FirstRand

What they don't teach at engineering school (and what they do)

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The chances are good that you've been exposed to the overuse of the phrases problem-solving and critical thinking. Almost in the next breath, you've probably heard about the insatiable demand for engineers in the workplace. And while it may be true that engineers learn and practise these skills, these phrases don't tell us much about the thinking principles and approaches which underpin them and are at the heart of engineering and science.

So naturally, as a graduate engineer with exactly zero years of experience, I am going to ponder on these approaches that are at the heart of engineering and science.

Aristotle first defined a first principle as "the basis from which a thing is known". So, at its core, thinking from first principles involves breaking a concept down into its fundamental constituents and building from the ground up. It means questioning one's assumptions until only the absolute truth remains.

Author James Clear, of Atomic Habits fame, explains first principles thinking using Johannes Gutenberg and the printing press as a prime historical example. Gutenberg invented the printing press by considering the process of printing and dissecting it into its three constituent parts: movable type, paper, and ink. He then leveraged the existing technology of the screw press to make the printing press and, in doing so, revolutionised information distribution.

So it shouldn't be surprising that this philosophy forms the foundation of the methodology employed both in business and in STEM fields: first principles thinking, or reasoning from first principles.

Controversial business magnate Elon Musk famously applies first principles in his endeavours, too. "I tend to approach things from a physics framework", he has said, since "physics teaches you to reason from first principles rather than by analogy". Using this type of reasoning, SpaceX was established to launch rockets into space, not by acquiring the rockets themselves, but by sourcing the raw materials needed to build them from scratch – a far cheaper and more impressive exercise.

In engineering, thinking from first principles forces one to think deeper about the problem at hand and inspect it from a number of angles until only the nitty-gritty of it remains, thereby simplifying the solution process. This is one of the methods engineers use in the development of creative solutions and is what might be camouflaged as critical thinking.
Adopting this process also shapes the perception that engineers are quick-thinking: by filtering out the non-essential components of a problem, engineers learn to process new concepts quicker than average.

I'd go even further to say that this notion of thinking from first principles is what helps engineers avoid going down rabbit holes of research and experimentation. Being able to cut through the noise and zone in on the fundamental problem components is what gives engineers the ability to retain a 'big picture focus'.

In a recent job interview, my interviewer said that he could always tell the engineers from candidates in other science disciplines, as they'd answer the technical questions more concisely than the latter, who would typically give more muddied and long-winded responses. And this, I think, is a by-product of the first principles thinking methodology, even though it is never explicitly taught as such.

Still, with all this in mind – nifty thinking tricks and all – it never occurred to me that I might one day study engineering. Too technical, too boring, and only for maths boffs (I thought). Four years later, after completing my undergraduate degree in electrical engineering, I still don't regard myself as a typical engineer (whatever that means).

What has changed, though, is the realisation that apart from providing me with some additional challenges to contend with, my 'right brain' tendencies also gave me a different perspective during my studies.

This brings me to what they don't teach in engineering school.

In an episode of the McKinsey Global Institute's Forward Thinking podcast, a corporate scientist at the 3M company, Jayshree Seth, gave a fresh take on the role of the human context in science and engineering. Instead of using the well-known STEM acronym, for science, technology, engineering, and maths, she makes use of SHTEM: science, humanities, technology, engineering, and maths.

"In our drive for answers", she says, "the humanities context can drive us toward asking the right questions. Where science is seeking to analyse, humanities can help us synthesise".

And this is my aha moment: while engineers and scientists are often all-consumed by the content at hand, it is truly the applications of such content to human contexts that give solving these problems societal value.

In the heat of the AI race, where intelligent agents are participating increasingly in daily life, the engineers, scientists, and researchers at the forefront of this revolution are constantly being challenged to consider the human contexts impacted by the seductive tech, and to use a set of moral principles to inform the design of such structures. Known as AI ethics, these principles ought to be set in place to prevent all kinds of unconscious bias, prejudice, and historical patterns from seeping into intelligent algorithms.

For me, this is where the real potential of engineering lies: at the intersection of science and the humanities.
Circling back to the concept of thinking from first principles, I want to return to the following phrases: big picture focus, fundamental problem constituents, and asking the right questions. The above all extend naturally into the humanities domain, where thinking from first principles becomes a metaphor for finding focus, digging up problem certainties, and attempting to answer how solving them would complete the puzzle.

So just as first principles can be used to escape the technical details for a broader appreciation of the problem at hand, using them can also reveal how these solutions fit into the broader context of society. And this is precisely the role of the humanities: reminding us to think beyond the minutia, enabling us to become better problem solvers, critical thinkers and innovators.

In the words of the late Steve Jobs, "Technology alone is not enough – it's technology, married with liberal arts, married with the humanities, that yields us the results that make our heart sing".