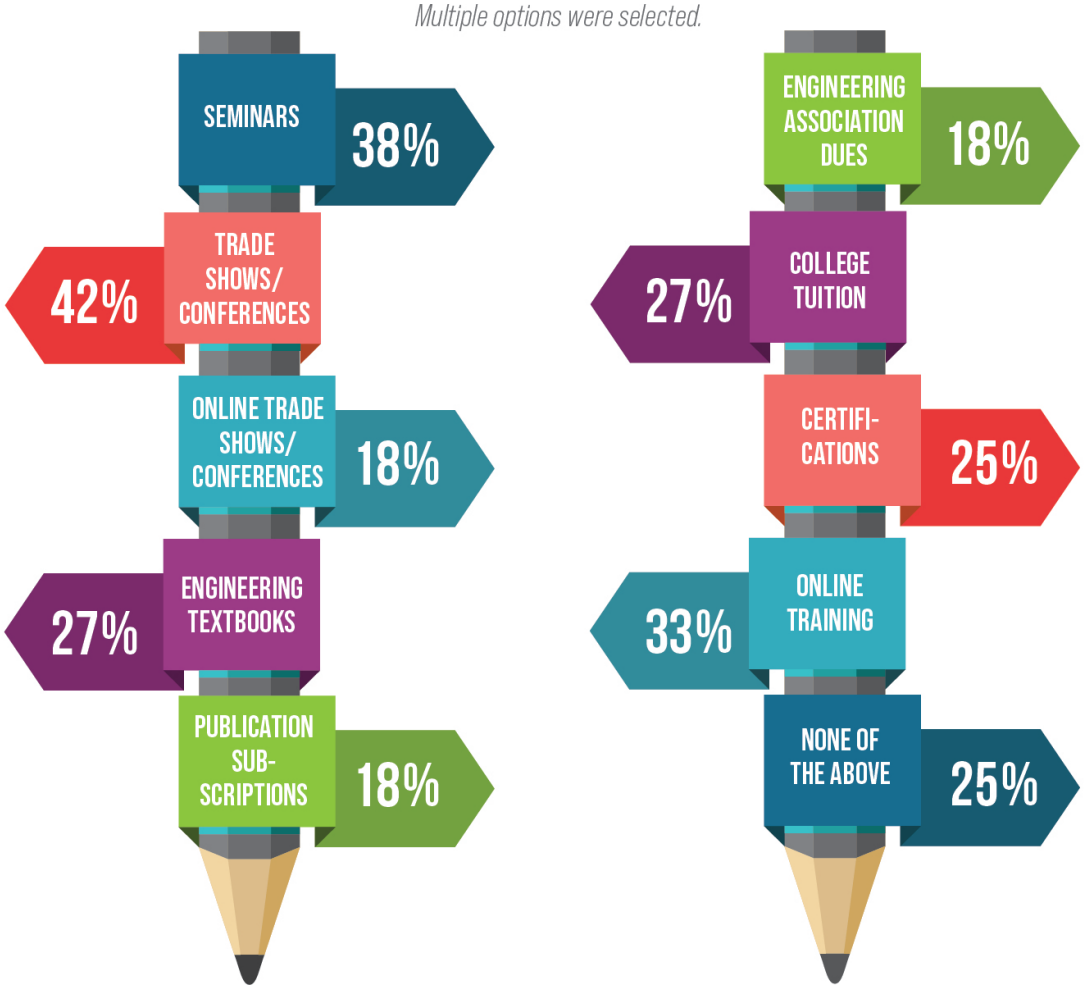
We asked about a few new education modes this year in addition to the publication websites. Some 34% of respondents avail themselves of vendor-sponsored events while 19% stop in at in-house education sessions sponsored by your employers. We wanted to know if you take advantage of online tradeshows/conferences, and about 17.6% say they do. Another category of education mode that's resurfaced in the wake of COVID-19 is podcasts, and 15.3% are tuning in.

There are educational options that are free of charge, but there's quite a few that are not. We asked whether your employers reimburse you for those costs. Sadly, 25% of you report that you're on your own in this regard. But over 42% say they'll recoup costs for attending



For which of these forms of education does your company reimburse costs to engineers?

Multiple options were selected.



tradeshows/conferences. Nearly 38% say the same about seminars, and about 32.5% get repaid for the costs of online training sessions. If you're taking college courses, over 27% get tuition costs back as well as costs for textbooks. Close to 25% are reimbursed for dues to engineering associations.

Time and Time Again

While fears of contracting disease have largely receded, enabling you to more readily get out to shows, conferences, and seminars, lack of time remains the perennial thorn in the side of the knowledge hungry. Compared to the general population, electronic engineers are a well-paid lot, but your employers are often getting more than their money's worth out of you. That's clear from the number of anecdotal responses to our survey decrying the surfeit of time for continuing education.

"[It's difficult to] make time available outside of work and personal time to stay current with advances in engineering and technology," one respondent said. "The technology moves along too fast to keep up," offered another, while a third observed, "Lots of information is becoming obsolete very quickly."

The imbalance between work and private life remains a concern for many engineers, as

any time spent with technical journals or watching videos at home means less time for the family and/or friends. “Any study of new tech has to be done on my own time with my own funds,” offered one respondent.

Then there’s the problem of the sheer volume of material to be had. What’s the source? What the heck do they know, anyway (“…sources who claim expertise when their knowledge is superficial.”)? Which material is useful now and which might be useful in the future (“… just filtering out the far-future stuff from that which might be relevant soon.”)?

The rate of technology change is a constant refrain among design engineers, who cite anxiety about keeping up with emerging technologies such as machine learning and artificial intelligence. “It’s a matter of navigating hype-fueled spam, focusing on content relevant to my job,” said one survey respondent. “It’s about filtering out all the ‘executive summary’ and ‘infomercials’ promoted as educational for engineers (generalized puffery),” adds another.

Without a doubt, staying abreast of technology trends and project-relevant information is a difficult endeavor. Here’s hoping you’re able to maintain and expand your knowledge base sufficiently in 2024 to keep you at the top of your game.

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Credit: Manufacturing © Wrightstudio

CHAPTER 6:

Engineering in the Cloud

ALIX PAULTRE, Editor at Large, *Electronic Design, Microwaves & RF*

Electronic engineering in the working environment of today can involve using remote tools, telepresence, and online collaboration. What does our annual Salary Survey tell us about the new working reality?

Electronic engineering has never been an easy vocation, and the pressures on the designer and developer to create products using the latest generation of technology and functionality continue to increase. Every year Electronic Design and Microwaves & RF conduct a Salary Survey among our readership to get industry views and perspectives from the EE community about the way they work and their thoughts on the marketplace from their perspective.

Close to a thousand readers responded this year to our annual Salary Survey, giving us a snapshot of the industry from the point of view of the working engineer. This is one of a series of analysis articles created by the editorial team using the answers to get a better understanding of the workplace environment and how engineers design, develop, and collaborate.

Working everywhere is the new reality

One of the biggest impacts of the pandemic was how it changed the way people work. Where once an engineer was expected to show up at the office every day, there are now a lot of people working from a home office as well (**Fig. 1**). Over 90% of survey respondents said they work from both a company office and their home, with a small but significant percentage of respondents (over 7%) saying they work from home full time now. This is still exceeded by the number that work completely in the office, which currently stands at about 20% of the community, and about 25% of respondents stated they have a partial work from office requirement.

The impact on where people work isn't just limited to the day-to-day aspects of the job, it also affects travel and other presence-based activities. When asked how the day-to-day of their work environment changed (**Fig. 2**) when it comes to travel, about 60% of the respondents said their work situation has changed. While about 40% of the readership are allowed to work from both the home and office, about 8.5% have a corporate ban on travel, and a little over 3% stated they are prohibited from attending live industry events.

The big takeaway from this set of questions is that the engineering community is reflecting the issues from the pandemic as a microcosm of how society at large is addressing it. In some ways the migration to a more flexible workplace environment can be a benefit to a working professional, but it depends how the company involved establishes the rules and relationships under which their employees work.

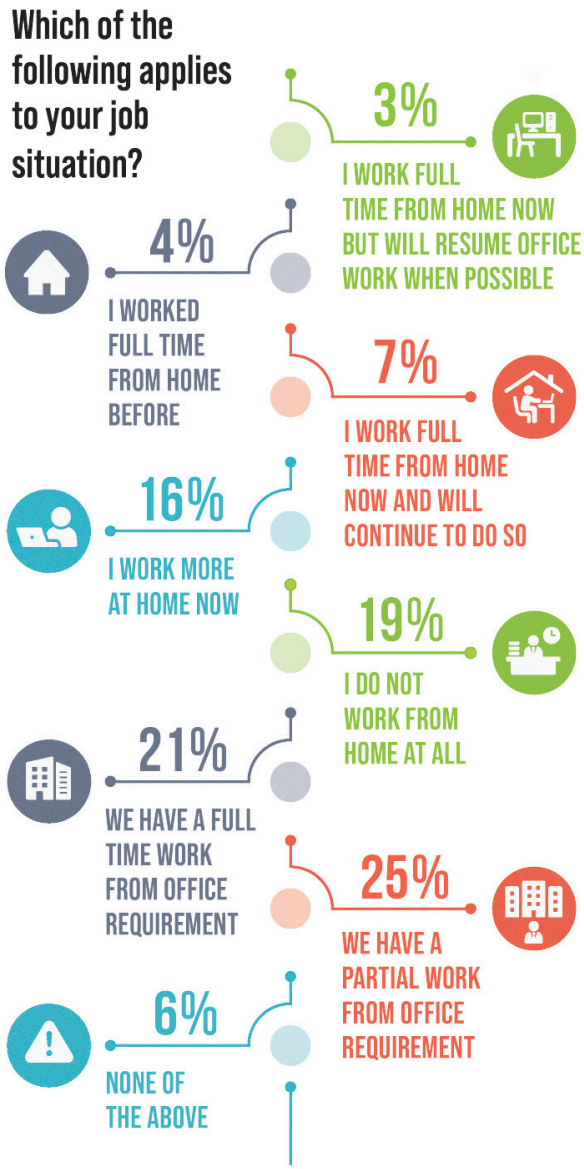

Fig 1. There are now a lot of people working from both a home office as well as a company workplace.

The tools engineers use to collaborate

The tools that engineers use to create, design, and develop have also been growing in utility and functionality, directly enabling people to be able to work from anywhere. Collaborative software design tools and other ways to coordinate efforts remotely existed prior to the pandemic, but in one way COVID19 created the "perfect storm" that pushed more companies and individuals to adopt them. This can even be seen in the expanded reliance on texts and emails to collaborate in a design effort.

When we asked our readers about the collaboration tools they are using on a regular basis, email was king at over 95%, exceeding even the telephone (65%) as a communications tool. Messaging and text chat applications made up about 75% of the responses, which was also the rough percentage of people using video conferencing software to collaborate (**Fig. 3**). VIrtual event platforms are also growing in prominence, with close to 20% Of course, all this remote work means that scheduling and planning tools (41%) are important to coordinate efforts and schedule events. To manage, track, and store the work done, about 40% of the respondents said they use Cloud-based file and document management solutions, and close to 20% use application-specific collaboration support tools. Even social media is making an impact in the engineering community, with over 15% of the readership saying they use it in their work.

In this expanded use of online tools, the engineering community is again mirroring the greater societal migration to a more online lifestyle, and not just in the working environ-

ment. The fact that social media is encroaching into the workplace underscores the expansion of the internet into more and more facets of our lives and working situation. The use and reliance on web- and Cloud-based tools and business solutions will only grow as time goes forward.

Collaboration and the work environment

When it comes to the new collaborative environment, the people you work with remotely could be members of an internal team, or they could be employees of companies you're partnering with. The need for cross-company collaboration is underscored by the new electronic design ecosystem, which is forcing many companies to work at the edges or beyond their usual areas of expertise.

This leads more and more companies to form development partnerships, where they leverage one another's skillset in the creation of a new design. Collaborative efforts not only address a company's strengths and weaknesses, they also help the individual engineer.

How has the day-to-day of your work environment changed? *Multiple options were selected.*

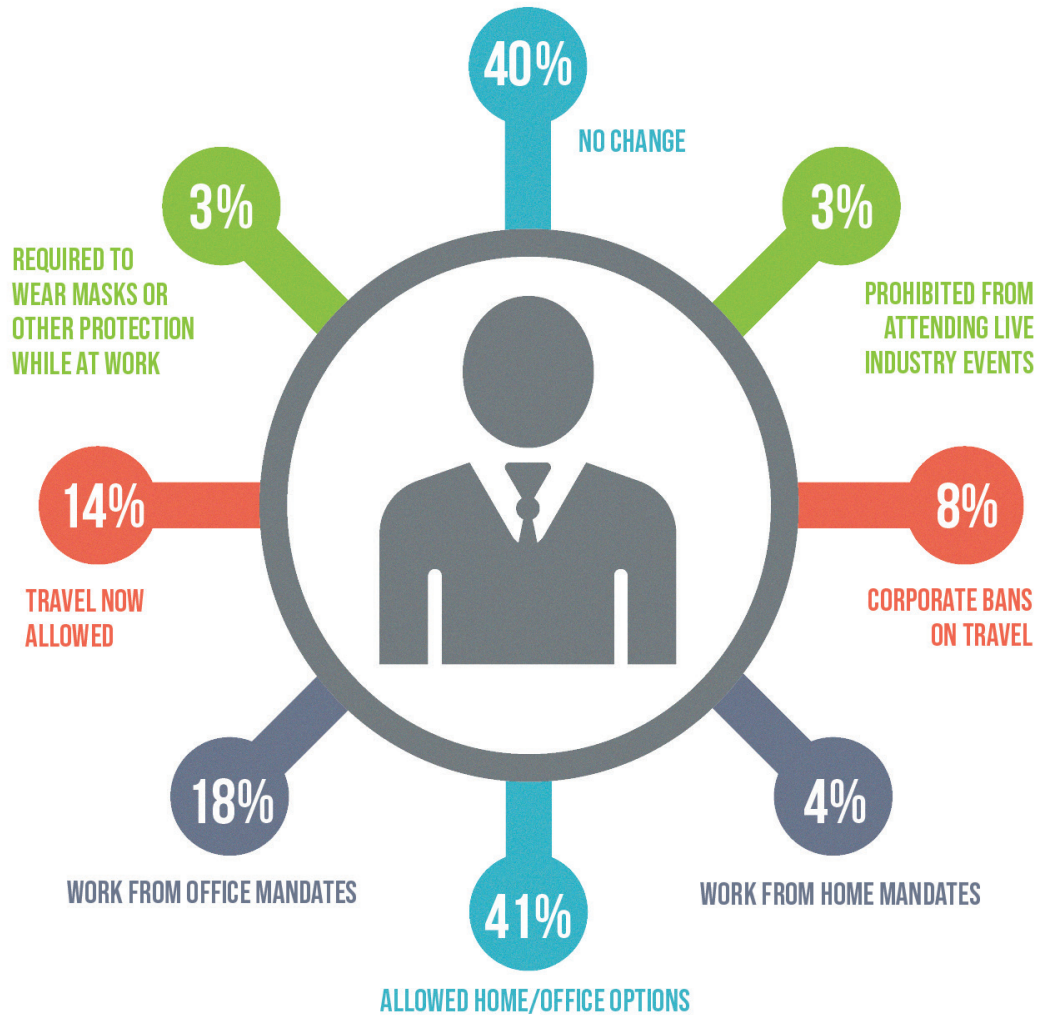

Fig 2. When it comes to travel, about 60% of the respondents said their work situation has changed.

Roughly half of the engineers replying to the survey said they were being given more tasks outside of their main expertise, and collaborative efforts bring in more people with a more diverse palette of skills.

When asked if they are doing projects involving collaboration with other companies, respondents replied with a resounding yes (over 65%), which means most of the companies in the electronic engineering business are working with at least one other company. This kind of cross-company collaboration demands that the tools used are highly functional, reliable, and resilient. Over 25% of the respondents said they are collaborating more with others than they did in the past.

Workplace issues

When it comes to the work itself, we asked our readership what keeps them up at night, and the number one issue on the respondents' minds is staying current with new and emerging

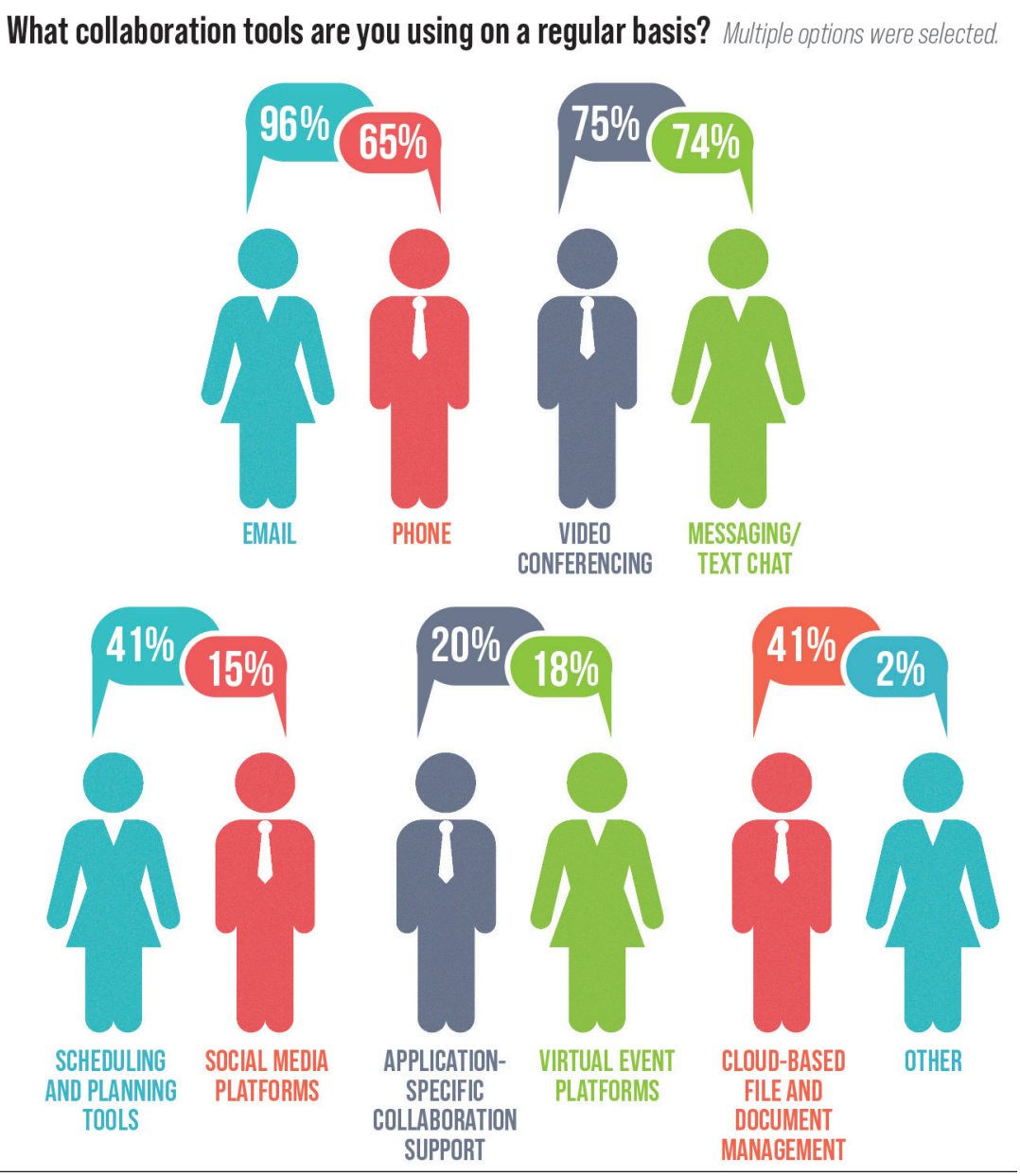

Fig 3. Email, texting, and video calls all beat out the telephone as a tool for collaboration.

technologies (33.33%). This was followed by concerns about the general health of the economy, at 30.41%, reflecting the personal concerns of the respondents (**Fig. 4**).

Other major concerns dealt with industry issues, such as component availability issues (31.54%) and component delivery schedules (19.84%). Of course they also worried about their own company as well, with product reliability issues (31.06%) and product quality issues (30.73%) foremost in their minds. When it came to issues resonating in the public space like age discrimination and outsourcing issues there wasn't much stress among the respondents, probably reflecting the professional career aspect of being an electronic design engineer.

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Fig. 4. The number one issue on the respondents' minds is staying current with new and emerging technologies.

Credit: Dreamstime, Nd3000

CHAPTER 7:

Engineering Remains Viable and Important Career Path

SARA JENSEN, Technical Editor, *Power & Motion*

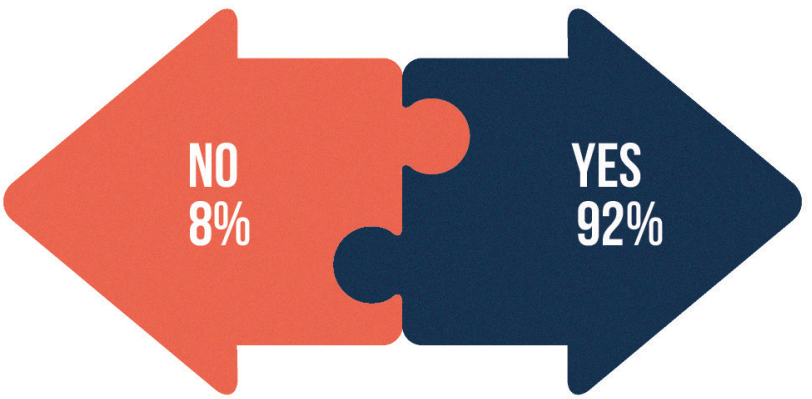
The engineering community remains positive about the continued need for engineers as technologies evolve.

A key finding from *Power & Motion's* 2023 Salary & Career Survey is not a surprising one – careers in engineering are important to the continued advancement of society yet filling open roles remains difficult.

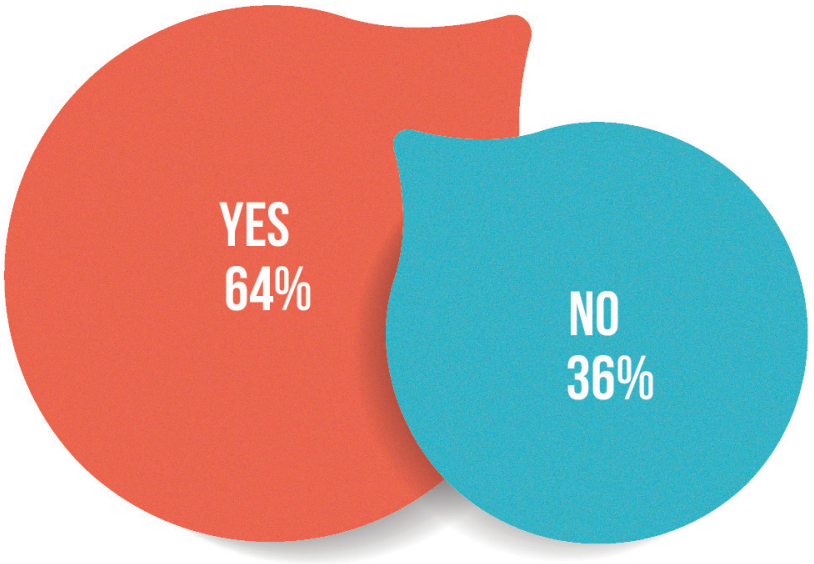
The majority of survey respondents, just over 68%, said they believe there is an engineering shortage while 63.6% said their organizations are having difficulty finding qualified candidates for open engineering roles. And this is not unique to the fluid power industry. Surveys conducted by affiliate brands to *Power & Motion* in the electronics and mechanical engineering space had similar results.

Engineering, like many industries, is reaching a point where there is a wave of people retiring and fewer people entering the field. The fluid power sector in particular has noted

Would you recommend engineering as a career path to a young person looking to choose a profession?



Are you being given more tasks outside of your main expertise?



challenges with attracting new talent as it is not necessarily an area of the engineering field many consider going into.

Efforts are being made by various industry associations and other organizations to educate younger generations about the opportunities in engineering, and fluid power specifically. These efforts may be starting to show as once again in 2023, a large portion of survey respondents – about 28% – noted being in the engineering field under 10 years.

The general consensus from this year's survey is that a career in engineering can be a rewarding one but more efforts may be required to overcome the shortage of those entering the industry.

Conditions Currently Positive for Engineers

Overall, there appears to be a sense of satisfaction among those working in fluid power engineering roles. The majority of respondents expressed feeling satisfied to extremely satisfied in their current roles, with just 15% indicating they are not satisfied. This was further demonstrated by the fact that just over 90% of survey respondents said they have the same job as they did in 2022.

Aspects which influenced this job satisfaction had a lot to do with the design work involved as well as company culture. About 77% said the challenges which accompany the design of new products were important or very important to their job satisfaction while another 70% noted the opportunity to design products that can benefit society being important to their job satisfaction.

Researching potential design solutions and the pressures associated with solving design problems were also highly rated as important factors.

Compensation was also an important satisfaction factor for many; most respondents, 61%, feel they are being adequately compensated at their current company with 35% saying they believe their employer is competitive with others in the industry in this regard.

However, 27% see their employers as somewhat less competitive regarding compensation

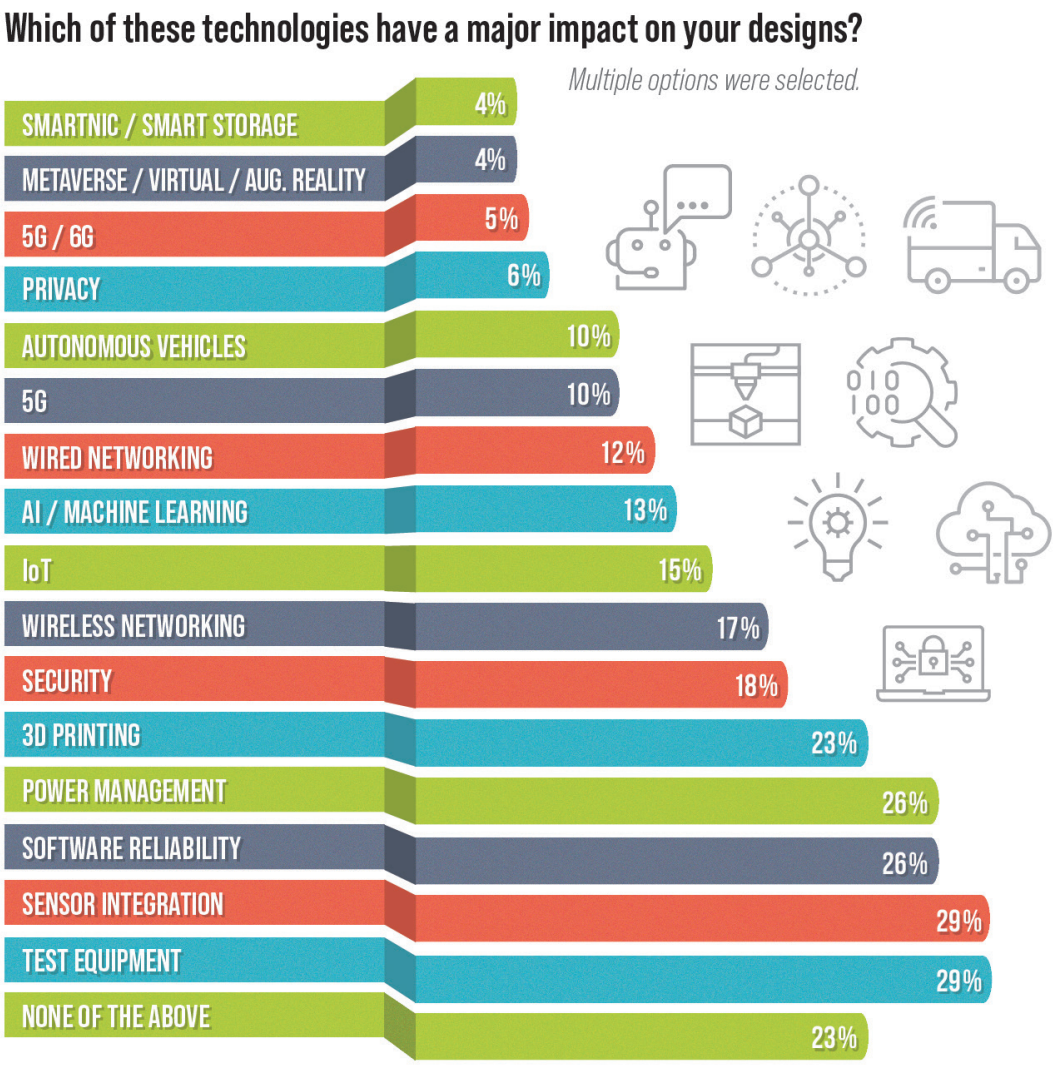
compared to other engineering companies. Over half of respondents, 53%, believe an 11-25% pay increase would better align their compensation with the work they do while 28% said just a 1-10% increase would help in this matter.

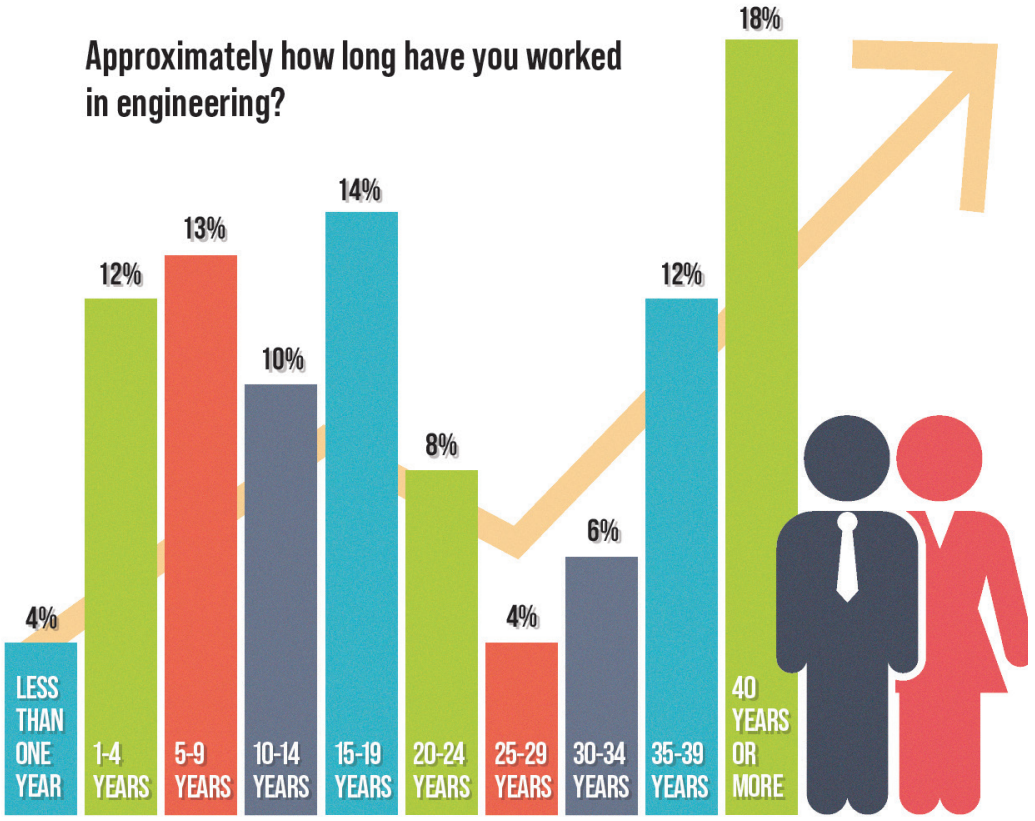
Most respondents, just over 80%, see their total compensation in 2023 increasing compared to the previous year with many indicating an increase between 1 and 6%. About 23% of respondents expect an increase of over 6%. These compensation expectations are more positive than those from 2022's survey results – 71% of respondents at that time expected a compensation increase with just 5% expecting one over 6%.

A larger majority in 2022, 23%, expected their total compensation to stay the same as the previous year while in 2023, just 16% of respondents felt this would be the case.

Given performance of the company or the individual, at 63% and 43% respectively, were noted as reasons survey respondents might receive a bonus or other payment above their base salary, it is possible to infer that the total compensation increases expected in 2023 are due to positive market conditions or employees making efforts to retain employees – or a combination of both.

Although most respondents are satisfied with their current jobs, 59% said they would follow up if they learned or were approached about an interesting job opportunity. Another





20% said they are actively seeking a new position while an almost similar amount, 22%, said they could not imagine changing jobs in the foreseeable future.

Job Challenges and Technological Influences

Today, there are a range of industry trends and technological advancements influencing product development – bringing about new design opportunities and challenges for engineers.

Almost 29% of survey respondents said sensor integration is one of the technologies having a major impact on designs. This is not surprising given the increasing use of sensors in hydraulic and pneumatic systems to collect performance data as well as improve control capabilities.

READ MORE about this growing trend - Sensors and Software in Motion Control:Key Benefits to Consider

Power management and software reliability were also noted as having a strong influence on designs. Increased emphasis on improving efficiency, due in part to the growth of electrification, and connectivity between systems and machines are likely drivers for this trend.

Also high on the list of technological impacts is 3D printing, with 23% indicating it having a major influence. There are several benefits which can be achieved with 3D printing including the ability to produce more complex geometries as well as lighter weight components. In addition, there is the opportunity to use fewer materials and reduce the

amount of machining required to produce a part, benefiting sustainability initiatives.

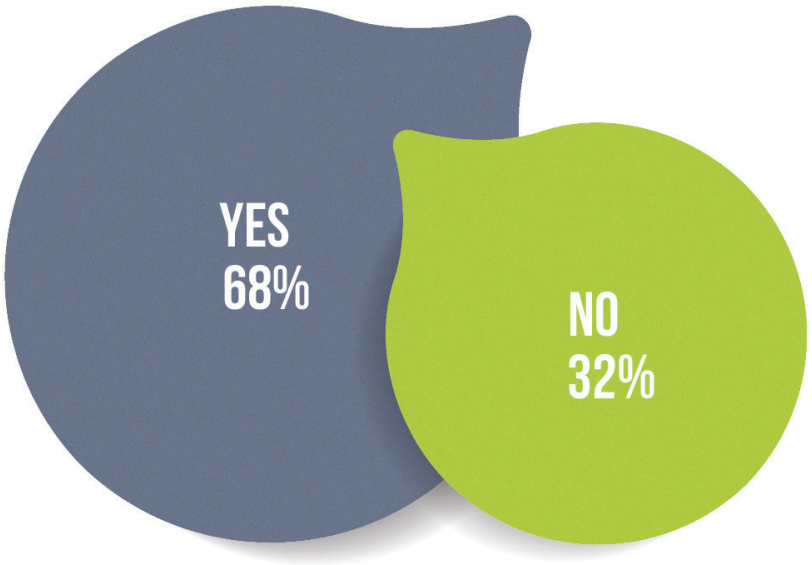
Use of artificial intelligence (AI) and machine learning (ML) is increasing in many industries, though only 13% of respondents said it is impacting their designs. Thirty-six percent of respondents said they are not using AI or ML in any aspect of their job while 31% said they are still evaluating these technologies for their business and another 24% said they are being evaluated for use in products. Just under 10% said AI and ML are impacting their business or products.

As far as what engineers think of AI and ML, there was an equal response rate at 35% that these technologies have a positive affect on tools and processes as well as not being ready for use in fluid power and needing regulation. Another 33% see these solutions providing a competitive advantage.

Similar sentiments were expressed in the surveys conducted by *Power & Motion's*

What are the professional issues that keep you up at night? *Multiple options were selected.*

Do you believe there is an engineering shortage?



affiliate brands, indicating the use of AI and ML in engineering is still in the early stages.

A number of respondents, 30%, said staying current with new and emerging technologies is a top professional issue keeping them up at night and over 60% of survey respondents said they are being given more tasks outside their main area of expertise.

Increasing development in the areas of electrification, automation, and connectivity, among others, mean electrical and mechanical systems are coming together more than ever, requiring many engineers to expand their knowledge base to ensure optimized performance of the components and systems they are designing.

Most respondents noted product quality issues as the professional issue which keeps them up at night, with just over 43% indicating as such. This was followed closely by 37% noting product reliability issues as a major area of concern. Also high on the list were component availability issues and delivery schedules, indications that supply chains are still a work in progress for many.

Long-Term Potential for a Career in Engineering

Though a career in engineering has its challenges – as any job does – the majority of respondents, 70%, said they believe it to be as promising a career path today as it was 5 years ago. The satisfaction levels and salary potential noted by survey respondents are good indicators of this sentiment.

In addition, many said the fact that roles are starting to open as a wave of engineers begin retiring will offer advancement opportunities for the next generation. Others specified the fact that ongoing technological advancements will require engineers of all types to develop new solutions.

As one respondent put it, “The world is changing faster than ever and will only accelerate. We need engineers to create effective products with these new technologies.”

Another respondent said, “The increase in the rate-of-change of technology is increasing the technology to learn and apply, as well as making it difficult for existing engineers to

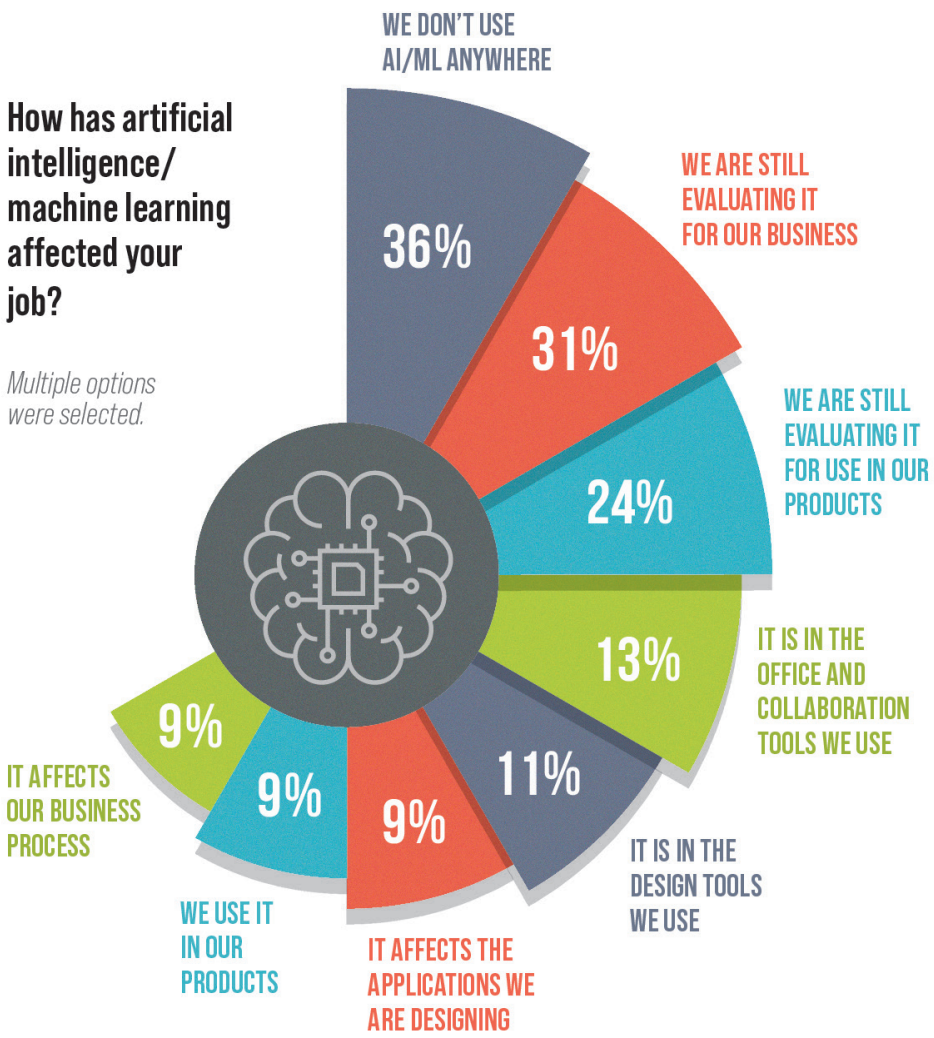
keep up. This increases the opportunity by making more positions in more new niches, as well as the opportunities that open due to attrition."

Numerous respondents also noted the lack of people entering the field and the difficulty of finding those with the skills required. Sixty-five percent of respondents said mechanical design was the specialty for which they were having the most difficulty finding qualified candidates. This was followed closely by 51% noting systems engineering as a challenging area to find skilled candidates.

Power, digital, and software were also high on the list of engineering specialties for which it is difficult to find candidates.

When it comes to filling open engineering roles, there was almost an even split between those who said their companies are looking to increase the number of engineering jobs at their company, 44%, and those who said their company plans to maintain their current level of engineers, 46%. Just 10% said their companies plan to scale back engineering staff.

Thirty-four percent said they see an increase in hiring at their companies though just under 20% said hiring for new positions have been put on hold with some indicating freezes have been placed on hiring other than for replacement of existing positions. Another 13% said budget cuts are being made to their company's engineering department but there were



also 33% which said they see no effect to hiring and budgeting taking place – indicating there is a bit of a mixed outlook in the fluid power engineering industry.

The anticipated market slowdown in 2024 could be a reason for this; growth for fluid power and its customer markets is anticipated to be slow or even flat before ramping up in 2025, so some companies may be holding off on hiring but they will also want to prepare for the growth expected in the remainder of the decade.

Besides hiring more talent, ensuring engineers who already work at a company want to stay there is just as vital. Most respondents, 67%, believe their companies are just as focused on employe retention this year as they were in 2022. For those companies looking to do so, the ability to work in team situations, company culture and value, and recognition from others were all highly rated factors for job satisfaction beyond the design work and compensation levels possible – and therefore aspects companies could keep in mind when looking for ways to retain as well as attract engineering talent.

While many see engineering as a good career path, 43% said they have considered leaving the profession at some point with 50% indicating their desire to try something different as the reason. Other highly rated reasons include doing something less stressful, having more free time and making more money.

Almost 20% indicated they were ready to retire, further signifying the generational shift that is starting to take place in the industry.

Just 5% said they consider leaving because of the poor job outlook for engineers which helps further support the mostly positive sentiments expressed by respondents throughout this year's survey.

The overwhelming majority of respondents, 92%, said they would recommend engineering as a career path to a young person who is looking to choose a profession. Respondents cited future opportunities, salary potential, an ever-increasing need for engineers, the challenging but satisfying work involved, and the variety of work possible as reasons they would recommend engineering as a career.

One respondent noted that because burnout – which 33% said is a reason they considered leaving the profession – is becoming better understood and handled, "engineering is a very engaging and necessary profession. Engineers can create massive positive change and are consistently challenged to think critically and learn more, which is very rewarding."

Another respondent said, "Engineering has the tools to let you fly, climb or think out of box."

With these and other positive sentiments expressed by respondents, it's clear there remains a bright future ahead for engineering.

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