40 years of “Innovation” in India

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(Main illustration)

“Innovation is The Next Big Boom on India Inc.’s Horizon!” declares a Management Guru. “Innovation Drives Us!” says a commercial from a truck-tyre manufacturer. “Innovation Amidst Tranquillity” blazons a full-page ad for overpriced bungalows in fake Spanish style oddly mixed with Gothic. “Innovation will drive India’s inexorable march towards becoming a Global Design Hub!” opines a Design Celeb… Of late, “Innovation” has become a much hyped and misused word in our country, and a lot more people are preaching about innovation than innovating!

What’s the reality on the ground? Let’s first look at a historical perspective over the last 40 years from my vantage point of being a consulting engineer-designer-innovator for the last 31 years.

I am a practising engineer, not a writer, journalist, academician or philosopher. As a practising engineer, I have it in my nature and training to see and understand things quantitatively and objectively. Therefore, I have tried to make sure that the various observations I make here are quantitatively correct and statistically significant. Before I go further, I wish to clarify that technological innovation and engineering design go hand-in-hand. The former cannot take place without the latter.

Ever since I graduated from the hallowed portals of IIT Bombay in 1976, I have been designing all sorts of mechanical machines. I designed my first real-life machine for the industry in 1975 when I was still a student. After IIT, I decided to stay back in India and go on designing machines, as the

challenges and opportunities to do original work here were much greater than those the developed world offered.

With stars in my eyes, I sincerely believed that as time passed, we would become a more mature nation, technologically more self-reliant, and achieve the efficiencies and quality of life approaching that of the developed world, which we all could enviously see even in 1976.

Effects of Liberalisation

In the 70s and 80s and early 90s, as our 'Licence-Permit Raj' Bharat lived behind closed doors, a large amount of real engineering design and innovation went on everywhere, especially in smaller companies; and usually they grew much faster than the then-prevalent so-called 'Hindu' rate of growth. This might be difficult for the younger generation to believe, but it is true!

Admittedly, much of it was copying – mostly from catalogs and machine manuals - but since we could not import or manufacture many crucial components of what we were copying, we had to perforce redesign and innovate. We routinely saw these innovations in various trade fairs like IMTEX and others. I myself designed many dozens of high-end machines from first principles in many different fields in that pre-liberalisation period. Every machine-building industry had decent machine-designers and draftsmen who worked on paper on manual drafting machines and slowly but surely created many good albeit old-fashioned and over-designed machines.

Then the much-dreamed-about, much vaunted Liberalisation (and coincidentally the advent of CAD) came about, and VERY quietly, the bottom fell out of indigenous design and innovation. All these small companies and entrepreneurs rushed to get a foreign name on their letterheads, and on their machines. At the same time, anyone who was not CAD savvy began to be looked down upon as Old School.

So within a span of a few short years, because of these two factors, a large number of our coveted design engineers and design draftsmen went out of real work, and many out of real jobs. Many took retirement; many more could not adjust to the advent of CAD, and failed to pass on their machine-design skills to the CAD-dependent Gen-Next.

The Gen-Next merrily took off on mastering CAD skills, believing that CAD skills equalled machine-design skills. This false notion has persisted till today, and real machine-design skills are becoming extremely scarce in India instead of becoming plentiful. This is quietly but steadily corroding our industry AND economy from the inside.

Let's see this in a global perspective

In the period after WW2, many countries of the world embarked upon a race to become a developed nation from almost the same starting line as us. These were Japan, South Korea, Taiwan, Malaysia… Many others started much later than we did – Brazil, China, South Africa, Thailand… As of now, all of them have almost achieved their goal of becoming a developed nation. At the same time, thoroughly devastated European nations like Germany, Poland, Czechoslovakia, Hungary, Italy… persevered and ran the fastest, and more than recovered their lost grounds.

In India, we always try to interpret the rapid and fast-maturing industrialisation of these countries in monetary and political terms, being the money- and politics-obsessed (and technologically ineffectual) people we are. This is a very naïve viewpoint, which makes us miss their real secret to success.

After WW2, without much fanfare, Japan, Taiwan, South Korea (and later China and others) started their race to prosperity with buying and then copying machines from Europe and US and developing their indigenous industry. Simultaneously, they quickly (*and 'quickly' is the key word here*) learned the underlying engineering and design philosophies behind these sophisticated machines. *And herein lies their secret to success:* they then started improving upon the originals in leaps and bounds, and rapidly started mass manufacturing a vast array of products in very modern factories. Their low cost was an added catalyst to this effervescent chain-reaction. Within a couple

of decades, many of the Eastern technologies came abreast of the Western innovation engine, and soon overtook them.

As India struggled and limped with her own feeble 'socialist model' of industrialisation, South Korea became the world's largest and best shipbuilder, forcing many renowned Western shipyards to close. Japan overtook and took over the entire world's electronic industry. Communist Russia went into space before the US; Tiny Taiwan became the entire world's machine-tool builder and globally threatened machine-tool industry (and certainly overran ours). Thailand and Malaysia account for almost all of the world's microchip production. Now China is steamrolling the entire world's mould- and die-making industry (which is the very heart of industrialisation), among many other spectacular wins. China has also emerged as the world's largest single producer of consumer electronics and home appliances. Brazil has mastered the bio-fuel race and Spain is far ahead in solar energy technologies. Israel, despite its troubled existence, has given many unique innovations to the world.

Figure 1: Korean shipyards (Notice van in red circle at bottom right)

Figure 2: Korean shipyards.jpg

Figure 3: A Taiwanese machine tool

Even today, we are nowhere near winning even one of these races; however much we may try to console ourselves with hollow patriotic boasts. We may pride ourselves in our software and IT talents, but the facts remain that not even one of the many massive leaps in software, communication and IT has originated on Indian soil. Quantitatively, our software and BPO industry grew mainly out of clerical labour arbitrage, and that arbitrage is slowly disappearing now.

The myriad tranquillising signs of industrial progress you see today are *utterly and completely* dependent on foreign companies, their technologies, machines and designs. Virtually nothing of their technologies, machines and their engineering designs are percolating fast enough into our own indigenous domain, excepting a few cheapo copies in a few areas. We simply haven't evolved mechanisms to do so.

Let's return to discussing India's innovation and industrialization; the two go hand in hand – you cannot have one without the other! One point always missed here by ALL commentators is the fact that in order to manufacture something completely new (like a CFL lamp, or a new kind of mobile phone, or an LCD screen, or a new-generation container ship, or a new kind of weapon system, or a new kind of process like laser cutting) you need dozens upon dozens of *completely new kinds of physical machines*. Obviously, these machines too need to be invented and detail-designed by engineering designers, prototypes built, tried out and perfected in a short time. This enormous task goes on in all industry round the world – mostly cooperatively, and sometimes competitively.

All the newly emerged economies, except us, have quietly developed engineering design capabilities on a vast scale in a short time.

Figure 4: CFL Manufacturing Line

Indian industry, however, has continuously failed to participate in this ongoing global engineering development process in any significant way. We too started our race with copying machines and technologies, but we could not shed our heavy cultural and habitual baggage, which weighed us down in this race. Of course, our Government and its officials have incessantly hindered us rather

than helped (and it is fashionable to blame them), but they are only a minor reason for our technological backwardness.

So why have we remained so technologically backward?

What are the invisible baggages we still carry? Spurred on by our increasingly immature media, we have surrounded ourselves with many myths. Let's list some major ones:

1. **Myth: India is fast catching up with the world technologically.**

   Fact: We are only *using* (or furiously installing in alien-owned factories) newer and newer technologies and machines, not generating / designing even a minuscule portion of those – as now we can import anything we want. Many countries are racing ahead with developing newer technologies and machines at a faster and faster pace, and we are falling behind farther and faster. We are becoming increasingly dependent on imported technology and machinery, losing entire vital indigenous industries (machine-tool building, plastic moulding, die making…) in the process. *Our ever-increasing dependence on other nations for new technology and new kinds of machinery is making us a slave nation all over again, and is creating a deep cancer within our industry.*

Figure 5: Employment Generation in China

2. **Myth: India has given many inventions to the world, latest being *jugaad*.**

   Fact: We have invented absolutely nothing worth the name after we (allegedly) invented the zero. Look around – the pressure cooker, the auto-rickshaw, the diesel locomotive, the CFL lamp, the sports shoes, the mobile phone, the thermometer, the refrigerator… and the machines which make these and so many other things, and the machines which make the raw materials for these… *we have invented absolutely none of them*. We have clumsily copied many things but *not* learnt how to develop newer technologies and design completely new kinds of machines.

Figure 6: What have we designed and made in this?

We have deluded ourselves to believe that *jugaad* is same as innovation. It is NOT! *Jugaadbaazi* has not brought us the LCD TV, the smart phones, the washing machine, the luxury bus, the aircrafts, the x-ray machine, or processed food (including *dana-dana ek samaan* Basmati rice). In fact, *jugaadbaazi* has given our society and nation absolutely nothing, except misplaced vanity. It is a matter of national shame that books extolling *jugaad* have become bestsellers in India.

Figure 7: The Great Indian Jugaad – Shame on Us

3. Myth: Automation is a capitalist evil in our overpopulated socialist country.

Fact:

a. 1.2+ billion Indians *cannot* sustain, flourish, or be nourished without a high degree of automation – which has lifted so many people of so many (even communist) nations out of drudgery and poverty – and significantly reduced wastage of resources. A few examples: Almost 1/3rd of India's vegetable and farm produce is wasted. Much of it simply rots, as we do not have machines to dress, wash and pack vegetables right in the fields to give them

longer shelf life and retain their nutrition. Our roads are still cleaned (rather not cleaned) manually. Urban sanitation machinery (therefore urban sanitation) does not exist anywhere in our hyper-filthy cities… just to name a few. Less than half of our people have access to a basic toilet. Majority of our factories are labour-intensive repositories of filth and junkyard machines.

Figure 8: Scene from Each and Every Indian City

Figure 9: Food Packaging Machine under Trial in India

b. Secondly, innovative mechanisation and automation across the country will need millions of skilled people in many fields. *As a seasoned engineer, I can vouch that this machine-dependent industrialisation I am talking about will generate widespread, better paying, cleaner, more fulfilling employment of a higher social level than the kind provided by the wretched NREGA.*

4. **Myth: Since IP rights in India are not well protected, inventors are discouraged.**

   Fact: I can tell you as a professional inventor-designer that this belief is just a cover-up for the sheer lack of engineering inventiveness among us.

5. **Myth: It is expensive to do R&D, that's why people copy.**

   Fact: As I explained earlier, copying is not the problem. Our problem lies in NOT learning anything from that copying process; since our copycats' *one and only* focus is to cut cost anywhere, anyhow and at any cost to himself and to others. The whole nation is paying dearly for our dear *"reduce cost at any cost"* mentality.

6. **Myth: India has the largest pool of young capable engineers.**

   Fact: May be numerically true, but ask any placement consultant how completely difficult it is to find even entry-level people with specific domain knowledge. Qualitatively AND quantitatively, our engineering work force is *very* poorly trained, capable or even motivated to

develop new technologies and machines. Majority fresh engineering graduates immediately abandon their profession and join a bank, a BPO, or a marketing setup (or take up non-core jobs in core industries) not merely because these offer a higher starting salary, but also because they are afraid of physical machinery, and averse to working with their hands.

7. **Myth: India has a very large pool of cheap manual labour so we need not mechanise.**

   Fact: False, because:

   a. Indian labour is *not at all* cheap in terms of cost per unit productivity.

   b. A *very* large proportion of our labour is untrained or improperly trained (and many are untrainable) for all kinds of badly needed skills.

Figure 10: Employment Generation in India

   c. Suitable labour is often not able to relocate to where the jobs are, and vice versa.

   d. Many vital skills, like precision machine assembly and operation, die making, etc., are becoming increasingly scarce, with no mechanism in place to train and motivate young workers. Socially we still look down upon a highly skilled engineering worker and look up at a graduate engineer working as a virtual clerk in a bank. The skilled worker doesn't know the theory; the engineer has no connexion with the machines – this forecloses new development.

   e. India's ability to quickly develop efficient automation solutions in every field is VERY severely limited, and is not keeping pace with whatever demand exists.

   f. Most importantly: today, a vast and increasing number of things simply cannot be manufactured manually, or cannot be made manually at the scale the market is already demanding. Therefore, we are already furiously importing entire shiploads of these things (or the machines to make them), or just ruing our misfortune if we cannot afford these sophisticated machines.

   So much for our cheap labour!

8. **Myth: Our young engineers are good at CAD and so will soon become capable of designing innovative machines.**

   Fact: CAD is only a tool. It's a tool that fragments the profession of machine designers as it makes it difficult for them to change their CAD platform, and hinders them from finding a job best suited to their skills.

9. **Myth: The world is now a Global Village, so we can import whatever we need.**

   Fact: This is a VERY myopic and damaging viewpoint! A moment of pondering will show up its fallacy: If this is true, then why are *all other* countries investing so heavily in developing indigenous machines and machine-building skills? We simply cannot become a great nation by continually exporting rice and iron ore, and importing machines and technologies!

10. **Myth: India is on the way to become a superpower.**

    Fact: every superpower has reached that crest by creating a vast and modern technology-generation and machine building (and by corollary machine-design) infrastructure. We *do not* have such vibrant and deeply interconnected engineering infrastructure that makes a nation a true superpower.

11. **Myth: China will soon falter and start having problems, leaving the field open to us.**

    Fact: 'Sour grapes!' There are no signs of China faltering on any indices in any significant way. When it comes to innovation and engineering development, the entire Chinese nation works like an army phalanx to a whole raft of detailed interconnected long-term plans. In India, we keep arguing, working at cross-purposes, obstructing development, praising ourselves, and celebrating our super-chaotic, lethargic democracy.

Figure 11: Designed and made in China

Figure 12: Designed and made in India

12. **Myth: India is too big for anyone to bring about any significant change rapidly.**

    Fact: To see the fallacy in this thinking, we only have to look at the fast-paced development and quality of life in China, the US and the EU.

So why have we remained so technologically backward?

After exploding some popular myths, let me list some little-known or ignored facts:

1. Most serious fact of all is the steady, widespread and invisible de-skilling of our work force. Today the industry cannot find trained industrial workers, as most educated young people are not willing to work with machines. Simultaneously, the not-so-educated ones are also not willing to do the work of machines any more – like sweeping roads or washing utensils or recycling garbage or filling products off a running conveyor belt into shipping boxes. *When people are made to do a menial task that is better done by a machine, they are obviously far less efficient than a machine, and by corollary de-motivated too.*

2. Across the board, we stubbornly *refuse* to look at innovative automation until our house is on fire – I have the front-row seat on these scenes of despair! On one hand, capable engineering designers are far too few in India; and on the other hand, those who really need their contribution either really can't afford the costs of development any more, or (the majority) are way too cagey to risk their money (which they otherwise routinely pour into advertising and self-aggrandisement). Most don't have the stomach to persevere through the normal failure-punctuated development cycle. It's an appalling situation, my individual success notwithstanding.

   In the words of the great Dr. Raghunath Mashelkar (Former DG, CSIR), "The 'I' in India does not stand for Innovation; it stands for Inhibition and Imitation!" How very true!

3. Thousands upon thousands of ordinary items, which we were (or still are) manufacturing in inefficient manual ways with increasingly lower quality, obsolete technology and designs (because of our obsession with cheapness), are now importing them by container-loads from China and other eastern countries. Examples: *Diwali Diyas*, *Rakhi* components, bathroom tiles and fittings, sewing needles, small air compressors, all sorts of fasteners, small and large machine tools, telecom switches, household appliances, CFL light-bulbs, door latches, even paper-clips! The scale and extent of such imports is draining the remaining life out of indigenous manufacturers. The widespread knee-jerk Indian response is to cut costs (and quality) even more brutally, akin to a losing athlete starving himself in hope of quickly shedding weight to be able to run faster.

Figure 13: Nokia's production machinery

4. Compared to other industrialised and industrialising nations, we remain extremely inefficient in terms of per-capita productivity. Our relative efficiency averages between 1/3rd to 1/5th of the developed world's average, and this is *not* improving. China exceeds the developed world's average productivity – and this has been achieved by rapidly mechanising and automating thousands of manual tasks and skills.

   Many multinational brands, which have edged out Indian brands in various sectors, now get their manufacturing done wholly or partly in China. Many Indian brands are also getting lot of their manufacturing done in China. China is low-cost because it is efficient!

5. We still primarily export raw materials and raw agro-produce, and regularly import high technology and machinery by millions of containers a year. This scenario has hardly changed in the last 65 years. Our Asian neighbours like Japan, South Korea, Taiwan, China, Malaysia, etc. have managed to reverse this scenario completely!

6. The policy stagnation and a born-again licence-permit Raj through callously increasing layers of permissions and procedures are again hindering all attempts at rapid technological advances via the private sector. Power, defence, transport, agriculture, infrastructure are all major sufferers.

   Since our Governments cannot enforce laws effectively, they habitually counter this by creating more and more laws and rules. This is severely hindering any rapid technological development and making the entire industrial machinery even more inefficient.

7. In the developed world (including China), if an engineer needs to design and build a new kind of machine he can design most of it with all sorts of bought-outs, go to a big departmental hardware store, fill his cart (or order stuff online and get it in 2-3 days), farm out the manufactured parts, get well-made parts in a few weeks without banging his head, put the machine together in a short time, and start testing and debugging his new design!

   In India, every such exercise everywhere in the country is an increasingly slower and uphill *battle*, to put it mildly. However innovative the designer is, he is hindered, delayed and short-changed at every step of this development cycle.

   Two decades ago, you could buy good and increasingly better quality of all sorts of engineering bought-outs. Today you simply *cannot find* simple decent quality Made-in-India engineering items like plated fasteners, hand tools, hacksaw blades, circlips. This list is vast and growing. The foreign-brand invasion notwithstanding – *we are actually becoming more and more backward industrially, transmogrifying from an independent to a dependant nation.*

8. And lastly: Our frenzied media and obstructing politicians still have NO clue to how China has brought about its present-day Great Leap Forward so quickly!

   Very unobtrusively, China has consistently sucked in thousands upon thousands of experts from all over the world (retired or otherwise) in each and every conceivable field right from microbiology to tyre design to rolling mill erection to glassblowing to rail track laying to servomotor design… to train its own highly motivated professionals despite their severe language barrier!

   Specifically, on one hand, China has zeroed in on retired / jobless experts in the declining industrialized countries of Europe and the Americas, and offered these experts very lucrative contracts with a pot of gold at the end of their tenure. Many Indians experts too are in China on similar assignments. On the other hand, China has sent its students out by the million to every possible center of technical learning in the west, academic or otherwise. These students invariably go back to China and join the Dragon.

   Japan, Korea and Taiwan did much the same thing earlier at a much smaller scale, and came out winners. We have already frittered away our chance of massively gaining technological prowess from the decline of the industrial nations.

Now, I proudly say here that a great many Indians count among world's most innovative doctors, surgeons, lawyers, businessmen, actors, artisans, soldiers, etc., etc. However, the moment it comes to technological and machine-related innovation, we somehow drop to the bottom rung – so gross is our national disconnect with machinery and technology. We *merely use* the latest of global technologies and machines everywhere, but at $1/6^{th}$ of world population, we cannot *create* even a few of them.

I also proudly say that innovative changes for the better *do* happen everywhere in India in many spheres including technological. However, their *scale* always remains minuscule. Our REAL

problem is that as a nation we are collectively incapable of scaling up these betterments. If one municipality, school, industry, institution or an individual does something innovative, we repeatedly prove ourselves incapable of reproducing or scaling up that innovation. Betterment of any kind is now becoming slower and slower in India as the world around us progresses faster and faster.

Worse, we slowly let our gains go to seed. If something good of a large size makes its appearance on the Indian scene, it only takes a few short years before it all starts coming apart at the seams instead of getting even better with time. Look at the IRCTC, the private courier services, mass housing, urban infrastructure, BRTS, the Golden Quadrilateral, various Private-Public-Partnership projects…

Figure 14: Day-after-day Wastage of Time and Resources across the Whole Nation

Nevertheless, we do scale up bad things *extremely* fast and efficiently: corruption, female foeticide, misuse of public utilities, stealing electricity, illegal mining, adulteration, dynasty politics…

It is sad that the vast majority of us, the People of India, remain perennially immersed in arguments, entertainment, ornamentation, media hype, self-aggrandisement, and remain completely immune to the vast amounts of filth, chaos, mediocrity and inefficiency. As one foreigner put it so graphically, "India is like an aircraft which is ready to take off, but never ever takes off."

All of the above is already resulting in increasingly slower growth, *and we are slowly becoming irrelevant in the world order*. The editorial of The Economist of March 24th 2012 succinctly concludes, "A slower growing India will be more financially vulnerable, poorer, full of frustrated young people and taken less seriously by the rest of the world."

What needs to be done?

It is customary to end such a 'negative' article with suggestions for change. So here are my suggestions for bringing about innovative, widespread and quick changes, knowing fully well that innovative change in our country will *always* remain a case of way too little and way too late:

1. Learning to scale up good change quickly, by *not* procrastinating, *not* obstructing change for personal gains, ego or self-aggrandisement. *Today, scaling up the change is actually even more imperative than change itself.*
2. Learning how to do something better and faster rather than cheaper and more mediocre.
3. Working on Education to make it shed irrelevant baggage and include various modern skills *and* civic sense (like garbage segregation, traffic civility, unambiguous communication)… This lays the foundation of innovative minds flourishing in a healthy, clean, peaceful society.

4. Motivating AND facilitating young people to learn about machinery and industrialisation, acquire skills to use, design and build *advanced* machines of all sorts.
5. Getting out of the *jugaad* mentality, as any *jugaad* solution can neither be scaled up, nor work reliably in the long run, nor make the practitioner (nor the society) any richer. For this, the entire nation's social mindset has to change.
6. Reducing our addiction to entertainment in various forms – Bollywood, TV, music, sports, social networking, as these have become habitual anaesthetics for our various pains.
7. Fixing our national habit of offering an *instant* argumentative explanation for every shortcoming or a problem (big or small) as a necessary AND sufficient response. Such defensive argumentativeness routinely pre-empts real solutions.
8. Stopping coining and playing with new words and phrases; and doing something real.
9. Bringing the Media around to shift its interminable focus from politics, crime, sports and numbing entertainment… to skills, training, cleanliness, civic sense and promotion of technology of the non-entertainment kind.
10. Having a re-look at our contagious optimism: This may sound cynical, but in reality, this has become poignantly true: From *Satyamev Jayate* (Truth always prevails), our de-facto national motto has become *Sab theek ho jayega* – everything will be alright… implying somehow and by itself. Unless we get seriously alarmed about our future being bleak, we will not change.
11. Lastly, learning to accept and comprehend criticism, and to quickly work on fixing the problem instead of instantly attacking the critic. In the land of Kabir, the latter has become our most predictable, all-pervasive national nature!

I rest my case.

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