Great Science and Technology in India – at IISc and higher educational institutes? - further analysis and possible solution

H. S. Mukunda, Professor, IISc (retired)

After Mr. Narayanamurthy's strongly worded speech at the convocation address at IISc on July 15, 2015, many articles by distinguished scientists have appeared – Prof. G. Padmanaban in Hindustan times on August 11, 2015, Prof. C. N. R Rao, in Current Science, 11 August 2015, Dr. R. A. Mashelkar in Current Science, 25 September 2015, Vijay Chandru, a former professor of IISc in Hindu, August 03, 2015, and several others in various other magazines.

I wish to dwell on the core theme in the light of what has been stated by these distinguished scientists, indicate a missing element in each of these observations, draw upon the a recent history involving success in building excellence out of an existing dilapidated system and outline a strategy to grow, even if slowly, from the current situation to excellence in multiple dimensions.

The tone of most of the writings I have read is somewhat defensive and on occasion using offense as a tool for defense, partly related to Mr. Narayanamurthy drawing parallels from MIT (USA) without adequate and deeper reflection of the accomplishments and the role played by academia including IISc in India. The positive point of his address is the start-up of strong debates contributed by many distinguished people.

Prof. Padmanaban who spent his life time of active work at IISc and as a director for four years has made two critical points. He states "…*Are we doing cutting-edge research? Not really. It is very good research, but not the breakthrough kind. Even senior scientists do not want to leave the comfort zone to risk an untrodden path. It's still 'publish or perish' that decides the future of scientists"* and "…*The problem with the IISc is its laid-back environment*" The question that arises is if can we do something concrete about these two aspects.

Prof. C. N. R Rao has in fact suggested that if a few billion dollars were provided for, he could help create a world class university. Even if this were possible in say, five to ten years from now, what about IISc with its long history and the dozen other science and technological institutes of higher learning of history not as long, but substantial and those established in recent times; should these be written off? I think there is an alternate pathway I want to describe that should bring up all institutions. Great work happens because there is a very large pool of good scientists doing good work, large pool of scientists doing very good work and a smaller number

doing extraordinary work in a pyramidal manner – Greatness does not appear in isolation albeit with a very low probability.

Dr. R. A Mashelkar invoked lack of "irreverence" as a possible reason for lack of high quality research. While this may well be so, if we have not seen better evolution towards irreverence over this period and no hopeful situation coming along, how long can the country wait for the right people to arrive – is there no sure approach to obtaining results instead of unsure expectations?

Prof. Vijay Chandru has brought insight from the systems in the truly successful situation in the USA explaining what may be lacking here and expresses hope of creating a structure through NITI Aayog. No matter what structure is suggested, creation of new knowledge of worth to the society around and the World at large is an act that should happen within the institution and discussions on the way forward must happen within. Inputs can come from outside but that is no argument for the lack of intense discussions within.

The example that I would to bring to the attention of the scientific community is of Dr. Abdul Kalam on what he did at DRDL, Hyderabad - aspects that have not figured in any of the recent articles on him by many distinguished people. I was familiar with most of the scientists and directors from that time – quite often engaging them in conversations on why ISRO appeared performing better that DRDL in rocket engine based vehicle related developments. There was a clear despondency in DRDL with most active scientists having no self-faith, feeling that nothing significant would happen in their organization. Dr. Kalām's entry to DRDL as its director in 1982 after successful SLV launch was of course greeted with enthusiasm, but the lack of trust between product developers and users, namely, defense services was considered a stumbling block, yet. That he created an integrated guided missile development program (IGMDP) with five different classes of missiles along with user community on board and sanctioned by the Government was in itself extraordinary achievement. Then onwards, he devoted all his time – on a 24 x 7 basis to these projects, brought to fruition the most important ones. With Dr. Gen. Sundaram as the project director, Prithvi, the semi-tactical surface-to- air missile saw its successful flight and further tests leading to interest in deployment by the army in about six years. The joy this development gave to the organization was stupendous. We must remember that the change occurred in just six years! What is crucial to appreciate the role played by Dr. Kalam. He would engage with individual scientists at several levels and technicians in workshops at DRDL with a zeal and commitment that was simply not seen in the organization till that time. He could drive his colleagues to intense work and also show compassion at moments of personal misfortunes in ways that all those associated with him felt clearly that they were working with him and not simply for him - implying working for the country. He brought greater fame to DRDO through the realization of the strategic vehicle, AGNI over years both at DRDL and later as SA to RM. The third vehicle -surface to air tactical missile, AKASH was fruitfully completed to the satisfaction of the user community more recently and based on this, DRDL has received orders for 30000 systems – an extraordinary achievement by any standards.

During the period when he was the director, he made no fundamental changes to the organization. He gave the organization what was needed most – a leadership with organizational interest the uppermost with little visible personal gains demonstrating to people at every level that they also mattered and mattered to the organization (I have christened this quality elsewhere through a dimensionless number – called Gandhi number – a number that the is the ratio of what any individual does for outside of oneself to what is done for oneself. Many past distinguished people belong to this category; amongst people I have known, Prof. Satish Dhawan and Dr. Kalām would qualify for a very high Gandhi number).

What would be inferences for the question on hand, namely, performing excellent science and technology in academic institutions? The analogy that I am drawing from the above illustration of Dr. Kalām is illustrative. In the case of DRDL or ISRO, the goals are clear – develop a system with specifications. It is not so for an academic. The goal is excellence in science wherever it takes. In such a journey, it is possible, one goes a long way along unknown paths and is struggling to move ahead – as it will be so for excellent scientists, but there is another extreme that is more common – being lost in justifiably significant, but in truth insignificant work being pursued for decades. If effort is made to let deeper reflection on the latter aspects, some who are "lost" can indeed be "retrieved". I know of many who are looking deeply inside for direction, but do not get any for long times for a variety of reasons and think that it is below their self-esteem to seek clarity from colleagues. Most importantly, excepting promotions that affect their immediate stature, there is little institutional demand for performing excellently. I am discounting long or short speeches at faculty meetings when the directors make remarks demanding excellence. It is simply not clear to anybody whether such a demand is more than statutory. This is the reason for what Prof. Padmanaban described as "lay back attitude".

What then is the solution? Two things that directors should do – (a) Interact directly with individual faculty members on a one-to-one basis for an hour or two each year exploring the broad contours of individual research - motivation for research or development, what the peers that the faculty members interacts think of this class of work, does the faculty member have difficulty in getting things published, are there any serious bottlenecks in the conduct of work within the campus and offer suggestions, when possible, to get to higher levels in the exploration of the field and all that encompasses academic world. The fact that the chief executive is directly interested in his/her work becomes the strong motivating factor individual pursuit to excellence, (b) Hold meetings of small groups of academics pursuing similar subjects in a more relaxed environment along with divisional chairmen and chairmen of connected departments (senior academics overseeing progress of work and promotions) to discuss cooperative work enhancing the total accomplishments, (c) Often use the presence of and distinguished academic visitors to hold similar group meetings and encourage a vibrant discussion and only make mental notes. The last technique was what Dr. Kalām used to calibrate various people including "experts" and academics, gently prodding people to perform better or accomplish more. The directors of institutions should deal with these subjects beyond administration a role that seems to occupy most for most time. It brings about close connectivity between the director and the head of institution with the faculty; it helps own up

the faculty and the faculty owning up their head as academics, apart from a boss clearing papers and dealing with promotions.

It is realized by many directors after a while that there is some deadwood within their academic family. It is important that serious attempt be made to identify, nudge such people to get out of such situations. It is far more serious these days when full professors have an academic life of 25 years or so and can cause havoc if they are non-functional and spread an impression that the kind of life they are living is also worth living. Such problems cannot be resolved unless dealt with directly by the chief executive speaking quietly, gently, but surely to the individual faculty.

Further, the point made by Prof. Padmanaban on the impression that "publish or perish" attitude being dominant is sometimes denied by some directors. However, from what I have known, there is a visible broad tendency to disown developmental and technological accomplishments even if they are truly science based; and even if this is untrue, it is certainly true to say that this is the public impression. It is therefore extremely important to speak about work of significance to the nation in various relevant forums allowing the possibility for rejuvenation of broad based academic values.

Over years, there has been decay in the functionality of segments related to contact with the industrial world. Prof. M. N. Srinivasan of Mechanical engineering department who took care of the Centre for Scientific and Industrial Consultancy laid early foundations for a dynamic and interactive place with Prof. Dhawan responsible for starting this center. Slowly over twenty years with some ups and downs it became a reactive center rather than a proactive one. Prof. C. N. R. Rao started the SID (initially society for instrumentation and development and later society for innovation and development) wanting a strong proactive center for industrial interactions. For some time in early nineties, several discussion meetings between various faculty groups were held to understand the new relevant science and technology activities across the Institute. I am unaware if such meetings have taken place in the last decade. Essentially this institutional arrangement has also degraded into project processing center in a reactive mode. Serious efforts must be made to keep the dialogue with industry alive on a periodic basis both semi-formally and formally. It is also equally true to say that interaction of academia with DRDO and ISRO is going down over time. I reflected on this at a research council meeting at DRDL, Hyderabad some time ago and suggested that they invite younger faculty to be brought in for briefing and awareness meetings. Conscious efforts must be made institutionally to keep the links with reality alive. There is no escape from reality checks for any academic work particularly in engineering science.

Lastly, Narayanamurthy made a point that MIT, USA provided him with a booklet indicating list of technologies that they offered the nation during his visit. Even at IISc, in 1996-97 when the then prime minister, Mr. Deve Gowda visited IISc, five technologies were presented to the nation by Prof. G. Padmanaban, director then. These events have neither been followed up or preserved over a time essentially due to the fundamental lack of respect for these by those distinguished men in the tower (where offices of director and other functionaries at IISc are

located with somewhat similar ones in most institutions) and continued attempts to dismantle institutional segments of significance for this kind of outreach.

In summary, there is much room for raising the quality of work and projecting them to the world with academic authenticity. There is responsibility for the heads of institutions in knowing the broad contours of academic work of individual faculty members –whether it is for the cause of international science or national development and providing needed encouragement, also that they care for their colleagues with a smile or gentle nod of recognition more often. In stating the last words, I remember Dr. Kalām rather vividly.