"How does engineering contribute to the UK economy and how can that contribution be increased? Is there a role for UK engineering in higher education in making this happen?"

Today, when one compares the prevailing perception of British engineering to the present day state of the United Kingdom's economy, he or she cannot help but notice some stark similarities. Once a leading creative force and major player, internationally renowned for its wealth, innovation and coveted vision, the United Kingdom's image now risks settling for an early retirement. A backseat if you will, that is linked to a lingering idea that engineering advancement and economic growth are disassociated, superfluous to one another or even mutually exclusive. This article seeks to dispel such ideas by highlighting the various ways in which engineering does contribute to the economy; examining as well, the influence and potential held by higher education in re-glorifying such contributions, indispensable for sustainable and competitive economic growth.

To anyone familiar with the engineering discipline, there is no doubt that it has consistently and diversely contributed to the growth of the British economy. Technology and innovation have led advancement: improvements have paved the way for increased business efficiency, better access to international markets and efficient management of people and processes.[1] The way we communicate has also rapidly changed in the last two decades alone: increasing dependence on smart phones and video communication, Internet based applications and analysis software, all emerging as strong stimuli, underpinning the very nature of how we do business.
Making 4.1% of the UK GDA, a chunk worth over £50 billion, digital communications engineering directly inspires competition and breeds innovation.[2] For example, the advancement of 4G networks later this year seeks to accelerate the way in which we interact, further annihilating the confides of distance and restricted national and international reach.

When considering overcoming expanse literally, however, the growth of transport and visionary interconnecting is an unrivalled platform with the potential to save time and alter the demographics of monetary growth. Despite the success of Eurostar, the first high-speed rail network boasting the ability to connect Great Britain to the continent in under two and half hours, we have not seen the emergence of high-speed cross country trains until now. High Speed 2 is a project that had long been debated, sitting stagnant in the pipeline, and is now expected to begin manufacture in 2017, aiming to link London to the midlands by 2026. It is modelled around the famed Japanese "bullet train", project Shinkansen, known to have distinguished the Japanese economic model from the 1960s by saving on average ¥500 billion annually, connecting its two largest cities, Tokyo and Osaka, and cutting CO_2 emissions down to 16% of what there would be travelling the journey alternatively.[3] This begs the question: has HS2 come decades too late and why is it subject, still, to so heavy a delay?

Infrastructure is not the issue. It is clear from Hitachi's choice to manufacture in the North East that the United Kingdom maintains a solid manufacturing foundation, receiving glowing references from fellow Japanese company, Nissan, who continue to prime their productions from Sunderland. Neither should Britain's proud industrial heritage be forgotten. The Victorian era ushered in an industrial boom, enhancing cities with a series of sewers, canals and railway expansions, which altered the surface of the United Kingdom. London's own economy would not boast its financial affluence without its world beating public transport network, including a 150 year old tube system which is presently subject to ground breaking planning and engineering overhaul before 2025. However, as the capital's ever evident monopoly over the country's wealth and public transport development becomes an increasing issue, engineering projects on the scale of HS2 are vital in not only sustaining and spreading progress throughout the UK, but also in curbing an emergent north-south wealth divide.

The question, then, is clearly one of expanding vision and the pressing need for economic remodelling in favour of manufacture, design and innovation. Cultivating respect for the Chartered Engineer, a title that remains infuriatingly misconstrued in the UK, is paramount in championing such growth, and can only be achieved by changing perceptions at the grassroots: encouraging young people to take up engineering. According to Professor John Perkins in his report, *Review of Engineering Skills*, this is vital in "adding flexibility and resilience to our economy, and enabling more people to take advantage of the opportunities created by technological change…we owe it to our young people to equip them with the skills, including engineering skills, that British industry and the British economy needs now and will need in the future".[4] With an estimated demand for 830,000 professional scientists, engineers and technologists forecasted before 2020, more needs to be done by our leadership to promote engineering both in and leading up to higher education.[5] Despite the UK spending only 0.07% of its GDP on HE capital, three times less as a proportion of GDP than the U.S or Australia, about 32% of students who take engineering and related technological subjects flock from abroad.[6] Whilst not undervaluing the vital benefits that foreign talent brings, in terms of gifted students, academics and engineers, paramount in keeping the UK internationally competitive, more needs to be done to encourage home grown talent and strengthen higher education as an industrious force. Every year such institutions generate over £3 Billion through the research they produce.[7] Clearly British universities are respected and lucrative contributors to the UK economy in their own right and deserve due support in remaining so.

One way of doing this would be to further promote companies to sponsor students and even departmental activity. Successful examples of this can already be seen: Apple's establishment of a core fan following built on favouring students, or indeed Autodesk embedding its seeds into the minds of tomorrow's industry by offering heavily discounted or free software at University level. In securing a stake in the future they should not stop here, however, as expertise and involvement could prove mutually beneficial. With many Universities driving forward creative young minds in pursuing design, companies need to get more involved in supporting innovative University projects and ultimately leading productivity through research.
Whilst many would suggest the government incentivise, even offering fees' reductions to those pursuing engineering, there is an increased pressure placed on engineering departments, as it stands, to provide a research led education within budget. Further investment from companies would go a long way, sooner, in strengthening engineering, whilst at the same time, raising brand promotion and product quality for the industry as a whole.

Essentially, in order to increase engineering economic output, the UK needs to be able to tap into its resources. Ralph J Smith states "Engineering is the professional art of applying science to the optimum conversion of natural resources to the benefit of man". To benefit any sort of functional society we need to sustainably, feasibly and cleanly generate power: a task that remains hotly debated, heavily invested in, and packs the potential to fuel our economy. We need only look over the channel to France in order to understand the fiscal advantage in large-scale energy production. Not only does energy export bring in about EUR 3 billion, cheap nuclear generation accounts for 75% of the country's electricity, providing reliable, low cost household electricity and facilitating further scientific endeavours such as those at CERN and ITER.[8] Comparatively the UK has become a net importer of energy as of 2004, spending £9 billion more on importing energy despite possessing incredible generating potential in both renewable and natural resources.[9] IMECHE, the professional body of Mechanical Engineers, calls upon increased governmental support for developing electricity storage now, to enable the UK to remove its dependency on Europe in waiting for long term "smart" or "super" grids before a sizeable shift towards renewable energy.[10] So even though Britain possesses coal reserves, over 40% of Europe's wind generating capability and is even a leader in Carbon capture technology, ultimately the resource which remains untapped are the Engineers required to access our full economic potential in solving problems of power.[11]

Clearly no one solution to energy can be relied on, diversity offering a far more versatile solution in tackling the transition away from fossil fuels. Yet when it comes to diversity in the engineering world, the gender balance in particular needs to be addressed to provide the necessary production of Engineers capable of solving these problems. A quarter of a century after the sexual discrimination act, engineering remains particularly inaccessible for women, with only 8% of the industry, worth a fifth of the UK economy, made up of females. Though this as a percentage has doubled in the last twenty years we still hold the greatest gender imbalance within Europe.[12] Therefore, should incentives be given to attract female students towards engineering at University? Rather than favouring quotas and breeding a sense of inability amongst female students in higher education, perhaps a more sensible approach should be taken early on to encourage girls to consider engineering as a viable field of study. In particular supporting STEM subjects in schools and organisations such as UKRC (UK Resource Centre for Women in Science, Engineering and Technology) in promoting image change the likes of which Medicine, Law and other traditionally male dominated fields have managed, is something which needs to be increasingly considered by both Higher Education, Industry and the government.

The 2012 Olympics brought to light just how much of an impact such collaborative spirit can have when momentous organisations are motivated together by common objectives and time constraints. Delivering a successful Olympic games, on time and with meticulous execution, the UK charmed in economic appeal: encouraging trade through international outreach, internal investment and improved infrastructure. A heavy and brave endeavour certified a legacy for athleticism, the nation and its commerce: with sport also sparking the drive to innovate. Why then should such a legacy restrict role models to those on the track and field? From the progressive foresight behind building a sustainable Olympic park, to commanding the world's attention with the brilliance of the opening ceremony, the incredible engineering output and project management was exemplary. Even in terms of aiding team GB's athletes on their path to medal glory, teamwork between UK Sport and implementing technology pioneered at designated centres for sports engineering at Sheffield Hallam, Bath, Birmingham and Loughborough bolstered our athletic chances, enhancing the way we train and compete.[13] Proving a strong catalyst to our athletes, the same ethics of teamwork within engineering needs to spark further combined contributions; pioneering efforts such as these showcase that creativity and ingenuity still exist and are made in the UK.

With China and India producing ten times more Engineers annually than their similarly sized western counterparts, the U.S.A, the UK cannot afford to ignore lessons learned from international growth, or its time in the limelight will be at an end.[14]

Whilst endorsing a grassroots approach, potent collaborative efforts between higher education, the government and Engineering bodies also need to be streamlined in order to stimulate sustainable economic prospects. Creating wealth through an economy that embodies creativity, ingenuity and a skilled youth is something Britain needs to get back on top of. If not now, when?

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