

***“Roads? Where we’re going, we don’t need roads” – A “Back to the Future”
Guide to Inspiring the Next Generation of Engineers***

Jon Runyon, Cardiff University

When I was in primary school, I knew only one engineer personally. My uncle, a former fighter pilot in the Air Force, was a mechanical engineer. At the time, I did not know what his job actually entailed, but if a fighter pilot could be an engineer, that alone piqued my interest in the profession.

Perhaps I was lucky enough to have at least one example of what an engineer looked like from a young age. Aside from this family connection, however, I did not really know what it actually meant to *be* an engineer, and it would have been very useful to have more information. And not because that information would have sent me running in the direction of a different profession! On the contrary, I am quite lucky and humbled to be on my engineering journey. It has become a passion. Had I known more about it then, perhaps engineering could have been a true passion all along. And knowing what I know now, I find it rewarding to step out of my PhD studies and try, even in the slightest, to inspire the next generation of engineers as a STEM ambassador; to try to answer those questions for them which I had myself.

And what better way to do that than by channelling the wisdom that Marty McFly and Doc Brown passed on to me as I watched the Back to the Future films on many a rainy Saturday afternoon. As a mechanical engineering PhD in the energy field, how fitting that at such a young age I was introduced to the concept of “1.21 gigawatts”, Doc Brown’s power requirement for the flux capacitor propelling his Delorean DMC-12 through the space-time continuum. The concept did not mean much to me then, but holds an entirely different meaning now. What I once thought of as the single largest amount of electrical power possible, even enough to allow for time travel, is actually equivalent to, for example, the average daily electrical power imported by the UK from France during the first week of 2015¹. And that in itself is one of the things which make it great to be an engineer, to take a concept and transform it into data which has important meaning and value in the world around us.

There was certainly a lot to marvel at in the Back to the Future series from an engineering perspective, but there were also a number of great pieces of advice from numerous characters including consummate bully Biff Tannen and Goldie Wilson, a busboy in Lou’s Café in the first instalment in the series and later mayor of Hill Valley. Incorporating their quotes with those from Marty McFly and Doc Brown, I have compiled the following list of six pieces of advice about engineering which I would have given to my primary school self if I had a time-travelling Delorean of my own. And equally important, I see this as perhaps a way to inspire and inform the next generation of engineers.

1. Explore the world, but make sure your GPS has the latest map updates

Biff Tannen: *“Why don’t you make like a tree and get out of here?”*

I have been quite fortunate in that my engineering path has taken me all over the world; studying for a BSc in Mechanical Engineering at the University of Florida, moving to Los Angeles, California to work for one of the largest oil and gas companies in the world, and now currently working towards my PhD in Mechanical Engineering at Cardiff University. The world is a much smaller place now than it was when Back to the Future was first released in 1985. We are more connected than ever to each other, and this connectivity should be exploited for the benefit of the global community through collaborative engineering. As such, I would propose to the next generation of engineers to expand their network outside of their immediate communities and consider the global impact of their work, but do so cautiously, recognizing that cultural differences can often be overcome with dialogue and, as engineers, we are fortunate that the language of science and mathematics often translates better than many local dialects.

2. Take risks, but make sure you have completed a risk assessment

Marty McFly: *“What about all that talk about screwing up future events? The space-time continuum?”*

Doc Brown: *“Well, I figured, what the hell.”*

As children, we are often taught to be risk adverse, and for good reason. At a young age, we are sometimes unable to determine the full ranging impact of our actions without assistance and guidance from our caretakers. In engineering, you have to be willing to take risks, but they have to be calculated and assessed. In my career to this point, I have been intimately introduced to risk assessment procedures from an oil refinery in the United States to a combustion research facility in the United Kingdom. These assessments are critical exercises to ensure our health and safety, limit the environmental impact of our work, and mitigate economic risks. But it can sometimes be the risks we take as engineers which lead to the most valuable solutions. That in particular pushed me towards a career in research and development. Thus, I would encourage future engineers to be not only unafraid of taking risks, whether it is in their careers or in their ideas, but also to truly understand the impact of taking those risks.

3. Don’t be afraid to lead, but make sure you know when to follow

Goldie Wilson: *“Stand tall, boy. Have some respect for yourself. Don't you know, if you let people walk over you now, they'll be walking over you for the rest of your life.”*

Of the 650 members of the 2015 UK Parliament, approximately six have achieved at least bachelor level degrees in engineering². These numbers, however, should not imply that engineers have a tendency to shy away from leadership positions. With significant global challenges consisting of increasingly technical considerations, perhaps it would be beneficial for members of the engineer profession to bring their creativity, problem solving, and collaborative skills to the political arena. But I suppose it is equally as true that those of the engineer ilk may look upon the political world with a vein of consternation towards its inevitable opacity and elitism. But leadership does not only manifest itself within capitol buildings. Leadership is a mind-set that encourages dialogue, informed decision-making, a keen awareness of your beliefs, and the adaptability to work towards a goal with those who may disagree

with you. As engineers, we are often consumed in the science, and perhaps rightly so, to create in a world which has continuously changing needs. But we cannot simply operate in that silo mentality if what we create is to truly impact the lives of others. Thus, I would say to the next generation of engineers to incorporate elements of leadership into your work, but be humble and patient enough to know that as the world changes, you will have to work with others to mould your ideas to a new landscape.

4. Do your best in mathematics and science, but make sure to hone your artistic and creative sides

Marty McFly: *“Wait a minute, Doc. Ah...are you telling me that you built a time machine...out of a Delorean?”*

Doc Brown: *“The way I see it, if you’re gonna build a time machine into a car, why not do it with some style?”*

I am aware, judging by the portfolio of artwork my mother insists on keeping from my primary school days, that my destiny was certainly not painted in the stars. I always found primary school art classes challenging and avoided them altogether until my undergraduate computer-aided design course. Thankfully, engineering is blurring the lines between art and design. And as such, we must continue to embrace and nourish the creative side of our profession. My strongest subjects throughout school were always in mathematics and science, while putting pen to paper to create and design was always a struggle. With effort and practice, however, I found digital creating, from simple drawings to more complex 3D computer models, can flow with the same ease as those drawings of my peers I used to envy in art class. When I talk to students about the engineering profession as a STEM ambassador, this is one of the things which I continuously highlight. Engineering is often seen as a career track only for those skilled in mathematics and science. But I find it wholly necessary, if we are to increase interest and uptake in our profession, to encourage people who may have difficulty in those areas but still maintain a passion for the arts. Engineering is, at its core, a creative profession and many of the things that engineers create should be considered works of art. And so, to the next generation of engineers, make sure you embrace all of the tools that mathematics and science can give you to answer technical questions, but do not neglect the impact, and in fact inspiration, that the artistic and creative world can provide to your work as well.

5. Always ask questions, but make sure you can handle the answers

Marty McFly: *“What the hell is a gigawatt?”*

I was often the one with my hand up to answer a question from the teacher or professor. But getting the answer wrong was never easy. The feeling of anxiety and embarrassment would usually last for the next few days, when I would simply sit quietly and listen. Many students take that approach, only responding when singled-out for an answer, and often at times passing on the opportunity to ask questions, for fear of appearing to not understand the material. However, it is those questions which I answered incorrectly which have stuck with me throughout my education. When I started my first job in an oil refinery as a mechanical engineer, I quickly learned how to harness that anxiety into a process for quickly learning new things. A new graduate can hardly be expected to understand the complete workings of a complex manufacturing facility, but I knew I would have to give up my fear of appearing inadequate and ask questions of my colleagues if I was to be successful in my job. I have since learned this to be called the “imposter syndrome,” a feeling that one should not have attained various achievements by their own merit and competencies, and thus fear being seen as a fraud. So, to future

engineers I would encourage you to sit in the front of the classroom, ask questions of all those around you, make informed assumptions, and always try to learn something from your incorrect answers. And to current engineers and their teachers, keep your office door open to the younger men and women you work with, their questions may just inspire you as well.

6. Follow your passions, always

Doc Brown: *"You can make your future whatever you want, so make it a good one."*

In the final instalment of the Back to the Future series, Doc Brown gives perhaps the most useful piece of advice one could give. There is certainly truth to the fact that we as engineers can learn a great deal from the past. Our profession is built on the work of the scientists, thinkers, dreamers, and makers who came before us. But, in an increasingly uncertain world, one certainty is that we have the power to choose to follow our passion. And so, I would tell the engineers of tomorrow to always follow their passions to shape and inspire the world around them and in doing so, leave their mark on the next generation.

Inspiration can certainly be drawn from many places, from fighter pilots to time travellers in the movies. With renewed energy and focus, engineers today can be an inspiration to the next generation, wherever their future takes them.

References

¹ G.B. National Grid Status. Available at: <http://www.gridwatch.templar.co.uk/> [Accessed 01/04/2106]

² Hull, Duncan. *MPs with Science Degrees: How did Science & Technology do in the UK General Election 2015?* 08/05/2015. Available at: <http://duncan.hull.name/2015/05/08/scientist-mps/> [Accessed 04/04/2016]