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RESEARCH ARTICLE

Management of "Habitat" needs-A Critical Aspect for Global Positioning of Indian Science

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Abstract

Science and technology R&D in India faces several questions as to what ails it or why it lags behind the rest of the world despite having an ancient heritage and a large workforce. Ailment of Science in India impacts not only on the usual outcomes of R&D efforts but also on the innovations. Despite having one of the largest scientific manpower resources in the world, scientific R&D in India is however, far below its threshold on the originality and innovativeness scale.An "Organizational Quality Index" has been defined where minimal fiscal, infra-structural and spatio-temporal dimensions of an organization result in the best or the highest output and deliverable. An environment for outstanding research work or a "Habitat" impacts overall output and the Organizational Quality Index.Three levels of habitat factors, namely the foundation parameters like team work, strategic planning (vision, mission and mandates) and resources; other essential parameters such as R&D ambience, an opportunity for continued learning, a "step ladder" hierarchy rather than an "elevator hierarchy" are at the second level and finally we have four vital supports on which the entire habitat is structured and these include pride and respect in one's work; transparency and fairness in the work and its management; honesty and integrity at work and actual work ethic that is upheld at all times. A "habitat" for scientists will enable a productive work-force with requisite support structures in place to nurture and sustain creativity, innovation and all path-breaking R&D activities not just for a niche recognition but also to make Indian scientists the worthy inheritors of an ancient science mandate that gave the number "zero" and the decimal place system to the world.

Keywords: *Fox, Habitat, Hedgehog, Organizational Quality Index, Scientific R&D.*

Introduction

An organized endeavour succeeds only when all its stakeholders perform to their optimal benchmarks. The R&D Institute or a Business venture or a manufacturing industry are no different from each other as organized endeavours and, therefore, their success or otherwise can be attributed to a finely balanced synergy between resources (financial, human) and organization (infrastructures, legislations, social responsibilities). Such a synergy is easy to envisage at virtually all levels of functioning. Thus if an organization is somewhat poor in financial resources, but provides inspirational or motivational infrastructures that are second-to-none, the organization is successful in attaining its benchmarks even when the resources are less than optimal. The converse is equally true for an organization that, lacking infrastructures but richly endowed with say human resources, can still meet or even exceed its benchmarks. The motive force that drives the efforts to success comes from the inspirational leaders, visionaries, out-of-box thinkers, dedicated and inspired workforce, unambiguous legislation and highly responsible societies. In this scenario, when one considers a specific organized endeavour to be failing or lagging behind the global or contemporary trends, it surely calls for specific questions and to seek answers thereof. As a theme for this article, we consider Science or scientific R&D in India as an organized endeavour. Often there are several questions raised about Science in India. What ails science in India? Why it lags behind the rest of the world despite having an ancient heritage and a large present day workforce? These questions have been debated at several instances in scientific periodicals, newspapers and other national or international forums. Answers to these questions must be sought from within everything that science in India encompasses, be it the scientists or their institutions or their philosophies and the motive forces that drives them towards a scientific endeavour or even the early nurturing that occurs at the school and University level for the scientists. What is SCIENCE? We consider it to

be **S**erial, **C**ontrolled **I**nvestigations into **E**mpirical and **N**atural **C**ascade of **E**vents. Science thus entails repetitive and routine studies as well as unique and innovative studies. Ailment of Science in

India impacts not only on the usual outcomes of R&D efforts but also on the innovations. A commonly stated point of view is that despite having the third largest scientific manpower resource in the world Scientific R&D in India, is however, far below its threshold on the originality and innovativeness scale. So what inhibits the productivity (originality, innovativeness) of Indian scientists? It is this question that we are trying to address here building up on the premise that ailments of science in India may have human and/or organizational factors that are a bottleneck to progress. In the former, everything about human endeavours in science needs to be examined especially to assess whether or not we have the requisite wherewithal to excel in science. Thus we need to ascertain how good the Indian scientists are, how they perform in terms of national as well as international benchmarks and whether or not they have the requisite attributes for setting new benchmarks. Such an exhaustive analysis of the human endeavours in Indian science is beyond the scope of this article. We have instead highlighted only the human failings and related attributes that may be impacting on the qualitative and quantitative values in science. In the case of the organizational factors, we need to assess whether or not the organizations involved in nurturing and sustaining R&D in science in the country are the bottleneck to progress.

Science in India is mostly a state-controlled or state-funded organized endeavour and there are only a few autonomous or privately funded endeavours. It is our perception and belief that the organizational factors may have a greater role in deciding the progress or otherwise of the science in India. An individual performing well below the required threshold is surely blameworthy as a possible cause of the downfall in science but this is only a tiny share of the blame.

However, when the entire organization itself is below par in its role in development of the science in the country, then it is not just an individual but several who are adversely affected. Therefore, we need to examine all the factors associated with organizational performance and in doing so we also need to factor in the role of individuals within the organization. In the context of the state-owned, state-funded organizations in India for scientific R&D, the organizational factors that are the causative factors for failures to attain benchmarks may have greater linkage governance and legislative issues also.

Individual Factors

Haldane [1] in his inimitable way had expounded the premise that science in India was not advancing or keeping pace with the Western world because Indian scientists were (a) too polite, (b) rather unprofessional about their responsibilities, (c) influenced by a “caste system” based on academic degrees, and (d) seriously lacked pride in their profession, though they were proud of their salaries and positions. According to Haldane, such factors may end up choking the growth of Science in India. Another view that has been discussed about Science in India lagging behind in the world is because the Indian scientists are perceived to be lacking in curiosity, or scientific inquisitiveness that is an essential attribute of a scientist [2-4]. Kumar and Ranade have, however, argued that the above lack of inquisitiveness is relatively a lesser issue than the problem of non-accountable work ethics, a lack of self-respect and pride in one’s work, preponderance of obsequious reverence and sycophancy that has obscured the vision and inquisitiveness of Indian scientists and placed the science in the country on a downhill and retrograde trend [5]. Why India has not been able to harness its strengths into deliverables? This is the question that Desiraju [6] asks and at the same time attempts to answer. He links non-performance of the Indian science to (i) feudal mindset that the Indian scientists get from their deeply rooted cultural, religious and moral structures; (ii) corruption in all forms; and (iii) an assumption or even belief that that the answer to all our problems lies simply in money or the seeming lack of it. He reasons that in reality what India lacks is the quality of leadership and the level of honesty that are required for a breakthrough in science. At another level, Bhargava [7] in a letter published in Science, also blames the leaders of science in India as he notes that the scientific leadership in the country, with notable exceptions, rewards sycophancy and punishes independence, integrity, effective communication, scientific competence, and credibility. These failings are more about the leadership failures and these are in smaller numbers as compared to that of the rest of the scientists. At the level of an individual scientist, the criteria for failure are more about their perseverance or sustained R&D efforts or the

diffused superficial efforts sufficient to merely maintain their job, since the majority of scientists are wage earners [8].

The Erasmus Adage

Some individual scientists may spend a lifetime in a few or even just a single area of research while others may end up specializing in several braches and aspects of R&D. This dichotomy is best described by the Erasmus adage and its application to Science and scientists. A recent debate about "irreverence" and its impact on lack of advancements in science in India seemingly raised a few issues that seem to plague Indian science [2-5]. Balaram in his commentary [3] on this debate raised a point about the Erasmus adage on hedgehogs and foxes. This set us thinking that the adage is apt enough to apply to Indian science and scientists but is this is all that advancement of Indian Science is about? Can we simply break up and categorize Indian scientists as being either Hedgehogs or the Foxes? Does it apply in our context of science in India? By and large, Indian scientists are primarily wage earners who are forced to consider doing science as a routine job [8]. The reality is that doing science should be an intellectual pursuit driven by a curiosity and zeal to seek answers for questions of "what" or "why" or "how" about the natural phenomena, and daily life in this world. In this scenario we find that it is the motivation and involvement or commitment in science of the Indian scientists, whether for exploratory or innovative or routine knowledge generating activity that underpins productivity, and not merely whether or not they can be grouped into hedgehogs and foxes categories. Yet, it is also true that Science will not progress in the absence of its "hedgehogs" and "foxes". Who are the hedgehogs and fox scientists?

Stephen Jay Gould considers scientists as being either foxes or hedgehogs [9]. This kind of metaphor has also been applied to other categories of mankind. For instance Isaiah Berlin [10] discussed contemporary Russian authors and their literary styles including that of Lev Tolstoy. Both have the basis in the original works of Archilochus, the renowned Greek poet in the seventh century. His idea was first recorded in print by Erasmus Rotterdamus in 1500 with the Latin inscription:*"Multa novit vulpes, verum echinus unum magnum*."In English, this is translated as "the fox knows many things, but the hedgehog knows one big thing". The metaphor as applied to science suggests that there are two kinds of scientists (read as: explorers, inquisitive minds), the hedgehogs and the foxes. In nature, the hedgehogs rely on one tried and true defense, rolling up into a ball and baring their quills while the latter (the foxes) rely on a wide range of crafty strategies to avoid becoming a prey. Intellectually, the hedgehogs delve down into one topic and research it thoroughly while the foxes jump from topic to topic, surveying a wide range of ideas across a broad spectrum of research fields. Hedgehogs know only one trick while the foxes know many. Hedgehogs are interested only in a few problems which they consider fundamental, and stick with the same problems for years or decades. Foxes are interested in everything, and move easily from one problem to another. Most of the great discoveries are made by hedgehogs, most of the little discoveries by foxes. On a much wider and loftier scale, the metaphor is extrapolated to human beings who can also be categorized as either hedgehogs or foxes. On a lifetime scale, the hedgehogs have their lives as an embodiment of a single, central vision of reality according to which they feel, breathe, experience and think as a centripetal system, while the foxes live centrifugal lives, pursuing many divergent ends with a sense of reality that prevents them from formulating a definite grand system of everything, simply because they know that life is too complex to be squeezed into any unitary scheme. Thus, Sigmund Freud (study of the unconscious), Charles Darwin (natural selection), Karl Marx (the class struggle), Albert Einstein (theory of relativity), and Adam Smith (division of labour) are all considered as hedgehogs because they reduced a complex world and simplified it along a key or a central theme [see 11-15 for Wikipedia links to information about these scientists].

On the other end of the scale there is the incomparable Richard Feynman (quantum electrodynamics, particle physics, quantum computing and nanotechnology and Nobel laureate) as an excellent example of a fox scientist [16]. Other notable foxes include Leonardo da Vinci, the famous Italian polymath artist, scientist, inventor, painter; Isaac Newton, the English physicist, astronomer, and philosopher; and Benjamin Franklin – author, journalist, scientist, inventor, political philosopher and statesman; Dr. Albert Schweitzer, an Alsatian theologian, musician, philosopher, physician, humanitarian, and peace activist and a Nobel laureate; Herbert Simon, a very distinguished polymath, famous for work in psychology and computer science, philosophy of science, a leader in artificial intelligence, and a Nobel laureate; and Nathan Myhrvold, a computer scientist,

technologist, mathematician, physicist, entrepreneur, nature and wildlife photographer, master chef [17]. Who can ignore the outstanding contemporary or past millennium Indian scientists who are by all accounts worthy of being called as foxes - Acharya Sir Jagadish Chandra Bose, who was an outstanding Indian polymath, a physicist, biologist, botanist, archaeologist, as well as an early writer of science fiction and Damodar Dharmanand Kosambi a polymath known for his work on cytology, history, archaeology, languages, resurrection of many works in Sanskrit and as an author of one of the finest books on Indian history and critical essays on society [18-19]. These are a few examples of hedgehogs and foxes and it is obvious that science all over the world has advanced because of their notable contributions. Thus, science needs both foxes and hedgehogs for its healthy growth, the hedgehogs are needed to dig deep into the nature of things, foxes are needed for exploration on a wider than a deeper scale.

Failings and Shortcomings in Science

The application of the Erasmus adage, an interesting contrast of traits, also brings to the forefront some more interesting contrasts and in the context of science and scientists, and the extent to which these contrasts are resolved in either direction would perhaps define the status and success of the science in the country. The contrasts include but are not limited to "Persistence and Flexibility" or "Specialization and Variety" or "Teaching and Research" or "Empirical and Theoretical" research. The resolution of these contrasts or dichotomies ultimately defines the qualitative and quantitative features of science not just in India, but globally too. Therefore, resolution of the contrasts also throws up a clear perspective of the problems faced by the science in the country. Some of these perceived problems, failings or shortcomings along with their impact status are for the sake of comparison identified at human and organizational levels (Table **1, 2**). It is clear from the two tables that the human failings and ailments have mostly a short term impact while those of the organization have more long term impacts. A speedy resolution of the problems of organizational failings needs be achieved for all of these factors that have the maximum impacts on the status and success of science in the country.

Organizational Quality Index

The human and organizational traits (Table 1, 2) have an ultimate impact on the success or otherwise of the institutions and are interlinked to each other as well as to temporal factors such

Table 1: Possible human failings and ailments that have the potential for maximum impacts on Indian science and suggestions for amelioration of their negative impacts

Trait	Category	Duration of effects	Suggested amelioration of negative effects
Non-transparent functioning	Personal competence	Long term	Encourage open access
Lack of dedication and perseverance		Long term	Train and motivate personnel
Inability to have a contemporary knowledge		Long term	Motivation is required. Likewise training and facilitation of gaining contemporary knowledge through learning opportunities
Superficial and redundant studies and Duplication of work		Short term	Educate personnel about wrong doings; take swift actions when such cases arise
Sycophancy	Personal behaviours	Short term	Delink positional hierarchy with functional jurisdiction
Loner research habits		Short term	Encourage networking
Lack of strong work ethics		Long term	Educate personnel about wrong doings; take swift actions when such cases arise
Manipulation, fabrication of results and other frauds		Short term	Educate personnel about wrong doings; take swift actions when such cases arise
Plagiarism		Short term	Educate personnel about wrong doings; take swift actions when such cases arise

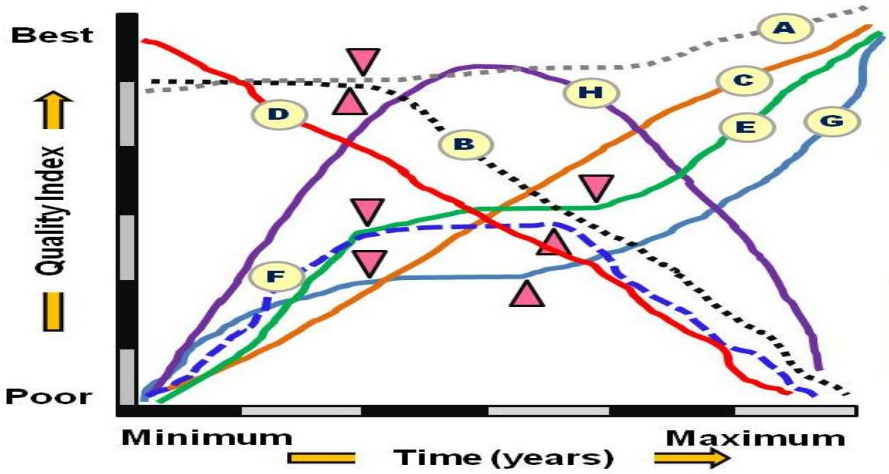
that a real-time simulation of these factors is dynamic with reference to one or more of these factors at any given time. Thus it becomes necessary to view the organizational dynamics with reference to time-dependent criteria and impacts on what we may term as the "Organizational Quality Index". This index we define as a cumulative parameter where minimal fiscal, infra-structural and spatio-temporal dimensions of an organization result in however, the greatest or the highest output and deliverable. Obviously such an organization will be the "Best"

Table 2: Possible organizational failings and ailments that have the potential for maximum impacts on Indian science and suggestions for amelioration of their negative impacts

Trait	Category	Duration of effects	Suggested amelioration of negative effects
Superficial and redundant studies; Duplication of work	Operational strategy (Organizational)	Long term	Inculcate peer review of research plans; archive older research work because often such older studies are recycled as new research (old wine in a new bottle!)
White elephant establishments		Long term	Restructure including revamping strategic plans; personnel
Financial issues – excess money or the lack of money		Short term	Inculcate money management and thrift practices; accountability of money and deliverables.
Non-transparent functioning	Operational procedures, rules, regulations (Organizational)	Long term	Inculcate affirmative action, equal opportunity and open access procedures
Procrastination		Long term	Office automation; ERP solutions
Non-accountability		Long term	Ombudsman level functionary; automation of procedures
Arbitrary reward-punishment systems; unclear appraisal systems		Long term	Ombudsman level functionary; restructure appraisal and other related procedures including making them automated
Indistinct functional or positional hierarchies		Short term	Demarcate hierarchies
Inability to network within organization		Long term	Inculcate networking in strategic planning
No mechanisms for forecasting, trend analysis		Long term	Establish specialist think-tanks
Neglect or tolerance of misdemeanours, breakdown of official rules and regulations		Long term	Ombudsman level functionary
Elitism not supported by appropriate work ethic		Short term	Networking and equal opportunity actions
Faulty recruitment policies		Long term	Inculcate strategic planning
Inability to prevent or control attrition		Long term	Analyse organization dynamics periodically; recognize and nurture talent

organization and it should then be possible to identify organizations at sequentially lower thresholds than the "best". A simulation of organizational dynamics impacting on quality or benchmarks in R&D work reveals some interesting scenarios. As depicted in Figure 1, the changes in quality over a period of time can be simulated and shows all possible rates of change ranging from a continuous increment to continuous decline and all possible intermediates between these two extremes. Curves A and B in the figure are for an established organization with a high quality index sustained for a few years before the turning point event dramatically changed the trend. In case of A the curve showed an increase in quality after the turning point event while in B it showed a declining quality trend. Simulation curves C and D are exact opposites respectively showing a continuously increasing and declining trend respectively. In the case of the curves E, F and G the simulations show 2 turning point events and differences in response of the trends to the turning point events. Finally the curve H could be used to simulate a natural time-dependent decline of the organization quality benchmarks.

No matter what kind of simulation trend a given organization follows, there are a few basic factors that influence these trends individually as well as cumulatively. Any or all of these changes can be "turning point" changes in terms of the magnitude of impacts on the organizational dynamics. Changes in manpower and executive parameters result in large effects on organizational dynamics in short time spans. For instance appointment of scientific manpower or the executive or relinquishment of office by an incumbent executive can prove to be turning point events for the dynamics of the organization in the subsequent years. These changes take place in



Factors	Effectivenes time frame
Manpower	Small local changes; large effects - within short time span
Executive	Large local changes; larger effects - within short time span
Legislative	Fixed changes; and effects within fixed time span
Societal and National	Large changes; small effects - very large time spans

Fig.1: Simulation of organizational dynamics with reference to Quality index as a function of Time. The different simulation curves (marked as A to H) are schematically and arbitrarily drawn. The catalytic turning points are indicated by red arrow heads. The factors and their effectiveness timeframes governing the curves are tabulated to the right of the simulation curves and are equally applicable to all the curves.

short time spans but cause large effects on the organization. In such a scenario one can think of same-time appointment of a group of highly skilled and appropriately qualified scientists or an efficient, highly competent and skilled leader/executive in the organization can cause such a profound change in the way the organization conducts its R&D and attains its benchmark threshold in a short span of time. Conversely the relinquishment of office by the above group of scientists simultaneously or by the executive such that their replacements have lesser credentials for success will surely cause a decline in the organization quality or benchmark thresholds. Likewise a single critical executive decision can be a turning point to tilt the threshold towards increment or decline. In a broader perspective, the legislative and societal and national parameters can cause large changes but with small effects in fixed time spans in both increment or decline trends. How much of these organizational dynamics impact on qualitative and/or quantitative aspects of science progress in the nation? How do the hedgehogs and the fox scientists within an organization respond to or are impacted by the dynamics? There may not be any easy answer for the above queries. A detailed investigation seeking answers to such queries is beyond the scope of this article. Instead, what we have generalized are the key elements that govern success of the organizations and their scientists on a wide scale. The common needs are among the key elements and are also the common determinants of the success for the scientists and the organizations that they represent. What are these common needs?

The R&D work Habitat of a Scientist

The above paragraphs have discussed individual and organizational traits that may impact overall output and Organizational Quality Index. These traits alone however, do not define success or otherwise of a scientist or a science institution. Likewise whether Indian scientists are hedgehogs or foxes are also merely an expression of their individual traits. Granting that both are required for the Science to flourish in the country there need not be any grounds for a concern or an alarming scenario. Yet, what is it or why is it that Indian science lags behind the rest of the world? For example as per the recent rankings of global academic institutions, the highest ranked institute from India is however, at rank 358 globally [21]. This type of low ranking even though the country has amongst the largest numbers of scientific manpower (India has the third largest pool of scientific manpower in the world, after USA and Russia) is the real reason why questions are always asked about India's ranking at global levels of niche, exclusivity, and innovativeness of scientific R&D. The survey ranking the different institutions in the world reveals that barring a few elite institutions, the others in the country are way behind in the list. What is significant is that unlike some of the institutions from USA or Europe, the gap between the successive Indian institutions is very large. This gap is indicates that all the Indian institutions do not have a common baseline to measure their development and progress over a period of time. Therefore, different institutions reflect different thresholds of achievements and when a common global baseline is adopted, the difference are brought into sharp focus. This is also the reason why "elitism" of the scientific institutions has been perceived to be one of the major reasons for the lack of global positioning for Indian science against the benchmark of excellence and innovativeness [22].

Merely having hedgehogs and foxes amongst the Indian scientific fraternity as well as the sheer large numbers of scientific manpower is not enough to create a level of excellence and a global niche for the Science in India. What is seriously lacking is actually an environment for carrying out outstanding research work, for innovative research work and for sustaining one's interest in R&D. In other words, it is a Habitat problem for the scientists in the sense that their requisite habitat is not being provided or is not available to them and this must be considered as the single most important factor to the detriment of Science in India. What are the habitat needs for the Indian scientists? We opine that the obligate needs of an average working scientist include, but are not limited to, assured support and availability of resources (both fiscal and manpower); an ethical and transparent work place that recognizes the completed work more than the worker; a work ethics that respects creativity and innovations; a transparent and constructive mechanism for career progression, performance appraisals and feedback and an efficient and widely accepted punishment and reward system. In Figure 2 we have schematically depicted some of these needs and their interrelationships. The habitat needs of a scientist are indeed a valid concern for scientists and institutions where there is non-development or poor development or at the best of times a development that is not on par with the global scenario. The rationale is easy to understand since the habitat is usually inclusive of all the factors that are essential for nurturing and sustaining development of individuals or communities.

For a scientist and a scientific institution we can envisage at least three levels of essential habitat factors or needs (see Fig. 2). First, we have the foundation parameters including but not limited to team work, networking, organization, strategic planning (vision, mission and mandates) and resources, both human and fiscal. At the second level are a whole lot of essential parameters such as R&D ambience, a nursery or a think tank for knowledge, opportunity for continued learning, peer, societal and national recognition, motivating factors, and a "step ladder" hierarchy rather than an "elevator hierarchy". Finally we have four vital supports on which the entire habitat is structured and these include pride and respect in one's work; transparency and fairness in the work and its management; honesty and integrity at work and actual work ethic that is upheld at all times. Given all this, the roof signifies the originality of

Fig. 2: The structured needs for achieving and sustaining scientific benchmarks of excellence are depicted schematically as a habitat structure. There are the foundation needs depicted along the brick wall base while general needs are shown as a scroll hanging down from the beam supporting the roof. The roof in turn is supported by four pillars which according to us constitutes the most important needs for achieving scientific excellence benchmarks. The roof in this case signifies the originality of the output, its innovativeness and is also the attainment of a benchmark.

the output, its innovativeness and is also the attainment of a benchmark, for merely having a foundation or the supporting pillars do not make a complete habitat. At the same time it is also clear that a roof will never stand without the support of the pillars which in turn are grounded on a firm and structurally sound foundation. Surely deprivations of any of these parameters or problems with their quantity or quality automatically result in shortfall in achievements

and institutional progress. Given the best of the habitats and equalized parameters, then it would be highly interesting to assess whether the hedgehog type of scientists fare better than the fox scientists or *vice versa*. While pragmatic considerations dictate that the nation needs both kinds of scientists, we opine that however individually gifted a hedgehog or fox scientist may be, poor or deficient habitat can prove to be detrimental to their success or progress. Further, even if the adage "necessity is the mother of all inventions" is true; a habitat deficiency is tantamount to a deliberately created necessity and may not serve to stimulate the requisite inventive R&D. A close scrutiny of the various parameters actually shows that these are all interdependent with each other and this is also the major reason why deprivation of any one parameter often cascades a whole chain of problems for successful completion of one's research work. This is also the reason why most scientists will come up with an explanation about lacking this or that as the factor(s) responsible for their non-performance and non-productivity. Though commonly accepted, the explanations are usually interpreted as an inherent lack of determination and a proclivity to making excuses by the individual scientists. Very rarely or never does the organization deem it essential to ascertain veracity and validity of the factors responsible for the scientist to resort to such explanations? It is easy to understand how habitat differences can reflect in differences in global positioning of the scientific institutions of India. Considering that by and large the scientific institutions are state owned or state funded, it is possible to infer that the habitat differences reflect these state funding and ownership differences and are more or less also linked to governance and legislative issues underpinning the state control of the institutions.

If we project that the habitat issue is the one responsible for many, if not all, of the malaises in Indian science, the real point of argument is whether or not a good habitat can be "provided" or "created". By considering provision of the habitat one has to show dependence on the "providers" such as the organizations, society and even the Government. However, if the Indian scientists can consider it their own responsibility to create the "best habitat" for their R&D work, they will have to surmount legislative, societal and organizational bottlenecks. A recent news report Stone [23] titled 'India Rising' presents a very positive view of science in India that is linked to a roaring Indian economy. The article talks of increased opportunities for expatriates to return home for their R&D careers. However, the article takes inputs from a few select individuals and elite institutions that by themselves do not represent the cross section of the Indian science in its totality. Moreover, the report does not delve into many core issues that underpin a below-par status of the science in India. For instance the report does not discuss the plight of the increasing number of Ph Ds produced by the Indian institutions who then struggle to find academic and research positions [24]. This is surely a reflection of the inability of the Indian science to support its functionaries, mostly because the financial, governance and legislative machinery is inimical to setting up adequate numbers of the Institutions that are actually required in the context of the physical area of the country and the sheer numbers of its populace. Further the select few institutions considered in the article are among the elite institutions of the country and such "elitist" perspectives have been listed among the important reasons for a general lack of a global niche positioning for the present day science in India [22]. Bhat [22] seeks to answer the query about why a competent and highly educated scientific workforce produce as is present in India fails to deliver innovative or outstanding achievements with the observation that elitism prevails in India. Scientists who become successful and eventually become science administrators, however, preside over decades of myopic science policies and self-preservation, nurturing those who are "respectful and compliant" (sycophants) ensuring a continuum of elitism, favouritism. Such a vertical transmission of mediocrity and incompetence leaves Indian science bereft of new ideas and energies. One of the biggest shortcomings of Indian science according to Abbasi and Abbasi [25] is its inability to reward, and hence inspire, excellence. Despite the largely patronizing and unimaginative education system in India, many researchers who are brave to oppose the system do emerge with capability of emulating the best in the world, and yet no mechanism exists to encourage demonstrated potential or to reward those who achieve better-than average output. The table **3** lists some of the important failures that have to be turned around into successes before we can really state that the "Indian Science is shining".

The list is merely a representative list and many more such factors that need to be turned around can be included in it. There is also an urgent need to involve the majority of scientific workers in the country in the overall scheme of things and judging by the age patterns a strong majority is of the people in the age-range 20-40 years old. In this context, Mashelkar [26] has stated that India

Table 3: The R&D scenario in the country that needs a "turn-around facelift" so as to enable the Indian science to really shine

S. No.	Failures / Shortcomings in Indian science that need to be turned around to success stories
1	More Science PhDs than the jobs available to them
2	Unchecked scientific R&D that involves divergent, highly redundant and repetitive or outright non-productive R&D
3	Increasing levels of unethical R&D behaviours and norms due to perceived threats in career progression and a high competition for limited grants
4	Suppression or mismanagement of creative scientists
5	Tremendous gap in quality as well as quantity of science in universities and the R&D institutes that misaligns with scientific manpower in the two types of organization with inverse relationships
6	Geo-political "casteism" that causes serious losses to R&D synergies among the various stakeholders and inculcates several undesirable features such as non-transparent functioning, lethargic and unenthusiastic R&D work culture and tendencies to circumvent legislative and administrative norms and processes
7	Mismanaged fiscal resources both for expenditures as well as for incomes so that a few "elite institutions" get redundant grants while several needy institutions are deprived even of the basic needs which may inculcate dishonesty in fiscal matters
8	Loss of credibility and trust values of the R&D institutions that has resulted in high attrition rates, non-availability of resources from the corporate and social responsibility structures

urgently needs a Young Academy since a nation of 1.2 billion people has as many as 55% of whom are under 25 years old. He contrasts great achievements with extant extremes of the opposites as for example the fact that though India's Moon mission Chandrayan-1 led to the detection of water on the Moon, yet rural Indian women continue to walk kilometres each day in search of water and many more similar dichotomies. He espouses the need for a "science for all" academy which aims to provide Indian solutions to the specifically Indian problems of 800 million resource-poor people. A lack of proper forum and processes involving the substantially huge section of the Indian population in the age bracket of 20-40 years is one of the bottlenecks for less-than-desired levels of outstanding achievements and innovation in science in India. But it is not so simple an issue of getting the youth to function in science – because mere numbers do not make up for all other lacunae. As listed in Table 3 above there are several crucial habitat lacunae that must be fulfilled before one can even contemplate any measure of success. As gargantuan a task as this is, we cannot really address all the ailments of science in India, unless we set up an urgent task force involving individual scientists, organizations, society and legislature to brainstorm on a war-footing the various pros and cons of this serious issue and come up with an extremely doable action plan to achieve targeted growth and benchmarks in science. We must first set up the requisite habitat for scientists to develop and evolve into a productive work-force that will also have the requisite support structures in place to nurture and sustain creativity, innovation and all path-breaking R&D activities not just for a niche recognition but also for the greatest benefit to the massive Indian populace. This path and this habitat that we create must be India-centric first and not merely a copy or a spin-off from any other country for Indian scientists to be the worthy inheritors of an ancient science mandate that gave the number "zero" and the decimal place system to the world at a time when the rest of the world scientists were still ignorant of each other's existence even.

Caveat

In trying to pursue a line of thinking about habitat needs, we first listed all that ails Indian Science in our way of thinking and perspective. This article is a commentary about this. To be sure, these are our views and no single entity or organization or person is in anyway linked to any of these ailments implicitly or explicitly. Should there be even the faintest perception of such a linkage, assuredly it is but merely a coincidence.

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