

# INJECTING SOUL INTO R&D

A Monograph by  
DZULKIFLI ABDUL RAZAK FASc

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HUMANISING SCIENCE FOR THE FUTURE





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**DZULKIFLI ABDUL RAZAK FASc**



**2015**

## **Injecting Soul Into R&D**

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### **Academy of Sciences Malaysia**

Level 20, West Wing, MATRADE Tower,  
Jalan Sultan Haji Ahmad Shah,  
off Jalan Tuanku Abdul Halim,  
50480 Kuala Lumpur, Malaysia

Phone : +6 (03) 6203 0633

Fax : +6 (03) 6203 0634

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# Preface

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## Dzulkifli Abdul Razak FASc

*President  
International Association of Universities (IAU)  
Paris, France*

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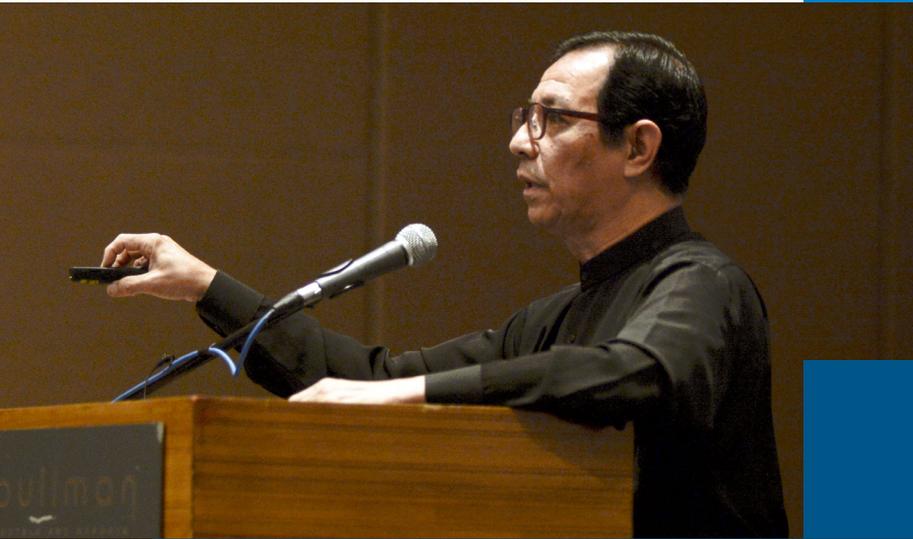
*Dedicated to my father, Datuk Hj Abdul Razak Abdul Hamid (1925-2013), the sole Malaysian to survive the atomic bomb explosion in Hiroshima, 6<sup>th</sup> August 1945.*

Science, as part of a knowledge system is not immune to changes. The word ‘science’ that originates from the Latin word ‘*scientia*’ has a general connotation as ‘a body of knowledge’ much like the meaning of the words ‘*ilm*’ in Arabic, and ‘*ilmu*’ in Malay. Science is also commonly associated with ‘natural philosophy’ (from the Latin word *philosophia naturalis*) as the philosophical study of nature and the physical universe; also known as the natural sciences.

Historically, as changes came into force, so did the understanding, emphasis as well as the processes involved in the engagement of science as a form of knowledge. Especially since the Scientific Revolution that began at the end of the European Renaissance period, science has undergone multiple drastic cycles of ‘reinterpretation’ that have led to what we know today as ‘modern science’. Science is established as an academic discipline that is based on a set of governing rules that are generally termed as the ‘scientific methods’.

Invariably, Research & Development (R&D) as the platform to generate new knowledge has been greatly impacted by these Scientific Revolutions. The American physicist, historian and philosopher of science, Thomas Kuhn’s book, “The Structure of Scientific Revolutions” some fifty years ago has had a tremendous impact on the way we understand the continuous and stochastic development and expansion of modern science.

Even today, we continue to see how science is constantly being remodeled or rebranded; from just Science to S&T (Science and Technology) to then STI (Science, Technology and Innovation), and more recently STEM (Science, Technology, Engineering and Mathematics). At each point of change, science has been fashioned to be increasingly utilitarian as well as a platform for wealth-creation. As a result, scientific progress has increasingly shifted towards a more ‘materialistic’ worldview, whereby greater emphasis is



given on profits and tangible products as opposed to focusing on the people and the planet. As a result of this materialistic shift, the 'natural' component of science has been somewhat eclipsed.

Thus the keynote lecture "Injecting Soul into R&D" that was presented on the 5<sup>th</sup> August 2015 during a forum organised by the Academy of Sciences Malaysia (ASM) was very timely. It allowed us to explore the changes that have occurred in the context of science; from the early concepts to 'modern' science as we know it today. This discourse is essential as we progress through the 21<sup>st</sup> century. This is because knowledge and the processes that are involved in the generation of knowledge are increasingly confronted by new challenges that we have never encountered before. In fact, these challenges are threatening our understanding of knowledge itself. In tandem, the impact of scientific progress on the environment and humanity at large has become a major area of concern for many.

In attempting to dwell deeper into these areas of concern, we need to look into addressing four questions. Firstly, what do we mean by 'soul' in the context of R&D? Secondly, how did R&D lose its 'soul' and what are the implications? Thirdly, how do we humanise science given that the element of 'soul' in science and R&D exists? And finally how do we embrace the 'soul' as part of science?

In short, in creating a 'soul'-driven R&D ecosystem, at least in the Malaysian context, we must take into account the general absence of 'soul' in our current definition and practice of STEM and its relationship with the term human capital vis-à-vis human beings. This is imperative to (re)awaken the 'soul' not only to the confines of R&D but also to (re)shape a more humane notion of science for the future of humankind and its relationship with nature; a relationship that is currently undergoing a severe threat of collapsing.



# Injecting Soul into R&D

## HUMANISING SCIENCE FOR THE FUTURE

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There are four parts to the soul-searching journey into injecting ‘soul’ into Research and Development (R&D) in the 21<sup>st</sup> century. These four parts have been framed into specific questions that need to be pondered and acted upon if we are serious in our pursuit to bring back the ‘soul’ into R&D and the larger science and technology (S&T) ecosystem. However, there are no readily available or easy answers to these questions. The 4 questions are as follows:

- 1. What do we mean by ‘soul’ in the context of R&D?**
- 2. What do we understand about how the ‘soul’ was ‘lost’ in R&D?**
- 3. How do we humanise science given that the element of ‘soul’ in science and R&D exists?**
- 4. How do we embrace the ‘soul’ as an integral part of science?**

The desire for “Injecting ‘soul’ into R&D” indicates at least two possible circumstances. One is that R&D is ‘soul’-less to begin with and there is a need to ‘inject’ ‘soul’ into it. The second is that the ‘soul’ did exist at some point in the past but we somehow have now lost it. I am inclined to believe in the latter, whereby the ‘soul’ in R&D has been lost. Hence we need to know how it was lost in the first instance, before we can figure out how to find and then inject it back into R&D.

According to the French Nobel Prize-winning philosopher and author, Albert Camus, *“Without work, all life goes rotten but when work is soulless, life stifles and dies.”* Since our lives often appear to be evolving in this manner, the question of ‘soul’ perhaps becomes a crucial topic of discussion. Everybody has their own definition of what ‘soul’ is. Thus there needs to be a consensus of what the ‘soul’ entails in the context of R&D.

To Mahatma Gandhi, the question of 'soul' takes a different dimension, of which he noted that *"The State is a soul-less machine. It can never be weaned off from violence to which it owes its very existence."* This suggests a notion that the 'soul' is not confined to individuals, but also extends to the state(s), government(s) as well as organisations such as the Academy of Sciences Malaysia. However, a conflict may exist between the 'soul' of an individual and that of the state or government; as inferred by Albert Einstein in his quote, *"Never do anything against conscience, even if the state demands it."* The association with 'conscience' makes the idea of 'soul' in the context of R&D more palpable. This is true, especially since the 'conscience' is almost always part and parcel of the human experience. If 'conscience' is equated to a moral compass that navigates how R&D is conducted and how scientific progress is channeled, then R&D cannot be 'soul'-less.

If we agree with the views of the 18<sup>th</sup> century philosopher, Jean-Jacques Rousseau that *"Conscience is the voice of the soul"*, then the 'soul' and 'conscience' can be considered as intertwined – a reflection of each other. In the context of R&D per se, the 'conscience' behaves like a guide for researchers to make and act on 'right' decisions. Nonetheless, this is not limited to merely executing the correct and robust methodologies during the R&D process. 'Conscience', when properly nurtured, can shape and materialise an individual scientist's R&D desires and discoveries. 'Conscience' reminds scientists to evaluate the impact of their actions, creations and findings. The impact of R&D can either be beneficial to humankind, non-consequential or worse, when it destroys people's trust in science and hope for life. An obvious example of a negative impact of a concerted R&D endeavour was the atomic bombings of Hiroshima and Nagasaki

in 1945. These bombings certainly put our humanity's 'conscience' to test. If the 'soul' did exist in R&D, how did we allow such destructive technology to be developed? Unfortunately, technologies with destructive intent or potential continue to be developed and used in the various conflicts around the world today. Although our collective 'conscience' continues to be tested, the efficacy of efforts made thus far to understand the basis as well as mechanisms to positively nurture and inculcate a holistic approach to R&D has been limited at best. Hence, this monograph is about the 'soul' in the context of the 'conscience' that govern R&D. I believe that it is something that all of us can relate to, and all of us have some sort of 'conscience' embedded in us. However, whether the 'conscience' is highly developed or not, is a different question altogether.

Since the times of the Greek civilisations, the power of 'conscience' in dictating our actions have been well-recognised. As quoted by the Greek tragedian, Sophocles, *"There is no witness so terrible and no accuser so powerful as conscience which dwells within us."* This suggests that if humans are really governed by well developed conscience, then there would be little need for any laws or rules. The 15<sup>th</sup> century French Renaissance humanist, François Rabelais emphasised that *"Science without conscience is the death of the soul."* This indicates that the search for what the 'conscience' and 'soul' meant were also relevant during the days of the European Renaissance. This is the context that I will use in the discussion about 'soul', and how it relates to 'conscience' as we begin to explore how science and R&D would be shaped if we were fully aware and conscious that the 'soul' and 'conscience' were a vital part of our 'beingness' or existence as scientists, researchers and above all human beings.

The first atomic bomb was a product of an R&D project, called the Manhattan Project in the 1940s. It was developed by very well developed countries. The project was led by the US and received support from Great Britain and Canada. The terrible impact of the bomb is recorded in our historical archives and serves as an example of how big science actually worked hand-in hand with big bureaucracy, sans 'soul' nor 'conscience'. Indeed, if Einstein truly embodied his quote, "*Never do anything against the conscience, even if the state demands it*", the bomb would not have been created in the first place.

Nevertheless, Einstein was only quoted saying this after the bomb had exploded. Where was the 'conscience' when the bomb came into creation and subsequently detonated? Where was the 'soul' at these crucial times? These are definitely questions that should have been asked in every step of the R&D process. As a result of sophisticated scientific innovation, the atomic bomb was quite different from any other bomb that had been produced previously. The impact of the explosion of these atomic bombs was catastrophic. Approximately eighty thousand people were killed instantly and almost everything else was pulverised into dust. The number of human deaths more than doubled the following year due to the long-term radiation effects and the infrastructure devastation. In short, the long-term effects of the explosion robbed the lives of more than two hundred and fifty thousand people. Although the R&D innovation behind the making of the bomb may have been technologically 'fantastic', sadly it sacrificed the lives of innocent human beings. Hence, there is a need to raise the question of 'conscience' and how we continue to allow such R&D to persist until today. The scale by which the R&D was conducted was unprecedented. The project that began in 1939, eventually employed more than 130,000 people and

cost about USD2 billion (about USD26 billion in 2015 dollars). Just imagine how we could have effectively used the USD26 billion to elevate the bottom billion of the world's population and restore their dignity as human beings? In contrast, this costly project resulted in the destruction of a large number of hospitals and medical facilities. Significant number of physicians and nurses were killed or injured. As a result, the victims were left to die because there were no facilities or people left to take care of them. Thus, the negative impact of the Manhattan project's R&D product extended well beyond just physical loss.

Strikingly, when we look at the archives of the Manhattan Project today, we recognise that there are many people who were not really negatively affected by the kind of devastation that the bomb created. In fact, many of them hugely benefitted from the 'success' of their R&D. These were groups of scientists who celebrated the success of the bomb when it exploded. And so what had become of the invaluable 'conscience'? A particular news report from Texas with the headings, "*Atoms harnessed for destruction*" suggests that the scientists were aware of the destructive purpose of the atom bomb. So much resources were devoted to this effort that resulted in the killing of a lot of innocent people. Now, where was the 'conscience' then? Where was the 'soul' of not only the individual person but also of the R&D itself.

These are questions that we have to ask in hindsight so that we learn from this and not repeat this tragedy again. It is especially so since there are a lot more wars going on today. For example, the more recent incident involving the bombing (dubbed initially as merely "collateral damage") of a medical facility operated by the Nobel Peace Prize-winning international humanitarian-aid non-governmental organisation - "Doctors Without Borders", *Médecins*

*Sans Frontières* (MSF). The US military finally took responsibility for the deadly airstrike in the Afghanistan city of Kunduz, describing as a mistake. MSF is calling for an independent panel to conduct an investigation on the air strike that some alleged could be declared as a “war crime.” This is just one example of the various war conflicts that is happening around the world.

Switching back to the period between 1939 and 1945, when the R&D of the Manhattan Project was being executed, perhaps the scientists did not believe in the ‘soul’ and God. However, when the bomb exploded, suddenly God came into picture. The co-pilot of the *Enola Gay*, the B-29 aircraft that dropped the atomic bomb on Hiroshima, Commander Robert Lewis, said “*As the bomb exploded, we saw the entire city disappear.*” He then wrote in his log, “*My God, what have we done?*”

We cannot escape from the matter of ‘conscience’, of God and of ‘soul’, especially if we are to talk about the billions of people who struggle to live at the bottom of the economic pyramid and devise strategies on how to save humanity from all the miseries of this day and age.

On the 6<sup>th</sup> August 2015, we launched a biography of the sole Malaysian survivor who was there during the nuclear bomb explosion. It occurred 70 years ago, and he was only 1.5 km away from the epicentre of the explosion. He escaped from the devastation of the bomb and lived to tell the tragic story of the ‘soul’-less science. A true story that acts as a reminder that we are accountable for all our decisions and actions that we make in the name of science.

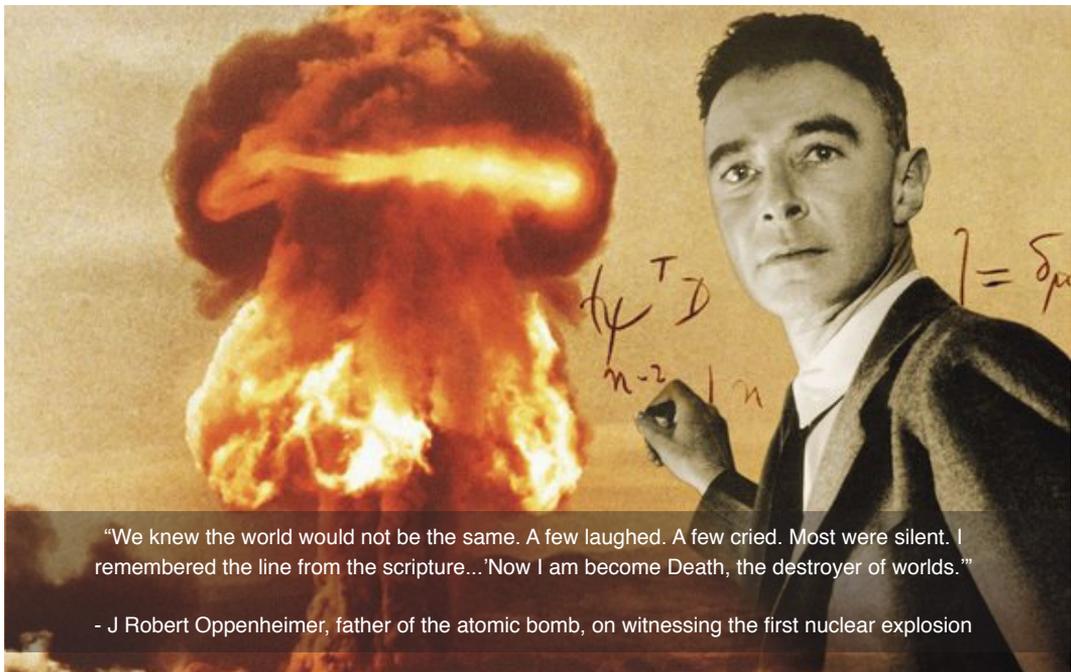


Figure 1: Robert Oppenheimer against a photograph of a hydrogen bomb test in June 1957

Source: Caesar 2012

Robert Oppenheimer, the brilliant principal scientist of the atomic bomb gave a speech on the 66<sup>th</sup> anniversary of the bomb explosion. In his speech, he was quoted as saying *“Now I am become Death, the destroyer of worlds”* (Figure 1). He quoted the Bhagavad Gita on this. This speech was made only about four years ago. He was overcome with a feeling of awareness that the science that he had promoted was not the science that saved humanity. It is also quite intriguing to find out that the site where the atomic bomb was tested was called Trinity. This has something to do with the elements of the church and the sacredness of the kind of research that was done. However, the kind of R&D that was conducted was actually very much in contrast with what Christianity teaches as far as preserving human lives is concerned. Even Harry Truman, the US President who ordered for the detonation of the atomic bombs, later confessed that *“We have discovered the most terrible weapon in the history of the world.”* His successor, President Dwight Eisenhower, admitted in a 1963 interview with Newsweek magazine that *“The Japanese were ready to surrender and it wasn’t necessary to hit them with that awful thing.”* So, where was the conscience when it actually mattered?

Einstein shared similar sentiments before he passed away. He was quoted as saying, *“I made a great mistake in my life when I signed the letter to President Roosevelt recommending the creation of the bomb.”* Hence, it is a lesson on the importance of due diligence and comprehensive review of impact when we make recommendations in the name of science. One should remain ‘neutral’ if unsure or at least err on the side of humanity and human dignity. Searching for the ‘soul’ when one is on the dying bed may be an often occurrence. However, it is perhaps too late by then. In this instance, Einstein admitted just before he died to

Linus Pauling, that he had made a grave mistake in signing that letter. If he had not signed the letter, perhaps there would not have been an atomic bomb. In truth, the signing of the letter had very little to do with science. It was more for military reasons, where the pursue of power is often deemed as righteous. We now know that it was all about sending a strong military message to the Germans, Russians and Japanese about the superior military power of the Allied forces, in particular, the US; that has shaped the destiny of the world that we live in today. Science was merely a tool that was manipulated for a particular mission. Unfortunately, science will continue to be ‘abused’ unless the dictates of ‘conscience’ have a significant bearing on the human ‘soul’, individually and collectively.

Einstein also left us with another pertinent quote *“The release of atomic power has changed everything except our way of thinking...”* There is no wonder then that there are even more destructive bombs and devices in the military armamentarium today than at any point in human history. As science advances, it appears that more research is based on military needs as compared to humanity needs. This problem is symptomatic of the materialistic worldview that may result in humankind drifting towards an unparalleled catastrophe. While we may not experience another Nagasaki and Hiroshima atomic bombings in the near future, there is a constant threat since there are many more countries possessing weapons of mass destruction today. We may have learnt a bitter lesson from the 1945 atomic bombings but the wars that are being fought and the disasters experienced around the world suggest that the lessons learnt have not been extrapolated to help us face new catastrophes due to new economical, ecological and socio-cultural challenges.

While the catastrophes today may not be a direct effect of bombings in the scale that was seen in Hiroshima and Nagasaki, the kind of destruction and sufferings that we see as far as human lives are concerned is even more widespread and gruesome than we have ever witnessed ever since the beginning of the Scientific Revolution. The mass human migration from war-torn countries that is currently taking place is perhaps far worse than anyone could have imagined.

Thus, if that is the kind of mindset that threatens the very existence of humanity, how do we illicit a change in this mindset? What sort of new worldview do we need to take on? What sort of new thinking do we need to create? How do we leave behind the tragic legacy that has been created in the name of science and technology? Einstein was profound in saying *“No problem can be solved from the same level of thinking and consciousness that created it.”*

At this juncture we have to go back and ask the question: What do we understand about how the ‘soul’ in R&D was ‘lost’? This takes us to the whole idea of what the Scientific Revolution that occurred in Europe at the end of the Renaissance Period and extended to the 18<sup>th</sup> century was all about. With the introduction of the scientific method that was defined and then applied in the 17<sup>th</sup> century, the qualitative worldview of philosophers was progressively replaced into a more quantitative and mechanical worldview that was defined through experimental research. The transition of worldviews is exemplified in the shifts in the R&D processes that have yielded significant discoveries in the last few centuries. From the ‘trial and error’ based approach, exemplified by the invention of the steam engine in 1775, to the design and development approach using a more systematic way of inventing things as was

the case in the inventions of Edison in the late 1800s and the Wright brothers in the early 1900s. Following this period, a rather linear way of R&D thinking was born. The establishment of R&D-based commercial corporations such as Polaroid (1937) to Intel (1968) were designed to develop products that benefit human society in general, much like those before this phase. Yet in contrast, between 1942-1946, there was the Manhattan Project that was designed for destruction of humans.

The next big change basically occurred with the creation of personal computers (Microsoft in 1975 and Apple in 1976) that have resulted in many other inventions. The R&D drive of both these companies was hardwired to the very strong entrepreneurial spirit of the founding legends. The progress in computing led to another kind of invention related to communications and media development in particular (e.g. Cable News Network (CNN) in 1980). Today, a new vista of user-created inventions have emerged, where end-users can create their own ‘inventions’ using advanced scientific and technological platforms that facilitate a more open innovation ecosystem.

Overall, all these scientific and technological developments have had very little to do with the ‘soul’ or the ‘conscience’ per se. The progress and development has been driven by economic power to create wealth with perhaps a secondary hope that it will eventually benefit society. Creativity and innovation has been crafted as a utilitarian platform in the name of S&T for the primary purpose of profit-making. As such, many of the non-economic benefits are usually incidental.

Before Information, Communication and Technology (ICT) became a big part of our lives, we thought that human beings were merely mechanical robots. The question of ‘soul’ did not come into picture as

everything was viewed from a non-human perspective. It was a very dehumanising, utilitarian, hollow, external and technically dependent perspective. Once computers entered our lives, the mode of thinking changed.

The human brain is likened to the central processing unit (CPU) of the computer, and the nervous system, the computer circuit or the motherboard. As a result, products like a computer brain were then put up for sale for a mere USD 5. This notion is all about trying to transpose what we understood of science to the human being; dismissing the 'soul' or 'conscience' that is attached to the human person. In other words, scientific thinking had reduced humans into subjects that could be mechanically and scientifically manipulated for a specific interest.

The historical worldview has been focused more on how science was developed or rather modernised into 'modern science' in Europe. Consequently, there is a 'void' that spans over a period of at least 1,000 years that has come to be known as the European Dark Ages. What matters most here is the realisation that there was a quantum jump that took place; a massive leap from the Greco-Roman civilisation directly to a 'new' civilisation that was influenced by the Renaissance of Western Europe, the Scientific Revolution and the Industrial Revolution. In the final analysis, there evolved a model of 'modern' society as we see today.

While this Eurocentric historical view is filled with great scientific discoveries and proof of amazing human achievements, it ignores the existence of a multicultural base that the European Scientific Revolution may have been rooted upon. This is because during the early European Dark Ages, around the 7<sup>th</sup> century, science flourished in other places in a different way - in a very holistic way where the element

of 'soul' was still 'intact'. The 'holistic' and 'balanced' nature of science was truly internationally represented through the cross-fertilisation of knowledge and ideas from different civilisations and cultures beyond Western Europe. These included the Persians, Chinese, Indians, Muslims, Christians, Jews and Zoroastrians - all involved collaboratively. In this way, science flourished in almost all disciplines and eventually returned to Europe, enabling the Europeans to rediscover what it had forgotten and lost during the period of the Dark Ages.

It is tempting to describe the Dark Ages as a period where Western Europe went into isolation that affected the quality of life, and generally caused mobility and knowledge development to cease and ground to a halt. In particular, it was a response to the widespread unsustainable lifestyles and consumption during the days of the opulent Roman Empire that eventually destabilised its institutions and caused massive disruptions. This then spiraled downwards, leading to various socio-cultural and economic failures. By the middle of the 5<sup>th</sup> century, the internal failures of the Roman Empire's economic, political and social structures that was fueled by the unsustainable culture forced its eventual collapse. The onset of chaos, conspiracies, corruption and nepotism were cited as some of the major reasons for the collapse. British historian, Arnold J Toynbee explains that it may be the case where "societies that develop great expertise in problem-solving become incapable of solving new problems by overdeveloping their structures for solving old ones."

Europe finally emerged from the Dark Ages, around the 14<sup>th</sup> century, in what was referred to as the Renaissance of the West; a word meaning 'rebirth' following the 'death' of what was achieved and learnt during the Greco-Roman 'classical'

period. From 1400 to 1479, tendencies to emulate and 'resurrect' the classics of Ancient Greece and Rome started, leading to a period of time when what was 'lost' was gradually reconnected, bringing with it, a new emphasis in the arts, music and thinking that has shaped what we now called the 'modern' era. This was followed by the Age of Enlightenment that emerged from the Scientific Revolution, when 'reasons' became the new 'foundation' in creating the Renaissance Man that was radically endowed with various forms of knowledge. Over time, it was the 'new' European thought that evolved, uplifting the human mind as the Holy Grail and having almost literal monopoly of the scientific 'truth' through 'reason and only reason'; leaving behind the 'soul'.

Arguably, the diverse civilisations and cultures well beyond Europe were also experiencing their own versions of 'renaissance' (though not known as such, since nothing was actually 'dead' or 'lost') and they took a different approach. In the Far East, Ancient China, for example, innovative scientific knowledge and technological inventions spawned throughout its vast territories over some 5,000 years of civilisation. Furthermore, the use of gunpowder, paper, printing and navigational devices (like the compass) are the oft-mentioned four great contributions of the Chinese that preceded the West. The compass, for instance, was also used to ensure how communities and their living quarters could be located in a manner that was aligned with 'nature' in order to preserve and enhance harmony and a peaceful relationship with the environment. Another example is in the use of paper as a product from 'nature' - all of which originated from the concept and knowledge embedded in the tradition and belief that regarded 'nature' as part of their socio-cultural dimension, if not spiritually.

This even extended into their lifestyles that cherished natural healthy living, based on the use of traditional and medicinal herbs and other natural sources, thus demonstrating respect and a deeper appreciation for 'nature' as an integral part of a sustainable living. Indeed, the award of the 2015 Nobel Prize in Physiology and Medicine to Tu Youyou, the first Chinese Nobel laureate in physiology or medicine, for the use of artemisinin, locally called *qinghaosu* that was derived from the sweet wormwood plant (*Artemisia annua*) in the control of malaria brings this point home. Collectively, the prize recognises drug discoveries from 'nature' since the other half was awarded for a novel therapy derived from soil bacteria to kill roundworms that cause river blindness and elephantiasis - two of the world's most devastating parasitic diseases. This rich, holistic and advanced knowledge base was nurtured over centuries from the learning centers (though not known by the Latin word, *universitas magistrorum et scholarium*) that dotted across the East. This occurred during a similar timespan in which the Indian civilisation also substantively contributed to global knowledge. Indeed some of these earlier centres of learning and sharing played vital roles as holistic and balanced knowledge centres that predated the oldest university in the West. It was only after 1088, did European-based universities begun to sprout after the establishment of its first institution – the University of Bologna in Italy. A university was designed to play the role of "the trustee of the European humanist tradition". This role has had far-reaching implications to the non-European world of knowledge and wisdom.

The numeral system we have today is a good example of the cross-fertilisation of knowledge that occurred during that period. Different cultures had different numeral systems. However the 'invention'

of 'zero' through the delineation of the rules that governed its use by Brahmagupta, an Indian mathematician and astronomer, around 600 CE changed all of that. After the collapse of the western Roman Empire some 100 years earlier, a mathematical 'vacuum' developed that created an opportunity for the so-called 'Hindu-Arabic' numeral system to expand internationally and last until today.

It is by far the most commonly used symbols all over the world, especially so in our increasingly digitalised world. It was adopted and embellished by the Arab and Persian mathematicians who travelled to or were based in India at that time. This again, goes to show how holistic knowledge was developed collaboratively and shared interculturally. This exchange of knowledge in India facilitated the seamless transfer of ideas further west into the Arab-Islamic world. By the 8<sup>th</sup> century, the Abbasid caliph, Al-Mansur brought this knowledge to imperial Baghdad. The knowledge was eventually shared and discussed at various academic centres including the major intellectual centre during the Islamic Golden Age, *Bayt-al Hikmah* (The House of Wisdom). This centre that was based in Baghdad provided an important link between Indian mathematics and astronomy and

the nascent upsurge in science and mathematics in the Islamic world.

Around the 9<sup>th</sup> and 10<sup>th</sup> century, the enriched knowledge that was gathered, spread to Europe and throughout the world via commerce, trade, education and also colonialism. It was around that time that the prolific scholar and teacher, Gerbert of Aurillac (who later became Pope Sylvester II) endorsed and 'popularised' the knowledge of the new numerals in Europe. By then, Persia had already caught on, as mentioned in the works on numerals by Al-Khwarizmi, the famous Persian mathematician, astronomer and geographer who taught in Baghdad. Further to the East, the oldest surviving Chinese mathematical text using a round symbol for 'zero' was Ch'in Chiu-shao's 1247 "Mathematical Treatise in Nine Section". Knowledge sharing from the Muslim world to China increased during the Yuan Dynasty (1271–1368), through the Muslims (*Hui* people) there.

Overall, as it revolutionised the knowledge of mathematics, it also influenced scientific thinking globally. The use of Roman numerals (Figure 2) was rendered mathematically obsolete, thus limiting its use today to symbols and decorative purposes (e.g. on clocks or preface pages of books).

I	V	X	L	C	D	M
1	5	10	50	100	500	1,000

Example:

1,944 = MDCCCCXXXIII = MCMXLIV

Figure 2. Roman numerals

Similarly, there were also words, especially in English that had Arabic origins that mutually enriched both languages, just like the reverse that occurs in today's world. Many learning centers, notably, "The House of Wisdom" in Baghdad not only preserved the knowledge by establishing extensive repositories of knowledge and great libraries, but they also advanced them by translating them and introducing new words, concepts and meanings in virtually all disciplines of studies. It attracted numerous scholars and dignitaries from all directions, including envoys from the Roman Emperor Charlemagne (774-814 CE) who was also known as Charles the Great.

The development of the Hindu-Arabic numeral system is one of many examples that illustrate the meaning and impact of the holistic and balanced science that grew out of the non-Western worldview and ethical principles. The interactions with the Eastern world is thought to have made it possible for the Europeans to reconnect to their forgotten history and cultural heritage that was supposedly lost during the Dark Ages in Western Europe. However the non-Western worldview and their impact on scientific knowledge and progress, until in very recent times, were hardly recognised by the Western world. The lack of official recognition of the impact of multiple civilisations from around the world has possibly led to a potentially biased Eurocentric conception of the Scientific Revolution.

When the solar system as delineated by the geocentric model of Ptolemy was challenged by the heliocentric model of the Catholic cleric, Nicolaus Copernicus in the 16<sup>th</sup> century, it was against the understanding of the church at that time; the earth was actually not the center of the universe. Copernicus ran into trouble for this and did not publish his work until when he was on his deathbed. Interestingly,

about 200 years before Copernicus produced his work, there were similar mathematical details in the works of the astronomer, Ibn al-Shatir of Damascus. Although there is no documented evidence of transmission of the specific ideas, there must have been some form of 'connectivity' from the past to Copernicus and other European scientists and scholars during the European Renaissance and the Scientific Revolution. The potential failure to recognise the 'connectivity' in the past and to claim all the credit for the scientific paradigm shifts in Western Europe may have resulted in the lack of understanding of the cultural values of the civilisations that they may have 'borrowed' the ideas from. However, this does not negate the scientific progress accomplished by the European scientists in Europe during that period. Nevertheless, it is often debated if the similarities in work were either coincidental or there was a "copyright infringement" issue.

It is very important to understand that during the so-called European Dark Ages, a scientific era with a different scientific approach and emphasis emerged in other parts of the world. It was science with 'soul', in the context of being holistic and balanced, and not a parochial approach to being the trustee of a specific tradition. In short, it is possible that we have ended up with 'soul'-less science because we have ignored the progressive contributions of other civilisations in our zeal for sole recognition.

In the past, the contributions of other civilisations were often regarded as mere footnotes to the modern science of the West. However, more efforts are being made to reexamine our historical worldview these days. In the book, "1001 Inventions: *The Enduring Legacy of Muslim Civilization*", works of Muslim scholars during the "Golden Age" of Muslim Civilisation between the 7<sup>th</sup> and 17<sup>th</sup> century

that have served as platforms for important scientific and technological advancements of our modern civilisation are captured. In another book entitled, “The Theft of History” by Jack Goody, a prominent social anthropologist and an academic at the University of Cambridge, pointed out that knowledge from other cultures and civilisations were ‘stolen’ and ‘used’ to better suit the various purposes and cultural context of a particular culture.

In the case of the Scientific Revolution of Western Europe, the focus progressively geared towards the discovery of new knowledge that was designed for the development of technological devices that ultimately fueled economic productivity. This materialistic worldview of scientific advancements as a means to wealth creation accelerated the emergence of the industrial revolution. Thus, an economic dimension was added to science in the modern knowledge system.

When the Hindu-Arabic numeral system was initially created, it could be likened as more of an ‘open-source, open-access’ initiative, where there were no copyrights. Everybody had access to it - there were no patents, intellectual property and supranational organisations that controlled or regulated its use. The knowledge was created for humanity to prosper as part of the ‘conscience’ and ‘soul’ that was inherent in the scientific ecosystem of that period.

However, when the ‘modern’ world adopted the zero-based numeral system and used it to develop the modern binary system that is used by almost all modern computers and computer-based devices, the rules of the game suddenly changed. These new inventions were now copyrighted. Intellectual property and wealth creation is the buzzword in most R&D ecosystems these days.

Organisations such as the World Intellectual Property Organization (WIPO) and the World Trade Organization (WTO) have been specifically created for this sole purpose. Patents have become a major income-earner and the scientific community has identified them as markers of success – like counting beans. As a result, ‘user-created inventions’ have multiplied by many folds.

Thus, because of the ‘open-source and open-access’ nature of the earlier ‘invention’ of the zero, it has been possible for the ‘originators’ of ‘user-created inventions’, computing giants and many other people to benefit from the resulting economic enterprise. In other words, because the initial intellectual property was shared, the knowledge was accessible for use by humanity for the benefit of humanity. Unfortunately, as time progressed, somehow or rather, it has increasingly been given a monetary price-tag. Modern science uses R&D as its platform for revenue generation. In the context of science from a business standpoint, it is not just about rewarding scientists. It is also about the investors or funding bodies that fund the R&D and science; which is increasingly dominated by the private sector that has financial profits as their bottom line.

This has something to do with the neglect of the “soul” or the loss of ‘conscience’ as human beings have progressed through modern science with an increasingly individualistic and materialistic lens. As a consequence, we have now put ourselves in a situation where knowledge has been monopolised by certain groups. Today, the whole idea of the bottom billion not being able to access knowledge to facilitate social mobility has become a critical issue. Hence, without access to relevant knowledge, the bottom billion will remain as the bottom billion, and thus, lesser equals.

This inequality in access to knowledge will expand the base of the economic pyramid. As a result, the gap between the rich and poor will increase and it will become even harder for the bottom billions to improve their lives. The challenge to overcome the problem of having science without 'conscience' or 'soul' will become even more insurmountable in the future if we fail to address it, thus drawing parallels with the collapse of the Roman Empire. The former CEO of Hewlett-Packard, Carly Fiorina in her speech entitled, "Technology, business and our way of life: What's next?" on the 26<sup>th</sup> September 2001, in Minneapolis, US highlighted: *"When other nations were afraid of ideas, this civilization thrived on them, and kept them alive. When censors threatened to wipe out knowledge from past civilizations, this civilization kept the knowledge alive, and passed it on to others. While modern Western civilization shares many of these traits, the civilization I'm talking about was the Islamic world from the year 800 to 1600, which included the Ottoman Empire and the courts of Baghdad, Damascus and Cairo, and enlightened rulers like Suleiman the Magnificent."*

The stark difference between then and now is that today, it is a matter of business based on the logic of economics and financial prosperity, whereas previously it was based on the logic of humanity and human dignity. We can trace this back to The Age of Enlightenment where spirituality and the value of the church was no longer regarded as important by certain quarters. The turning point was that the human mind was elevated as the only thing that mattered when trying to solve the problems of the world. As a result, it caused a rift between the State and the Church. The State was inclined to create what was recognised as the 'materialistic' or secular world that had nothing to do with

the church or on any other religious basis. Whereas, the religious response then, was to create a different kind of a world, the "heavenly world".

Eventually, a form of 'materialistic science' that was devoid of 'soul' and sometimes without 'conscience' gradually emerged. Although there was still God in 'materialistic science', its God was the 'mighty dollar'. This is best illustrated in the phrase, *"In God we trust"* that appears in the US currency despite the separation of the Church and the State. The irony is that the establishment of the economic dimension of science has created a form of scientific 'atheism'; where the return of investment of R&D expenditure is solely measured by the financial returns from the resulting R&D, be it from commercialised products or licensing of intellectual property. Thus, a more 'worldly world' has emerged. As a result, there are 'new' god(s), sets of ethics and rules that govern science; effectively inhibiting any efforts to bring back the 'soul' into R&D.

From a philosophical point of view, as quoted by Stephen Hawking in his 2010 book, "The Grand Design", *"Recent experiments in neuroscience support the view that it is our physical brain, following the known laws of science that determines our actions, and not some agency that exists outside those laws. For example, a study of patients undergoing awake brain surgery found that by electrically stimulating the appropriate regions of the brain, one could create in the patient the desire to move the hand, arm, or foot, or to move the lips and talk. It is hard to imagine free will can operate if our behavior is determined by physical law, so it seems that we are no more than a biological machine (that I interpret it as human capital), and that free will is just an illusion."*

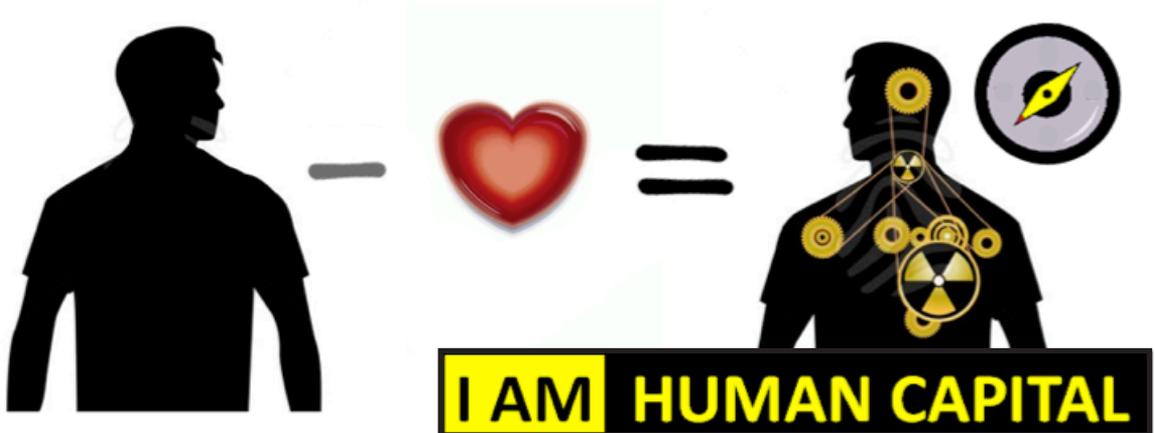


Figure 3. Human being devoid of soul is a biological machine

We are often confronted with a challenge to try and discard the ‘soul’ and sideline spirituality because we assume that we are falsely governed by it. However, the reality is that we are actuality governed by another set of rules - the physical law. It appears that we are no more than biological robots that lack ‘soul’ and ‘conscience’. This perfectly captures what ‘human capital’ is all about (Figure 3). Thus, what indeed is the relevance of the oft-used term - human capital in education?

To answer this question, let us refer to the work done at the Dublin City University (DCU) that studied the Irish Higher Education system, which is not unlike that of Malaysia. Interestingly, according to the researcher at DCU, Marnie Holborow, *“The making of human capital is increasingly seen as a principal function of higher education. A keyword in neoliberal ideology, human capital represents a subtle masking of social conflict and expresses metaphorically the commodification of human abilities and the alienating of the notion of human potential, both of which sits ill as far as the goals of education is concern.”* If you look at our policy documents, everything is centered

on building human capital. In contrast, the National Philosophy of Education does not even talk about nor acknowledge the term human capital. Instead, the emphasis is on the existence of a balanced and holistic human being.

Like us, the Irish have the Hunt Report that talks about the strategies of higher education up to 2030. The report is all about moving the ‘human capital’ up the value chain. This brings us back to the question of where is the ‘conscience’? How do you humanise science again? How do you bring back the ‘soul’? How do you awaken the ‘soul’? The word ‘awakening’ is chosen because there is a belief that the ‘soul’ is there but somehow it is in a state of dormant slumber or not being sensitised to the kind of science that is being engaged. As such, academics around the world need to rethink whether the term ‘human capital’ is relevant to the future development of education in the context of S&T.

Let us start with the renowned social theorist and physiologist, Jeremy Rifkin, who while reflecting the release of the first US-approved genetically modified

organism in the early 1980s, was quoted as saying “*We were making the first step out of the age of chemistry and physics and into the age of biology.*” This perspective extends to the whole idea of biological mimicry, where scientists learn by observing, dissecting and understanding the various occurrences and phenomena in nature and then try and invent and develop innovative strategies to mimic these observations in the laboratory setting. For instance, what can we learn from lizards? How can lizards stick on the ceiling without falling? What sort of knowledge is currently present? Is this natural? How can we modify it without violating the ethics of nature? What can we learn from insects? Incidentally, there is even a discipline now called ‘insectronics’. Scientists are now creating or building models that are based on nature so that we do not deviate too far out from what nature has provided us.

Although we may not be aware of it, long before these new emerging disciplines existed, many IT-related devices and gadgets have been inspired by nature; whereby the IT industry took a “biological path” in creating new innovations and inventions (Figure 4). One good example is the computer ‘mouse’, that is designed to control the movement of a computer’s cursor. Before the mouse, there was the ‘mother’board that was predisposed to infection by virtual ‘viruses’ and ‘worms’. It is possible to ‘treat’ your infected computer by using anti-viral softwares such as ‘PC-cillin’ that was probably named to associate itself with the antibiotic, penicillin. Note that all of these are biological-related terms but used mechanically.

The area of ‘artificial neural network’ and ‘artificial intelligence’ are emerging branches of robotics that have begun



Source: [www.usb.brandoo.com](http://www.usb.brandoo.com)

Figure 4. Computer hardware and software that have biological terminology

to tap into newer dimensions including more intimate human relationships. “The Love and Sex with Robots” International Congress that was planned to happen in November in Malaysia is an example of how science is being extended to more intimate and personal dimensions. However, it was cancelled because the Malaysian authorities deemed that there was “nothing scientific about having sex with machines”. However, the reality remains that the use of biological terminologies and simulation to mimic the natural world is predominantly confined to mechanical applications that are aligned to the idea of ‘human capital’. In other words, while there is now greater understanding of the biological basis of the natural world and how we can artificially mimic it, the future of science will not change unless our mindset and perspectives change.

There are scientific efforts being made now to scan the world around us for models that can inspire or be the basis for new innovations without transgressing the limits of nature and humanity as we have done so frequently in the past. These efforts maybe the new platforms we seek to move forward. These efforts will need to include a concerted effort to bring back the ‘conscience’ to the realm of science. Like happiness, ‘conscience’ may become easier to be ‘(re) injected’ (read: nurtured) into something biological and living as compared to something that is mechanical and lifeless.

We need to appreciate that a major shift in the R&D ecosystem is taking place; where we are moving from a mechanical to a systems-based approach that allows for an organic understanding of organically nurtured paradigms that are related to various biological-related fields such as biochemistry, biophysics biotechnology, bioinformatics and biocomputing. A lot of scientific explorations and discoveries

are converging on a ‘bio’ platform as an organic network of balanced knowledge. We have indeed entered into the Age of Biology.

We are shifting away from the mechanical and mechanistic physical dehumanising science that we have learnt to adopt for a long time. Theoretical physicist and mathematician, Freeman Dyson, wrote that “*green technology is based on biology, gray technology on physics and chemistry*”. He highlighted his concerns when he wrote “*For the first five of the ten thousand years of human civilization, wealth and power belonged to villages with green technology, and for the second five thousand years wealth and power belonged to cities with gray technology. Beginning about five hundred years ago, gray technology became increasingly dominant, as we learned to build machines that used power from wind and water and steam and electricity. In the last hundred years, wealth and power were even more heavily concentrated in cities as gray technology raced ahead. As cities became richer, rural poverty deepened.*”

Thus, we need to unlearn the way we have been used to living in a mechanical world and relearn how to symbiotically live in a natural world that supports and sustains life. For that to happen, we must rejuvenate the knowledge that we have forgotten or lost. We need to reconnect with our ‘soul’ and ‘conscience’ again, so that science remains closely intertwined with the essence of nature, human, *fitrah*, etc. The hollow world of ‘modern science’ is gradually beginning to be filled up again with some understanding of ‘spirituality’ as far as the human essence is concerned. Freeman Dyson in writing “Our Biotech Future” states that “*the twentieth century was the century of physics and the twenty-first century is the century of biology.*” The reasons why many believe in the existence

of this bio-centric shift include the fact that the field of biology is now bigger than that of physics as measured by the size of budget, workforce and major discoveries. Biology is likely to remain the biggest component of science through the 21<sup>st</sup> century. Biology was also found to be more important than physics, as measured by economic and ethical implications. Hence, there is a need to underline this fact because it is relevant to our discussion on the effects of science on human welfare, especially in the context of the bottom billion.

By finding and creating opportunities to mobilise biology within the framework of a modern S&T ecosystem, it might be possible to inject 'soul' into R&D and science. This being the case, the path to (re)humanise science and R&D is dependent on how it positively impacts on human welfare, especially the bottom billion. Those at the bottom of the economic pyramid may be significantly enhanced if biology is appropriately mobilised to reawaken the 'soul' within the framework of S&T. In doing so, the 'conscience' can be sensitised to act as the much needed moral compass to respond to the overdue call to help 'the bottom billion'. Therefore, by awakening the 'soul' and 'conscience' to the fullest, we have a better chance of nurturing human beings rather than just training 'human capital' or 'biological machines'. The human beings, in turn, will then, have an instinctively proactive call to help the bottom billion and humanity. At the recent 2015 World Economic Forum in Davos, Oxfam delivered a clear warning that by 2016, the wealthiest one percent of the world are going to own more than half of the world's assets.

There are serious calls for an urgent action to narrow the gap between the rich and poor. The advances of S&T that have been driven towards wealth-creation instead of the greater good of human well-being and humanity continues to widen the gap, resulting in many who are unconvinced that this gap will be breached or even narrowed in the near future. Unless the aspects of availability, accessibility, affordability and appropriateness (4As) are fulfilled in the R&D products that are being generated, the chances of closing the gap is low. We really need to work on leveraging on the promise and potential of the so-called Age of Biology.

Steve Jobs was once quoted as saying, *"Don't let the noises of the opinion of others drown out your own inner voice (that inner voice could be your conscience). And most importantly, have the courage to follow your heart and intuition. They somehow or rather already know what you truly want to become, everything else is secondary."* He made this revelation when he got acquainted with Zen Buddhism and invariably the spiritual dimensions that are closely associated with it. The deliberate mention of the 'heart' and 'intuition' is very apt in humanising science, but it does not fall in the scope of this discussion.

Now, we have come to the part of how to bring back or rather reawaken the 'soul'? Certainly, how do you change the mindset? Or, matters of the heart that are deeply embedded? How do we approach the discourse of what the new worldview of science would or even should look like? Perhaps, it is reasonable to look at the way we organise ourselves and the knowledge structures that have somehow locked us into a pyramidal and highly hierarchical construct. Humans, from the days of the

Renaissance have been reengineered to consider themselves as the paragon of all beings – claiming their position at the apex of the hierarchy. All the rest are placed rigidly below; creating a precarious relationship between one another, with specific individuals having the ‘ultimate’ say, making decisions on the fate of many, in a top-down manner. Given that we have ‘lost’ or ‘strained’ our connectivity with the environment, the overall situation has become ‘unsustainable’. To survive we have been forced to compete to excessively produce. This has in turn, exacerbated a culture of overconsumption and waste.

In other words, humans have self-styled themselves as ‘consumers’ - where materialistic science is the engine of growth for the sustenance of the ‘consumerist’ economy. Hence, innovation and creativity are encouraged as a technical platform to increase rivalry and spur even greater competition. The cycle has continued until it has begun to threaten the survival of the planet and all its inhabitants. As a result, the once cherished continuous innovative changes have somehow reached its limits. For example, the anthropogenic impact on environmental degradation is associated with severe and more frequent natural disasters worldwide. Despite the robust scientific evidence and general scientific consensus on the rate and extent of global warming and the potential for human actions to reduce these impacts, there are influential individuals who remain skeptics and even block the efforts of others in addressing climate change. The ‘arrogant’ mindset results in humans thinking that they are in control and that they are all-knowing. This is because these individuals fully believe in their ‘power’ of reasoning while also believing that the ‘rest’ of the world does not possess the same ‘power’. This gives rise to greed, gluttony and

gullibility. The current structures, like the mindsets that give rise to it, are failing and are no longer sustainable. So is science sans ‘soul’; it is just not sustainable.

There are now alternative views of the kind of changes that must be put in place in order to sustain the survival of the planet, not just for today but for generations to come. To begin with, a different kind of structure that leads to a different kind of sustainable relationship between all the various components of the ecosystem is warranted. The structure must be flexible and less hierarchical if not completely flat. It is about connecting and supporting the larger communities and its members in a networked fashion. Therefore, it is about ‘us’ rather than ‘individuals’ (you or me), and no one should dominate or be at the apex of the outmoded hierarchical structure. The processes should be more consultative and bottom-up, with a whole-community approach as a way to encourage collaboration rather than competition.

The focus of developing ‘human beings’ is about uplifting human dignity and enhancing human quality of life through the enculturation of humanitarian values of social justice, equity and the 4As that were mentioned previously. Unlike ‘human capital’, it is therefore alive because it has ‘conscience’ and ‘soul’ in a balanced and holistic way. Science therefore needs to have a worldview that advocates a kind of balance in order to remain sustainable for many generations. It cannot exceed the limits that destroy humanity and the environment in the way it has transgressed today. Should the imbalance be allowed to persist or grow in magnitude, there will be greater chaos and disorder than what we are already witnessing today.



Figure 5. Shifting Arrogant Mindset to Humility Mindset

Therefore, the shape of ‘modern science’ is no longer tenable. It needs to be refashioned again into ‘sustainability science.’ This counts for a different mindset and ‘heartset’ that thrives on humility rather than arrogance (Figure 5). A humility mindset allows for learning and sharing knowledge collaboratively rather than the current strategy to monopolise knowledge under the pretext of intellectual property, patents and copyrights for economic purposes. The prioritisation of economic over ecological needs and technological over socio-cultural needs have resulted in a disequilibrium. Scientific advancements should be less about more wealth creation and more about improving human welfare globally.

Unfortunately, technology has tended to be increasingly more divisive, especially along the North-South divide. The divide is growing and has taken different dimensions all over the world. Pertinently, the disparity is not limited between the developed world and developing world alone, but increasingly even within national boundaries. In Malaysia, the report on the “New Economic Model” highlighted that eighty per cent of the population is living on less than RM3000 a month. Globally, four billion people are living on less than USD3

per day. The annual death toll from poverty-related causes runs into millions; greater than that caused by wars. According to the United Nations, 21000 people die every day of hunger or hunger-related causes. The World Health Organization (WHO) also announced that one suicide occurs every 40 seconds globally; accounting for more than 800,000 suicides a year. Research has found that the death toll from suicide exceeds those that are from conflicts and natural disasters.

These statistics paint a damaging state of mental health of the world’s population. Unfortunately, these statistics do not appear in our mainstream radar or do not receive the attention it deserves from the public. Scientists are generally not concerned because they are preoccupied with publishing in high-impact journals as required by their funding agencies or institutions. How many people should die before it becomes a main agenda? Alas, it is not a question that we necessarily concern ourselves with. University rankings also have nothing to do with addressing these types of questions. So then, where is the ‘conscience’ as far as S&T is concerned? Moreover, as far as economic well-being is concerned, we may have advanced the argument for S&T as an

economic driver, but not the human being. Accordingly, the moral compass in R&D has become haywire to the point that the whole scientific ecosystem in Malaysia or even around the globe has become 'soul'-less and senseless.

Thus, let's return to Oppenheimer's quote "*I am become Death and I am the destroyer of the world*". If he took this quote from the 'Bhagavad Gita', then there must be wisdom in the scriptures around the world to awaken our 'soul' and sensitise our 'conscience'. How do you reacquire that wisdom? How do you bring that wisdom into science to modulate it as we progress forward? With global warming and climate change, as well as the wars that are going on, we will probably need to look back into the various scriptures to identify and regain the wisdom that will connect the 'soul' back to the mind to provide solutions for the global good beyond what the Scientific Revolution provided us. For that, I think we need to start looking at the intangibles, the Key Intangible Performance (KIP), rather than just the things that we can objectively count (output), the Key Performance Indicators (KPIs). There are no 'KPIs' for intangibles such as virtue, justice, mercy, joy, happiness, dependability and loyalty. Nobody nor a single matrix can measure these intangibles in absolute totality. There have been recent efforts to measure happiness. The reality is that actual action of eliciting happiness is more meaningful than just numbers and percentages. Thus, there is a need to reinstate the 'soul' to equilibrate the economic, technological and socio-cultural needs while at the same time set the 'conscience' as the compass to guide and maintain that balance. How do we achieve that?

The suggestion is that we need to reframe science in the context of balance and at the very minimum within the perspective of sustainable development. There are more concepts about balance

from the view of eastern traditions (*yin-yang, mizan, timbang-rasa*) and sustainability is one governing factor that will take science beyond what we are already managing currently. There needs to be a focus on the quality of life that transcends economic well-being. There also needs to be a greater discourse on spiritual well-being over and above overcoming economic poverty. There is also a need for discussions pertaining to spiritual poverty because this is the imbalance that has long been ignored, and thus it requires restructuring. The humanity focus is not just national focus. Often governmental talk about global communities does not translate beyond rhetoric. Thus, let us be realistic about it. When we talk about humanity, let us talk about humanity in the context of the bottom billion that needs to be reached out and saved.

By the year 2050, there will be an estimated 10 billion people on planet earth, 60 per cent of whom will make up the bottom billion. The world will not be able to survive if interventions are not put in place to steer away from the current trajectories. Even now with the millions of people migrating as refugees, we view science as being helpless. Ironically, we have been able to devise a plan that cost billions to land a few people on the moon with amazing precision, but we have failed to attend to the human beings on earth who have 'real' needs to survive. The lessons of the Manhattan Project has not even touched our 'soul' because our 'conscience' appears to be lulled in deep sleep and our senses have been numbed.

In the context of the higher purpose of S&T, and the search for wisdom, there is a need to recognise the scriptures as Oppenheimer and Jobs did to rediscover some of the knowledge that we have lost for a long time. Only then can we begin to understand and decipher questions such

as what is intuition? What is the inner voice? What is *karma*? What is *fitrah*? Indeed, all these terminologies have been alien to science since the time it was rendered 'soul'-less and the 'conscience' desensitised. Thus, these need scriptures to be brought back and reinterpreted in the context of reinstating the balance in science in today's world. The same applies to the economic dimension. It is important to be inclusive, equitable, collaborative and culturally-sensitive. Science does not exist as a one-size-fits-all solution. The scientific community needs to re-evaluate its own cultural norms as well as embrace all other cultural values as additional sources of knowledge to promote global sustainability.

Furthermore, technology needs to be fit-for-purpose, user-friendly, eco-friendly and culturally relevant to ensure sustainability. It need to act as an 'equaliser' or a balancing force that bridges the current gaps in equity. Hence, it cannot be an 'innovation' that separates humans from their socio-cultural needs and wants. In that sense, social innovation is just as vital as technological innovation. These innovations should be accessible, available, appropriate and affordable (4As) before the goals of inclusiveness, equitability, collaborative and culturally-sensitive can be achieved. To me, the 4As are the 'sensitisers' of the 'conscience'. Without the 4As, R&D will lose its intended effectiveness. If more efforts are made to ensure the achievement of all the 4As in R&D, it will be easier to ensure a balance in safeguarding if not uplifting human dignity.

In the effort to translate knowledge for humanity, we need to remain truly holistic human beings, rather than being reduced to human capital in a production line. In other words, the 'soul' must remain intact and the 'conscience' kept alive. This is in line with what was declared at the World Education Forum in Incheon last May,

*"...inspired by the humanistic vision of education and development based on human rights and human dignity; social justice; inclusiveness; protection; cultural, linguistic and ethnic diversity; and also responsibility and accountability... ."*

Through our Eastern lens, we also need to understand that the human intellect is not confined to the mind but also the heart. There needs to be a balance between the mind and the heart. We understand that the 'soul' of education is the education of our 'soul' or heart. If the 'soul' remains uneducated, any education will be short of what it is supposed to be. This is due to the lack of humility that is often associated with the 'soul'. Oppenheimer's great sense of humility shines through his quote *"No man should escape our universities without knowing how little he or she knows."* The reality is that we know very little as we go through our tertiary education. There are other elements that need to be put in place. It is these elements that will undeniably take us perhaps beyond the achievements of the Age of Enlightenment, within rationale and reason.

This is also applicable to R&D today, at least in the context of Malaysia. It is too devoid of 'soul'. It is also a reflection of how we collectively recognise the field today, as 'STEM': Science, Technology, Engineering and Mathematics. In Malaysia, we have a tendency to just go with the flow, we rarely think for ourselves. When the dominant and prevailing voice use 'STEM', we are more likely to follow suit rather than ask the basis of 'STEM' in the context of 'conscience' and ethics as part of good governance. Thus, 'STEM' needs to be changed to 'STEAM', whereby the 'E' stands for ethics. In tandem, all scientists need to be trained in ethics, responsible conduct of research and the philosophies of science. The 'A' in 'STEAM' represents the arts and aesthetics. Steve Jobs, in his self-titled biography, talked about how he

used his knowledge in aesthetics and art to create countless mechanical products such as iPod and iPad. Whereas, the ‘M’ in ‘STEAM’ refers to management, the ability to manage and ensure balance in governance to ensure a sustainable scientific ecosystem. Without good governance that is based on sound ethical foundations, the effort to inject ‘soul’ will remain elusive as science will remain largely unregulated and unbalanced. In the context of ‘soul’, we could also opt for ‘STREAM’, with the ‘R’ representing ‘recreational scientific knowledge’ (for example, gardening). As cited in the scriptures of traditional wisdom of the renowned Chinese poet and philosopher, Lao Tzu, *“All streams flow to the ocean because it is lower than they are. Humility gives the ocean power.”* Given all the knowledge that has been acquired, let us endow science with the power to move forward. However, it must be ingrained in humility and nurtured by a ‘conscientious’ ‘soul’. Since we do not know as much as we need to know, we need to be governed by sets of rules based on the ‘soul’, ‘conscience’ and wisdom and ethical principles. These components really need to be reinstated in science.

Thus, unless we act immediately and strategise our various efforts, the status quo will be maintained. We will continue aimlessly without a clue of where we are heading towards. In view of this I am glad that the Academy of Sciences Malaysia has taken this long overdue initiative to bring this discourse forward and mainstream. In fact, if the Academy excels in this direction, it would be an added value that positions the Academy’s future role in regaining the ‘soul’ in the Malaysian R&D landscape. Accordingly, let me leave you with another quote from Albert Camus to further stress on the importance of ‘soul’ in R&D, *“I would rather live my life as if there is a God and die to find out there isn’t than live my life as if there isn’t God and die to find out there*

*is.”* Therefore, let us work on what is best for us in repositioning science towards a more holistic existence that will in turn, help shape the future of knowledge and R&D to be more sustainable.

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# About The Author

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## Dzulkifli Abdul Razak FASc

Dzulkifli Abdul Razak FASc is currently the 14<sup>th</sup> President of the International Association of Universities (IAU), a UNESCO-affiliated organisation that is based in Paris.

He is an Honorary Professor at the University of Nottingham and is Chair of Islamic Leadership at the Islamic Science University (USIM) in Malaysia. He also chairs the Steering Council of the Right Livelihood College Global Secretariat that is based in the University of Bonn, Germany. Recently, he was appointed as a select member to the 2015 Hamburg Transuniversity Leaders Council, a think tank for the future of higher education. He was also made a member of the Global Leadership Initiative at the School of Frontier Sciences, University of Tokyo, Japan.

He served as the 5<sup>th</sup> Vice-Chancellor of Universiti Sains Malaysia (USM), from 2000 to 2011, a member of the World

Health Organization (WHO) Expert Advisory Panel on Drug Policy and Management since 1995 until 2010 and a member of the WHO Scientific Committee of Tobacco Product Regulation (2004-2006). His other international involvements include being a member of the Asia-Europe Meeting (ASEM) – Advisory Education Hub Committee since 2007 and a member of the Executive Council of the Association of Commonwealth Universities (2006-2011). Apart from that, he is a Fellow of the Academy of Sciences Malaysia (ASM), the World Academy of Art and Science (FWAAS) and the Malaysian Institute of Management (FMIM). He is also an Honorary Lifetime member of the Asian Academy of Management.

He is an avid writer. He is a weekly columnist for Malaysia's oldest daily, The New Straits Times, since 1995; and more recently The Sun, an English daily with the largest circulation. He is married to Masrah Abidin and they have four children.





**Academy of Sciences Malaysia**

Level 20, West Wing, MATRADE Tower,  
Jalan Sultan Haji Ahmad Shah,  
off Jalan Tuanku Abdul Halim,  
50480 Kuala Lumpur, Malaysia

Phone : +6 (03) 6203 0633

Fax : +6 (03) 6203 0634

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