



Robotics Engineer

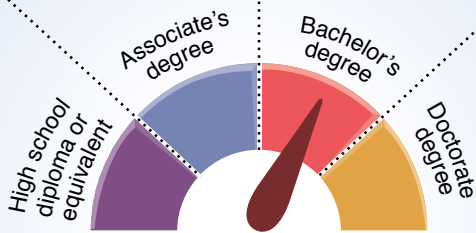
Kathryn Hulick

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ROBOTICS ENGINEER AT A GLANCE



Minimum Educational Requirements

Working Conditions



Personal Qualities

- ☒ Problem solving
- ☒ Creativity
- ☒ Attention to detail
- ☒ Strong science, math, and computer-programming skills

Median Salary

\$81,591



278,000*

Number of jobs

*Numbers are for mechanical engineers, a group that includes robotics engineers.

Percent job
increase by
2024

5%

Future Job Outlook

Source: Bureau of Labor Statistics, *Occupational Outlook Handbook*. www.bls.gov.

What Skills and Personal Qualities Matter Most—and Why?

First and foremost, robotics engineers must be very good problem solvers. They must have sufficient technical skill to recognize and understand a problem and enough creativity to think up an original solution. Robotics engineers must also pay close attention to detail—it takes focused dedication to solve difficult engineering problems. People in this career typically enjoy math, science, technology, and figuring out how things work. They may spend their spare time taking apart machines and putting them back together again.

Robotics engineers should also have a passion for robots and machines in general. “You have to have a lot of drive and really care about what you’re doing,”²⁵ says Corey Russell, a test engineer at iRobot. He explains that robotics engineers must sometimes work long hours to diagnose a problem or must implement a solution under a tight deadline. If an engineer loves what he or she does, putting in the extra time and energy the job requires is much easier.

Tackling Problems with Creativity and Persistence

Whether a robotics engineer focuses on electrical, mechanical, or software engineering or on some other aspect of robotics, he

or she will spend most days troubleshooting problems and developing solutions. This includes foreseeing problems before they occur. Eugene Kozlenko, a mechanical engineer who works on robotic limbs, is constantly coming up with creative solutions to problems. “You can’t go more than a few hours without having to come up with something clever,” he says. “Whether it’s the most cost-effective way to machine [build] a particular part, or coming up with a way to test a circuit that narrows down which component is acting up—every day is full of little opportunities.”²⁶

Thinking outside the box allows an engineer to come up with new, creative ideas every day. Paying strict attention to detail makes it possible to carefully analyze those ideas and plan a well-thought-out solution. Judgment and decision-making skills help navigate the numerous choices that go into designing or maintaining a robot.

Sometimes, however, a problem may seem too daunting. Or solution after solution might fail to fix the problem. It is at this point that a robotics engineer must have extreme patience and determination. He or she must be able to soldier on even when everything seems to be going wrong. Often, what separates an average engineer from a great one is the ability to persevere in the face of failure and frustration. “You have to keep a cool head when things don’t work because quite a lot of times they do not,” says Kozlenko. “I had a professor that told me to fail as often as possible because that’s how you learn, and that’s very true in robotics.”²⁷

Winola Lenore Rasmussen agrees. She is a computer science professor at WPI. She also owns a robotics company, Ras Labs, that produces synthetic muscles. She says it is important for robotics engineers not to get frustrated. “You learn as much from what doesn’t work as what does work,”²⁸ she notes.

“You can’t go more than a few hours without having to come up with something clever. Whether it’s the most cost-effective way to machine [build] a particular part, or coming up with a way to test a circuit that narrows down which component is acting up—every day is full of little opportunities.”²⁶

—Eugene Kozlenko, robotics engineer at Barrett Technology



Some robotics engineers specialize in one area or another. Regardless of specialty, most will spend at least some of their time troubleshooting problems and finding solutions.

Both General and Specialized Skills Are Needed

Robotics engineers need to have technical proficiency in a broad range of fields. This includes mechanical and electrical engineering, computer science, systems engineering, and more. Robotics engineers must be able to dip into knowledge from any or all of these disciplines when diagnosing a problem or envisioning a solution.

At the same time, it is also important for a robotics engineer to focus deeply on one particular area of engineering or robotics. The ideal robotics team contains engineers who each have their own distinct area of expertise yet are all familiar with the others' specialties.

Alex Owen-Hill is a writer who has a PhD in telerobotics. He says it is essential to maintain a balance between general and specialized skills. He explains:

As specialists, we are skilled in the fine details of our specialisms. As generalists, we are able to see “the big picture”—something our broad knowledge base allows us

to do. . . . We have to be good at mechanics, electronics, electrics, programming, sensing and even psychology and cognition. A good roboticist is able to understand how all of these different systems work together and is comfortable with the theory behind all of them.²⁹

Communication Skills Are Essential

Finally, all robotics engineers must be good communicators. First and foremost, they must be able to communicate well within their team of other engineers. Everyone must be on the same page about what needs to be done to improve a robot's design or fix an existing robot. "It's vital to communicate with the rest of the team, to come up with better solutions, and to be able to put the various parts of the solutions together,"³⁰ says Kozlenko.

However, robotics engineers must also be able to communicate very technical ideas to those who are not always familiar with them. These include salespeople, designers, and other colleagues who lack technical backgrounds but may be involved in making major decisions about the robot's design and function. Robotics engineers might also work directly with customers, who may or may not have engineering backgrounds. As such, robotics engineers must be able to explain technical issues and solutions in a way that non-technical people can understand. They must be able to understand needs, ask appropriate questions, and provide regular updates on progress in ways that are clear and accurate yet not overly technical.

"You learn as much from what doesn't work as what does work."²⁸

—Winola Lenore Rasmussen,
professor at WPI and owner
of Ras Labs

Since educational programs for robotics and engineering emphasize technical skills, students interested in the field may not realize the importance of writing and speaking. "Don't ignore your communications skills," says Maria Bualat, a robotics engineer at the NASA Ames Research Center. "You don't realize how much of your job is actually communicating your ideas to other people."³¹

Similarly, robotics engineers must also have good people skills, especially if they are promoted to a position that has management

Getting Your Hands Dirty

While robotics engineers spend a fair amount of time in front of a computer, they also enjoy building. Robotics technicians tend to do the majority of hands-on work with robots, including building them, repairing them, and running tests. However, robotics engineers also spend time hammering, soldering, wiring, and coding, particularly when they just want to test something out quickly. Students interested in robotics should therefore enjoy working with their hands.

Some robotics engineers love working with their hands so much they tinker with robots and other machines as a hobby outside of work. Robotics engineer Eugene Kozlenko has been tinkering ever since he created a water-powered jet ski from the parts of a water pistol and a remote-control car when he was twelve years old. “I always have two or three unfinished projects that I have lying around, just to keep my mind going,” he says. “Every now and then something I’ve been working on for fun becomes very relevant for something I’m doing at work.”

Quoted in Michelle Grottenthaler, “Rise of the Robots: Careers in Robotics,” WetFeet. <http://schools.wetfeet.com>.

responsibilities or customer-facing duties. Mauro Togneri, a management consultant who works with technology companies, says that a lot of engineers struggle with the shift from designing things to managing workers. “I always tell people when they become managers to keep in mind that while components such as transistors have predictable behavior, people’s behavior can, and will, change.”³² Paulo Younse, a robotics engineer at NASA JPL, agrees that it is essential for robotics engineers to have solid people skills. “The better you are at talking to people, working closely with them, showing them respect, helping them with their problems, and being a good leader, the better you will be at your job.”³³

Interview with a Robotics Engineer

Corey Russell received his master of science degree in robotics engineering from WPI in 2013. He now works at iRobot, a company that designs and sells vacuum-cleaning and mopping robots for use in the home. He spoke with the author about his career.

Q: Why did you become a robotics engineer?

A: Because it was awesome! In college, I was studying to be a mechanical engineer because I really liked math and physics. But I wasn't enjoying it as much as I thought I was going to. My school happened to have a robotics program, so I took the introductory course and fell in love with it.

A robotics engineer is a combination of four engineers, with the skills of a mechanical engineer, a software engineer, an electrical engineer, and a systems engineer all wrapped up in one person.

Q: Your job at iRobot is test engineer. Why isn't your title robotics engineer?

A: Robotics as an industry is growing very quickly, but a lot of employers haven't caught on yet that they need robotics engineers. But I think that's beginning to change. At iRobot, we do have robotics engineers. We also have electrical engineers, mechanical engineers, software engineers, and systems engineers who make sure everything fits together.

Robotics engineers get tasked with a lot of really challenging problems that require all the knowledge that comes with being a robotics engineer. They build theories and come up with ideas to get a project to a starting point, then they hand it off to people who are a little more specialized to do a lot of the rest of the work.

Introduction: Turning Science Fiction into Reality

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American Society for Engineering Education (ASEE)

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ASEE promotes education in engineering worldwide. It supports activities that increase student enrollment at engineering colleges and universities and fosters communication about teaching engineering among educational institutions, corporations, and governments. Members include engineering students, faculty, administrators, and professionals.

American Society of Mechanical Engineers (ASME)

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ASME welcomes all mechanical engineers, including robotics engineers. Members get access to conferences, competitions, journals, and more resources for advancing their careers. ASME programs support K–12 science, technology, engineering, and mathematics education; engineering and global development projects; student and early-career engineers; and public policy programs.

EngineerGirl

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