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# INTRODUCTION

In the first IEEE-USA e-book in this series on *Critical Thinking for Engineers*, we delved into analytical skills—the ability to examine something carefully, whether it is a problem, a set of data, or text. People with well-honed analytical skills create richer, better solutions to real-world challenges. In the second e-book in the series, on communication, we expanded on critical thinking—from that of an individual to that of a group—where both oral and written communications is essential to group effectiveness in achieving a team goal. The third e-book in the series, on creativity, explored approaches to creativity for both individuals and groups. In this fourth e-book in the series, we build upon our work thus far, by examining open-mindedness. To think critically, you need to be able to put aside any pre-conceived notions, assumptions, or judgments—and simply analyze the information you have. As Christopher Dwyer, Ph.D., at the National University of Ireland, states: “Open-mindedness is about being open to changing your mind, in light of new evidence.”<sup>1</sup>

In this e-book, we will dive into each of the following areas that collectively contribute to open-mindedness:

- Overcoming cultural bias
- Objectivity
- Humility
- Inclusivity
- Observation
- Reflection

Before we jump in, let’s start with an operating definition of open-mindedness, and why it’s important for engineers to cultivate the attributes mentioned above.

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1 <https://www.psychologytoday.com/us/blog/thoughts-thinking/201904/open-mindedness-and-skepticism-in-critical-thinking>

## What Is Open-mindedness?

Dr. Christopher Dwyer offers a rigorous definition in his *Psychology Today* article, *Open-mindedness and Skepticism in Critical Thinking*:

“Open-mindedness refers to an inclination to be cognitively flexible and avoid rigidity in thinking; to tolerate divergent, or conflicting views, and treat all viewpoints alike, prior to subsequent analysis and evaluation; to detach from one’s own beliefs and consider, seriously, points of view other than one’s own—without bias or self-interest; to be open to feedback by accepting positive feedback, and not to reject criticism or constructive feedback without thoughtful consideration; to amend existing knowledge, in light of new ideas and experiences; and to explore such new, alternative, or ‘unusual’ ideas.”<sup>2</sup>

In short, open-mindedness is about being willing to change your mind, in light of new evidence. The key word here is “evidence,” meaning based on data; rather than one’s attitudes, opinions, beliefs, assumptions, interpretations, or judgments.

## Why Is Open-mindedness Important?

A PricewaterhouseCoopers (PwC) survey of more than a thousand CEOs cited that “curiosity” and “open-mindedness” were leadership traits that are becoming increasingly critical in challenging times.<sup>3</sup> Imagine what would have happened to society, if the following lead investors did not have the foresight and open-mindedness to say “yes” to these business propositions:

- Shopping online for virtually any product (Amazon)
- A 100 percent electric car that goes over 200 miles without a charge (Tesla)
- Hailing a ride from your smartphone (Uber and Lyft)
- Streaming video programs—eliminating DVDs (Netflix)
- Easy sharing of stories and photos with your friends (Facebook)

In hindsight, of course, these propositions all look like easy bets; but at the time, they most certainly were not. It took open-minded and visionary founders and investors to bring the innovation to society at scale.

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2 <https://www.psychologytoday.com/us/blog/thoughts-thinking/201904open-mindedness-and-skepticism-in-critical-thinking>

3 <https://hbr.org/2015/09/why-curious-people-are-destined-for-the-c-suite>

## Overcoming Cultural Bias

You may recall the movie, *Hidden Figures*, a popular movie in 2014. It was based upon the true story of a group of female African American mathematicians who worked at NASA calculating flight trajectories for the Mercury Project and Apollo 11. The lead character, Katherine Johnson, died in 2020 at the age of 101.<sup>4</sup>



In many ways, she exemplified how a sharp, critically thinking person overcame strong cultural biases, and downright discrimination. How did she do it? Johnson said it best, “I didn’t allow their side-eyes and annoyed looks to intimidate or stop me. I would also persist, even if I thought I was being ignored. If I encountered something I didn’t understand, I’d just ask. I just ignored the social customs that told me to stay in my place.”<sup>5</sup>

I wish I could say that Johnson’s experiences are a distant memory, as cultural biases affect us to this very day. In fact, the Society of Women Engineers commissioned a workplace study recently. It showed that “women engineers and engineers of color continue to face bias and stereotypes. This leads to disadvantages in hiring, pay, promotions, performance evaluations, and mentoring and leadership opportunities.”<sup>6</sup> Johnson’s advice is sound, even today—persist, ask questions, and move forward. Here are some questions and tips that might help you maintain an open mind, when you and your colleagues are discussing ideas about a specific engineering project:

1. Am I judging the idea on its own merits; or am I influenced by the person, their appearance, their manner, and the delivery of their idea?
2. What if we assumed the proposed idea was correct? What would that make possible?
3. Do I feel an urge to reject the idea to defend my own idea?
4. Am I somehow threatened by the idea? Would I be admitting I’m wrong on some level?

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4 Katherine Johnson, pictured here at NASA’s Langley Research Center, where she worked as a computer and mathematician from 1953 to 1986. Credit: NASA

5 <https://www.scientificamerican.com/article/katherine-johnson-of-hidden-figures-fame-dies-at-101/>

6 <https://www.nspe.org/resources/pe-magazine/may-2017/bias-the-engineering-workplace>