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*EDITORIAL*

# Transformation of Innovation Culture Over the Years

Bidding adieu to year 2013 and with the arrival of new year 2014, a new dawn of hope comes in the horizon. Let us embrace this New Year and look back to the past years for introspection and assessment to get charged up with fresh thinking and spirit to enter into the New Year for further venture ahead. The success of a venture rests on the innovation because it is the soul of a dynamic system for progress and growth. Scientific innovation is an inexhaustible force for the prosperity of a community or a society at large. Without innovations, enterprises would proceed towards extinction; so it is, in a way, the life force for any dynamic society.

Year 2013 will remain memorable that it was the Centenary Year of many of the new events of invention and innovations of modern civilization. It marked the 100$^{th}$ year of Niels Bohr's proposition of the atomic structure of Hydrogen atom which is a classic example of innovation achieved through the incorporation of the Planck's quantum ideas on emission of radiation into the framework of the atom to show that an atom loses or gains energy in discrete quanta. This path breaking innovation of Bohr came into existence with the enunciation of the quantum model for hydrogen atom in the year 1913.

In the same year 1913, Bragg diffraction, also referred to as the Bragg formulation of x-ray diffraction was first proposed by William Lawrence Bragg and William Henry Bragg. The father-son duo presented their work at the Royal Society of London about the reflection of x-rays by crystals which is very helpful to understand the arrangement of atoms in the crystal structure. Year 2013 was also the 100$^{th}$ anniversary year of the landmark experiment conducted by Moseley to establish the classical correlation of atomic number with the frequency of x-ray emitted from the targeted atoms what is later came to be known as Moseley's law. Moseley's experimental evidence led to reconfiguration of the Mendeleev's old table to a new version. The other milestones of spectacular classic scientific discoveries or Nobel recognition occurred way back in the year 1913 include the concept of Zero-Point energy by Albert Einstein and Otto Stern; Declaration of Nobel Prize to Kamerlingh Onnes for investigations on the properties of matter at low temperatures which led, inter alia, to the production of liquid helium and observation of supraconductivity or superconductivity; besides, Soddy's group displacement law; event of Nobel Prize by Warner for his work on coordination complex etc.

The discoveries made in the nineteenth century are mainly classical mechanics, thermodynamics, electromagnetic theory, relativity theory, quantum mechanics and astrophysics. With the success of such discoveries, many researchers then started believing that there was nothing much left to be discovered in physics. But such believe was short lived and proved wrong with the innovation of highly sensitive new detector systems which could identify various subatomic particles those days remained unknown. In fact, the quest for invention and innovations of human race never stopped but continued to acquire success in the endeavor to proceed further through continuous effort to upgrade the scientific knowledge and try for technological innovations.

Science is not only concerned with the material aspects of mankind but is also trying to unfold the mysteries of creation of earth of this solar system and the universe at large. A step in this direction was an effort to discover Higgs boson or what is called God-particle to understand how mass is accumulated on the matter. With this mission of mankind, large hadron collider (LHC) at European Organization for Nuclear Research (CERN) has been built up and is hailed as the biggest scientific and engineering accomplishment to explore towards understanding how the universe came to acquire its current shape. In fact, LHC is the most expensive and largest international project venture of science where scientists and engineers selected from different countries across the globe have been working in close cooperation. More importantly, it is truly a testimony of international collaboration among the scientific communities cutting across the continents. Thus, the practice of science has gradually transformed truly into a global scientific collaboration culture because in today's human society, irrespective of country or community, science is intimately integrated to influence every aspects of human welfare and enquire. In the process, it took about hundred years to cover the journey of innovations from the concept of Borh's Hydrogen atom till establishing evidence of Higgs boson particle. Peter Higgs and Francois Englert have jointly received the Nobel Prize last year for pronouncing the theory of how particles acquire mass and predicting the existence of the Higgs boson particle. Interestingly, the declaration by the Swedish Academy of Science for their Nobel Prize happened exactly after 100 years since Borh's novel proposition of atomic model for hydrogen, the smallest size of atom in the periodic table.

With the overwhelming success of the LHC for the discovery of Higgs boson particles as officially declared by CERN, a new venture is planned to build yet a bigger version of LHC what is now termed as very large hadron collider (VLHC) for use as a next generation accelerator to carry forward further enrichment of knowledge of high-energy physics. Such accelerator ring will be 100 kilometers around and will run with collision energy of 100 TeV which is 7 times the energy of the LHC.

Thus, global culture of research as witnessed in the LHC mega project has brought about a perceptible change in the mindset of scientists to adopt the new approach of innovations

through integrated massive collaborative effort to seek solution for unusually complex research problem of mankind. Innovation in modern times has become powered by advanced computing capabilities enabling exploration of massive datasets which is based on data-intensive curating. But such big data computing may not practically be possible by any individual in his or her lifetime. Thus, a collective mass computing system has emerged. It comprises three major steps represented by 3Cs - capture, curation and creation for further progress. Thus, a new way of collective innovation is gaining momentum in recent times, for example through Online Science Games (OSG) where it combines the contributions of the communities of science and professionals. Often such online games have produced results to solving problems and providing solutions to the mysteries that have plagued scientists for a long time. Such innovative approach can be so interesting that many of the most complex molecular problems may be solved by enriching conceptual understanding through playing such online mind-game to evolve possible methodology of molecular design and synthesis.

*Foldit* is one of such online games launched by the Washington University has drawn great attention among the researchers worldwide because it showed how a group of some video gamers could solve the structure of Simian AIDS-causing Mason-Pfizer monkey virus (M-PMV) which puzzled the scientists for so many years. This was possible because of the *Foldit* type computer game and the solution was so good that enabled the scientist to fine tune the methodology to get the crystal structure of the protein. *Foldit* is a revolutionary new computer game enabling an individual to contribute to important scientific research from any corner of the globe. Such game is literally based on the operation of understanding folding patterns of peptides and protein formation. It is reported in the literature that the structure of proteins greatly influence their function, such that even a small change in the folding pattern can bring about a huge change in the protein function. The complexity of the three-dimensional structure and its close association with protein function all along puzzled the researchers until the idea of innovation of *Foldit* conceived which attempted to predict the structures of proteins by taking advantage of the puzzle-solving spatial intuitions. And people are invited to play competitively to get best folded structure. Players may theoretically design brand new proteins for drug design that could help tackle dreaded diseases. Some of the most fatal diseases like AIDS, Alzheimer, and Cancer are under study in close consultation with the *Foldit* output. One can participate in such collective innovative program by contributing towards solving the protein mysteries through *Foldit* approach.

It has been an established fact that scientific research and innovation are essential for the growth and progress of civilization and society. But researcher's responsibility is to assess the pros and cons meticulously and decide what gives the best in totality for the society. It is hoped that in this new year 2014 global research community will take more active interest on the topics of the contemporary global challenges on issues like green technology, sustainable energy, unfolding the mysteries of enzymes and perplexing protein problems in which *Foldit*-like approach may act as path finder. *Defence Science Journal* (DSJ) is a junction point with a purpose to help enjoin the whole research communities of the globe.

Precisely, 100 years ago from this new year 2014, Max von Laue received Nobel Prize in the year 1914 for the observation of x-ray diffraction which is considered one of the monumental discoveries in the history of science that opened up the path of innovation for the development of modern solid-state physics and materials science, chemistry and molecular biology. Structural biology opened up to determine target structures responsible for morbidity, including enzymes, protein receptors, zones of DNA, RNA etc. Generally biologists utilize x-ray techniques in a different innovative way by crystallizing proteins. Ramakrishnan, Steitz and Yonath jointly got the Nobel Prize for studies of the structure and function of the ribosome where x-ray studies played significant role to reveal the secrets of ribosome which even a few years ago thought to be unresolvable. The importance of x-ray is reassured with the work of understanding the nature of the machine that translates the RNA code into protein.

In the last hundred years, the branch of crystallography has earned more than 20 Nobel prizes, indicating its immense importance and relevance. The International Union of Crystallography has declared 2014 as the Year of crystallography which led the United Nations to declare the same at international scale. In this backdrop, the objective of the declaration seems to be more fruitful if United Nation can spread the message among the researchers to crystallize their thought process and action for innovation to achieve higher global goal more objectively for sustainable society.

Amusement can always find a place in the new year so it would be nice to have an anecdote here at the end. Leaving aside zero, year 2013 comprised the interesting positive numbers 1, 2, 3 which as if followed a sequence of AP series. On the other hand, this new year 2014 comprises positive numbers 1, 2, 4 as if, to find a GP series. So this new year 2014 as if belongs to GP series, thus hopefully we can wish a faster scientific progress through innovation than last year's.

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