Let's get poetic about the wonders of an engineering education

Lim Sun Sun and Roland Bouffanais

For The Straits Times

In a paradox rich with Dickensian undertones, one could say it is perhaps the best of times and the worst of times to be an engineer.

After all, many signs turn to the significant promise of being an engineer in an era when technology pervades every realm of our human existence. Engineers and the innovations they forge serve to lubricate, accelerate and automate many everyday processes, thereby enhancing our quality of life and boosting individual and societal well-being.

Every successive iteration of the industrial revolution has ushered in some laudable transformations, mechanising processes that are arduous, toxic or tedious. Just think about the seismic advancements in waste management, factory production and data computation that have liberated humans from these painstaking tasks. These are monumental achievements that engineers can and should claim full credit for.
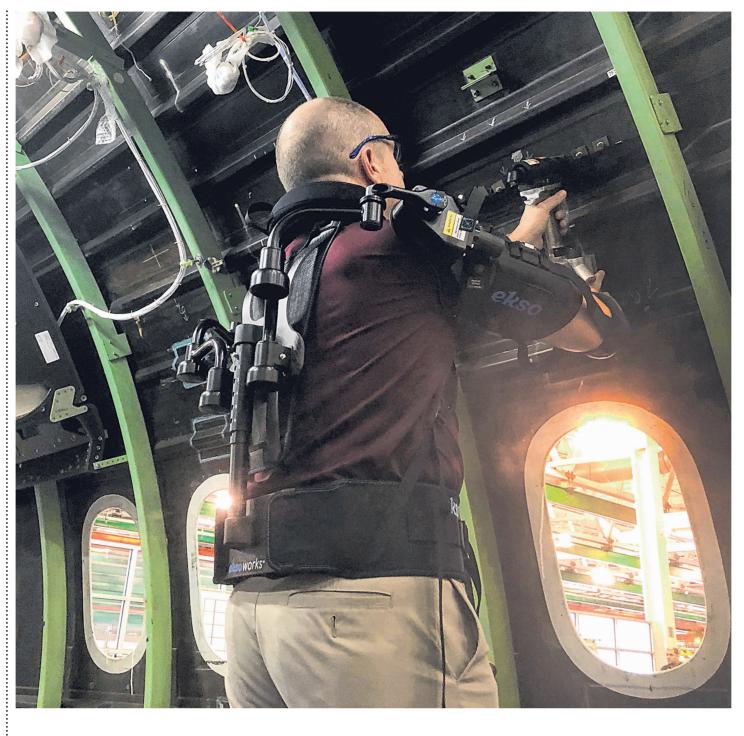
By the same token however, precisely because of the gargantuan impact technology has on our everyday lives, engineers are increasingly excoriated for many of the ills of innovation.

Consider the blame that has been laid on technologists for an ever expanding litany of societal problems such as environmental degradation, climate change, internet addiction, online disinformation, privacy incursions and even social polarisation.

With the swelling influence of Big Tech and the looming pall of Big Data, concerns about the grave responsibilities that engineers can and should bear are far from evaporating.

This unduly tarnished image that engineering has recently acquired is both unfortunate and aberrant, considering the discipline's lofty origins. Basic yet fundamental inventions such as the pulley, lever and wheel have revolutionised agriculture and transportation. Engineers have built on these foundations to tame electromagnetism, thereby enabling a rapid electrification of our planet by integrating and interconnecting power grids. These advancements have in turn triggered an avalanche of wireless data transmissions that drive our information society today.

As a city state devoid of natural resources, Singapore's economic success has also been closely intertwined with engineering and is largely attributed to our technical prowess. Widely seen as a technocracy, the country's leaders have been known to appoint engineers to the highest echelons of the government and public service, including luminaries such as Deputy Prime Minister Teo Chee Hean,

former Cabinet ministers Lim Hng Kiang and Yaacob Ibrahim and former head of civil service Peter Ho. Over the years however, the profession has gradually lost its shine among university hopefuls, with top students favouring seemingly more versatile disciplines such as law and business.

This trend of declining enrolment is regrettable as engineering is perhaps more industry focused, societally relevant and future-ready than ever before.

It steeps students in the competencies of analytical and systems thinking, and equips them with the critical skill of simplifying seemingly convoluted and impenetrable devices, structures or processes undergirding our world. Although the classical engineering approach of reductionism is often criticised as over-simplification, its very parsimony has enabled engineers to design increasingly complex and sophisticated products and systems.

The staggeringly intricate design of a new commercial airliner is a perfect case in point, being the fruit of the collective genius of aeronautical, electrical, material, mechanical, software and systems

A Boeing worker at a production factory in South Carolina. The intricate design of an airliner is the fruit of the collective genius of aeronautical, electrical, material, mechanical, software and systems engineers working in concert. Engineering is perhaps more industry focused, societally relevant and future-ready than ever before, and steeps students in analytical and systems thinking.
PHOTO: REUTERS

engineers working in concert.

The Internet, cities, social networks, and even the ubiquitous smartphone, are further examples of engineered complex systems which cannot simply be viewed as the sum of their constituent parts.

Neither can such multi-faceted systems be built with insights from narrow disciplinary lenses as they necessitate expertise that transcends traditional knowledge boundaries. Indeed, engineers have been relentless in collaborating across disciplines to forge new ways of understanding and creating complex systems, marshalling artificial intelligence to support and augment their irrepressible urge to innovate.

As a discipline therefore, engineering offers the next-generation innovator an impressive complement of theoretical, analytical, technological, and practical competencies. Furthermore, when farsighted engineering curricula break down disciplinary silos, and expose students to the humanities and social sciences, engineers can be even more conscious and conscientious in appreciating the deep impact of the technological

infrastructures they build. Vested with this formidable repertoire of skills, engineers can be pivotal players in many organisations across all levels, including at the executive, managerial and strategic planning levels.

Engineering is thus a remarkably valuable discipline for its time and its utility will only rise as Industry 4.0 becomes a reality. Each new chapter of the industrial revolution yields more profound changes to humanity at a confoundingly rapid pace, with far-reaching implications for virtually all human beings. With a technology-driven future on our horizon, there is no finer moment than the present for students to harness the strengths of engineering.

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Rethinking what teachers do

David Von Drehle

Of all the ideas we have forgotten from maths class, the most important to relearn – because it illuminates our most urgent challenges – is the difference between arithmetic and geometric progressions.

Maybe you recall. An arithmetic progression is a sequence in which the difference between numbers remains constant. For example, counting by twos: 1, 3, 5, 7 and so on. Each number adds two more.

A geometric progression is a sequence defined by a constant ratio. Doubling, for instance. Instead of adding two, you multiply by two: 1, 2, 4, 8 and so on. Each number is twice the one before.

Technology advances in a geometric sequence – since the dawn of computing, anyway. Intel

co-founder Gordon Moore's famous law predicted that processors would double in power every two years. Technologists believe we may be reaching the end of that sequence, but so far, Moore's Law has taken us from room-sized computers back when I was in grade school to the inconceivably more powerful computer I slip into a shirt pocket today.

But the functionality of most adult human beings grows arithmetically, if it grows at all. We won't wake up tomorrow twice as capable as we are today, and twice again the day after that. We add knowledge bit by bit and gain experience by slow increments.

For decades, this has been a manageable difference. Humans began with a huge head start over computers. And if you look back to the examples above, you will notice that the sequences are similar in the early stages. At step four, for example, the arithmetic sequence has reached 7 while the geometric sequence has reached 8. With time, though, the gap explodes.

Thirty steps into the sequence, adding two gets you to 59. Doubling gets you to nearly 537 million.

With that in mind, let's look at the striking teachers of the Denver public schools. At first blush, the picketing educators are seeking a simpler pay formula, which would end a years-long experiment in paying bonuses to steer teachers

towards targeted results. At a deeper level, though, the strike illustrates the incremental rate of human progress compared with the geometrical tsunami of technological change.

In 2006, Denver's then-new bonus system was state-of-the-art, an innovation embraced by teachers, administrators and taxpayers alike. Now, it has become an anachronism. It matters little whether this experiment was noble or cracked. What matters is how long it took. During the same 13 years, technology created the smartphone, the tablet and the Cloud, which, in turn, enabled countless educational apps, games and other resources that – for the first time in history – make truly individualised learning a universal possibility.

So while Denver was fiddling with formulas, what's needed is a blank-slate rethinking of what teachers do, how classrooms work and what schools are for.

Students from inner cities to rural hamlets can now (or soon) experience the world's most skilled instructors delivering optimal lessons – at the student's pace, in the student's language, at whatever time of day the student learns best. To leverage and augment such incredible resources, on-site teachers must become life coaches, role models, facilitators, therapists, motivators, demolishers of

obstacles and openers of eyes.

These are not qualities easily measured by student test scores or accumulated grad school credits. Yet they point to something essential about the future relationship of humans and our technologies.

We cannot outdo the computers in terms of standardised outputs or efficiency. We can only keep pace by emphasising those things that make us human to begin with: our capacity for connection, compassion, empathy and love.

As a kid, I was lucky enough to know a gap-toothed band director named Byron Gillette, who passed away in Colorado last month. I thought he was teaching me to play a trumpet when actually he was teaching me to live a life. My sister and I recently recalled life under his baton. "I remember Mr Gillette having me play clarinet solos at church," Lynn texted. "As a super-shy, super-awkward teen, it was really helpful." She's now a life-shaping educator herself.

How do we harness technology to help more teachers awaken more students to their possibilities and resources? How do we structure schools to create mastery of both the power and the perils of future tech?

These are just two questions in the long arithmetic sequence of human learning – but the answers, once we find them, could work wonders. WASHINGTON POST

How elitism is embraced by the US left

David Brooks

Over the past generation, global capitalism has produced the greatest reduction in human poverty in history. Over the past 10 years, American capitalism has produced 20 million new jobs. The productive dynamism of capitalism is truly a wonder to behold.

But economic growth alone is not enough. Growth alone does not translate into economic security for the middle class and the less skilled. Growth alone does nothing to reverse the social decay afflicting communities across America. This reality is transforming the political debate – and shifting everything leftwards.

Among conservatives, there are now a bevy of thinkers who are trying to find ways to use government to reduce inequality, promote work and restore community. For example, in the lead essay of the conservative journal National Affairs, Ms Abby M. McCloskey notes that the family you are born into and the neighbourhood you live in have a much stronger influence on your socioeconomic outcome than any other factors.

Her essay is an outstanding compendium of proposals designed to strengthen family and neighbourhood. Pell grants could be used to pay for vocational and apprenticeship training and not just for college. The federal government could support a voluntary national service programme by paying people, once in their lifetime, to work for a year at a local non-profit. The tax code could be tweaked so that people with no income tax liability could receive a cash credit for making charitable donations.

These proposals are activist but humble. It's not the federal government centrally deciding how to remake your community. It's giving communities and people the resources to take responsibility and assume power for themselves.

As many conservatives have shifted leftwards, so have progressives. From former president Bill Clinton to Barack Obama, Democrats respected market forces but tried to use tax credits and regulations to steer them in more humane ways. Obamacare was an effort to expand and reform private health insurance markets. That Democratic Party is ending.

Today, Democrats are much more likely to want government to take direct control. This is the true importance of the Green New Deal, which is becoming the litmus test of progressive seriousness.

I don't know if it is socialism or not socialism – that's a semantic game – but it would definitely represent the greatest centralisation of power in the hands of the Washington elite in our history.

The resolution is unabashed about this, celebrating and calling for more "federal government-led mobilisations". Under the Green New Deal, the government would provide a job to any person who wanted one. The government would oversee the renovation of every building in America. The government would put sector after sector under partial or complete federal control: the energy sector, the transportation system, the farm economy, capital markets, the healthcare system.

The authors liken their plan to the New Deal, but the real parallel is to World War II. It is the state mobilising as many of society's resources as possible to wage a war on global warming and other ills.

The document is notably coy about how all this would be implemented. Exactly which agency would inspect and oversee the renovation of every building in America? Exactly which agency would hire every worker?

But the underlying faith of the Green New Deal is a faith in the guiding wisdom of the political elite. The authors of the Green New Deal assume that technocratic planners can master the movements of 328 million Americans and design a transportation system so that "air travel stops becoming necessary".

They assume that congressional leaders have the ability to direct what in effect would be gigantic energy firms and gigantic investment houses without giving sweetheart deals to vested interests, without getting corrupted by this newfound power, without letting the whole thing get swallowed up by incompetence. (This is a Congress that can't pass a budget.)

If this were ever put into practice, there would have to be several new Pentagons built to house the hundreds of thousands of new social planners. The authors of this fantasy are right that we need to do something about global warming and inequality. But simple attempts to realign incentives, like the carbon tax, would be more effective and more realistic than government efforts to reorganise vast industries.

In an alienated America, efforts to decentralise power are more effective and realistic than efforts to concentrate it in the Washington elite. The great paradox of progressive populism is that it leads to elitism in its purist form.

The impulse to create a highly centralised superstate recurs throughout US history. There were people writing such grand master plans in the 1880s, the 1910s, the 1930s. They never work out. As the thinker Richard Weaver once put it, the problem with the next generation is that it hasn't read the minutes of the last meeting. NYTIMES

In an alienated America, efforts to decentralise power are more effective and realistic than efforts to concentrate it in the Washington elite. The great paradox of progressive populism is that it leads to elitism in its purist form.