

Report on Shortcomings of Indian Higher Education

MAACK, Netaji Subhas Institute of Technology

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Authors:

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Arjun Khera

editor and formatter, author of executive summary, introduction, research, reservation, recommendations, further contribution in administration

*MAACK
Delhi*

Madhur Batra

editor for figures, author for survey analysis, industrial relevance, contribution in administration

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Kunal Gupta

author for survey analysis, administration

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Amaan Nehru

author foreign university

Chhavi Aggarwal

author foreign university

*The Report are available at
<https://github.com/Arjunkhera/ReportWriting>*

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Executive Summary

Impetus to Change for the better:

The nation of India is witnessing a period of unprecedented growth, not only in terms of social and economic development but also in terms of dynamic demographics. Currently India is home to the largest young population in the world, and this number is set to further grow till late 2030's.

All this points to the major development needed in the education sector to skill this young population with the required Industrial skills and contribute in the development of India in specific and the world in general.

But the current quality of higher education in India is far from developed and requires a lot reforms to put it on equal footing amongst the world's leading universities. The aim is to highlight shortcomings and address strategies to ensure that students are provided the best in class education.

Reasons to dwell on :

The current higher education system is in a mode of crisis with a large percentage of students and faculty alike expressing concerns over various factors hampering studies.

The most common of these include:

Administration:

This word is the most often cited in regards to inefficiency. Every procedure in government colleges is underpinned through clearances by the administration. Yet all reforms, syllabus upgradations are caught in the bureaucratic web of slow governmental administration.

Research and Development

The progress of country is positively determined by the amount of money invested into research and development. Yet India lags far behind other nations in terms of net R&D investment. Further reasons are explored as to why institutes in India lag in R&D at grassroots level.

Lack of Industrial Skills

The health of an economy is determined by the number of jobs being created. In this golden period of Indian economic growth, the number of Industrial Jobs for engineers are at an all time high. However, many a positions are not utilised due to the lack of proper skills necessary for the job. This a severe reflection of how disjoint the current academic system is with the industry and how it need to keep in sync with modern trends.

The road ahead:

The findings generate a lot of areas where urgent attention needs to be paid. Reforms need to be carried out to ensure that this young population is given access to the best education. A significant path of this reformative journey involves addressing core issues in the governmental system and would only be made possible if the legislation is ready to work in arms with the education sector.

Heres hoping that the government pays attention to the cause of improving the quality of Higher Education.

Introduction

a.India: A nation roaring to grow

India today stands on the verge of explosive economic growth, paving the way for its journey as one of the leading countries in the world market. With a growth of 7.2 per cent in 2016-17, India has emerged as the fastest growing major economy in the world as per the International Monetary Fund (IMF).

Figure 1: World's fastest growing economies

The world's fastest growing economies

Forecast GDP growth, 2017



Source: World Bank

Source: World Bank

The acceleration of reforms, the move towards a rule-based policy framework and low commodity prices have provided a strong growth impetus. Moreover, deregulation measures and drives such as demonetisation and GST are improving the ease of doing business. With a

spree of initiatives such as Make In India, Skilled India and Digital India, the growth is only expected to reach further new heights[1].

Figure 2: Indian Consumer Index record



Source: Trading Economics

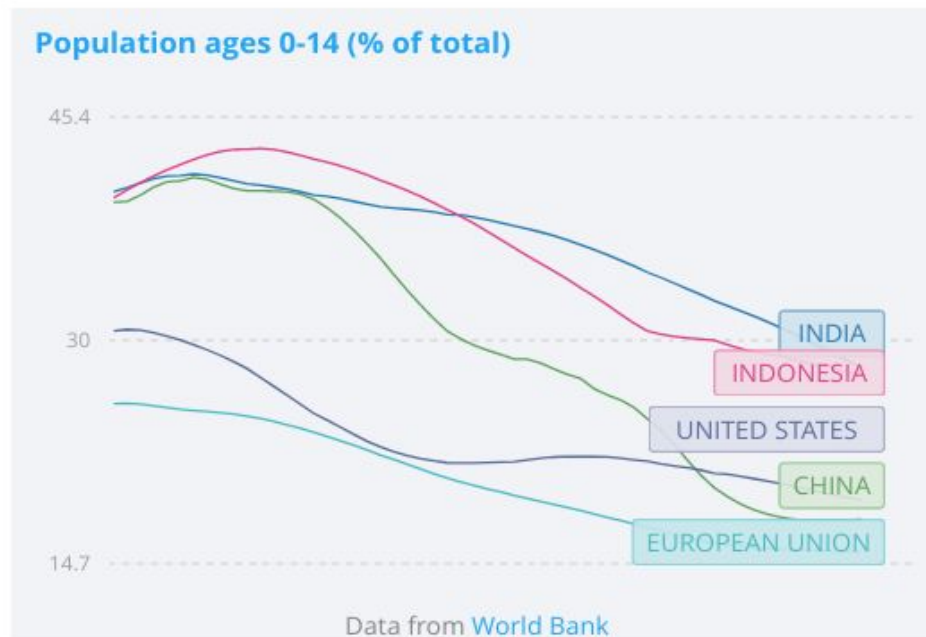
India's consumer confidence index stood at 136 by the last quarter of 2016, topping the global list of countries on the same parameter, according to market research agency, Nielsen.

Moody's has affirmed the Government of India's Baa3 rating with a positive outlook stating that the reforms by the government will enable the country perform better compared to its peers over the foreseeable future[2].

b.Young Demographics: Key element for growth

According to 'World Population Prospects: The 2015 revision' Population Database of United Nations Population Division, India has the world's highest number of 10 to 24-year-olds, with numbers equating to 242 million—despite having a lesser population than China, which has 185 million young people.

Figure 3: Population under 14 as a percentage of total



Source: World Bank

The regularity and efficiency of census operation in India have added rigor to the measurement of Youth in India. The decennial enumeration through Population Census throws up consistent estimates of youth in India. As per India's Census 2011, Youth (15-24 years) in India constitutes one-fifth (19.1%) of India's total population. India is expected to have 34.33% share of youth in total population by 2020. The share reached its maximum of 35.11% in the year 2010. China in contrast is seen to have reached the highest share in the year 1990 at 38.28% and is projected to have the share of youth force shrinking to 27.62% by the year 2020, a situation which Japan has experienced in around 2000. It is observed that India has the relative advantage at present over other countries in terms of distribution of youth population. India's advantage in young population is also evident when it is compared with other Asian Countries. India is seen to remain younger longer than China and Indonesia, the two major countries other than India which determine the demographic features of Asia. These three countries together accounted for 68 % of population of

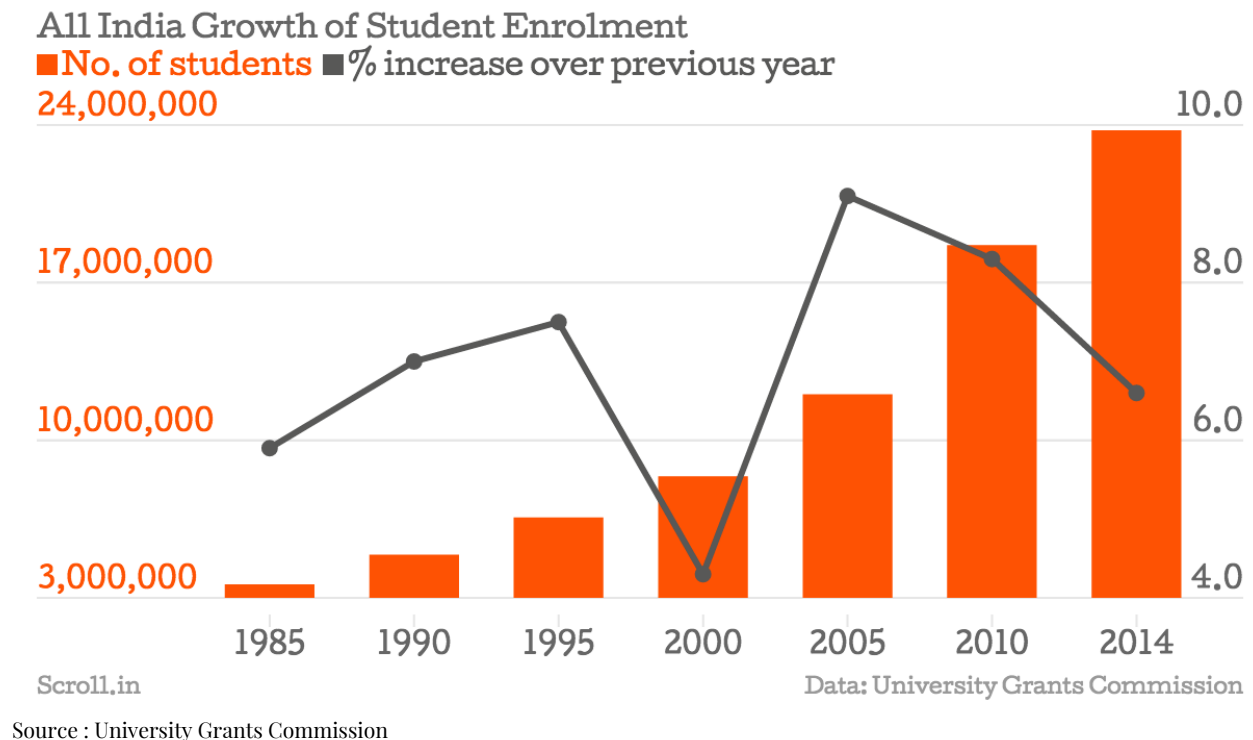
Asia in the year 2010 and the share of Asia itself is about 60% in world population. [3]

c.The role of Higher Education:

The combined effects of growth and the reserve of India's youth population place India at a strategic path of development well into the future. However, in order to realize this potential, significant investments and reforms need to be carried out in various sectors to create a path of sustainable growth, and education is a key aspect of this whole transition period.

Currently, India has over 550 million people below the age of 25 years with over 32 per cent of the 1.1 billion population is between the age group 0-14. This means that the number of people in India needing primary and secondary education alone exceeds the entire population of the USA. Since these students will be seeking higher education in India over the next decade it illustrates the sheer size of the Indian education market. Presently about 11 million students are in the Higher Education system. This represents just 11% of the of the 17-23 year old population. The government hopes to increase this to at least 21% by 2017- a target which still falls short of the world average. With the emergence of India as a knowledge-based economy, human capital has now become its major strength. This has put the spotlight on severe inadequacies of India's infrastructure for delivery of education, particularly higher and vocational education[4].

Figure 4: Exploding growth of student enrollment



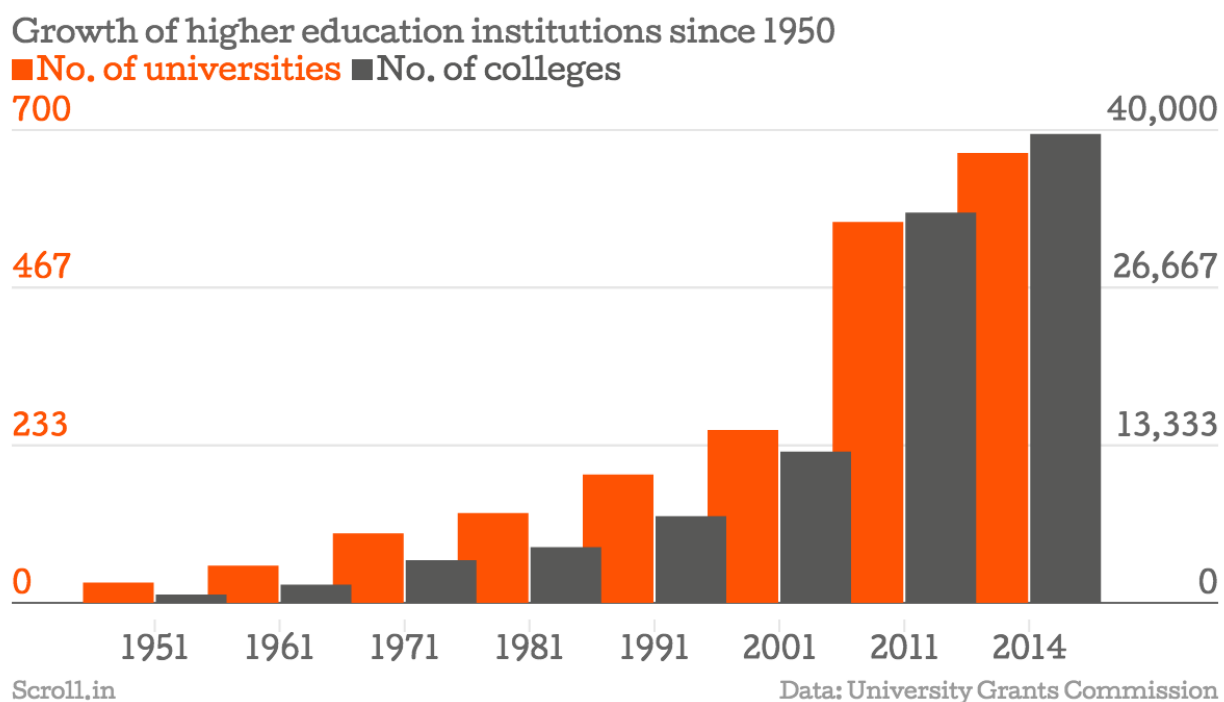
India's expenditure on education as a percentage of GDP has ranged in the 3 percentage range since the last twenty years. In order to tap into the potential of the vast youth population, there needs to be a significant increase in these statistics.

d.Critical Gap:

India today boasts one of the best statistics as far as quantity is concerned in field of Higher Education. The number of Universities has increased 34 times from 20 in 1950 to 677 in 2014. The sector boasts of 45 Central Universities of which 40 are under the purview of Ministry of Human Resource Development, 318 State Universities, 185 State Private universities, 129 Deemed to be Universities, 51 Institutions of National Importance (established under Acts of Parliament) under MHRD (IITs - 16, NITs - 30 and IISERs - 5) and four Institutions (established under various State legislations). The number of colleges has also registered a manifold

increase of 74 times with just 500 in 1950 growing to 37,204, as on 31st March, 2013[5].

Figure 5: Growth in number of higher education institutes



Source: University Grants Commission

The key area where significant attention is not being paid is quality. If we carefully analyse the results for institutions of high quality such, the acceptance criteria for students to get selected is exorbitantly high. The acceptance ratio of IIMs and IITs ranges about 1 to 130, and the situation in medical studies is even worse, where the ratio 1 to 1000, which pales even in comparison to institutes like Harvard and MIT where the acceptance ratio ranges about 1 to 10.

Majority higher education institutes in India where the talent makes it way are operated by the government, so much so that only a select Private Institutes remain in contention for top talent, which means that the responsibility to cultivate the next generation of engineers rests on the shoulders of the government.

Yet, if we look at studies conducted by various third parties and organizations, we find that there exists a significant gap between the demands of the industry and the current skill set of college graduates with a report pointing out that only 7 percent graduates are employable[6]. Keeping job statistics aside, a large percentage of students in colleges are not satisfied with the way the academic and curriculum works and are most likely to seek ways of self education rather than learning in campus[7].

Chapter 1

Analysis of the Survey

a. Purpose of the Survey:

To get a clear and a broad overview of the higher education system, a survey was conducted amongst the undergraduate students of engineering colleges across India.

A separate survey was also conducted amongst the faculty of Netaji Subhash Institute Of Technology to ensure that the report would take into account, factors experienced by all actors in the system.

The survey was subjective in nature as it allows more room for culminating various factors that possibly can't be covered using objective bulletins.

Figure 6: Key Commendations stated in the survey

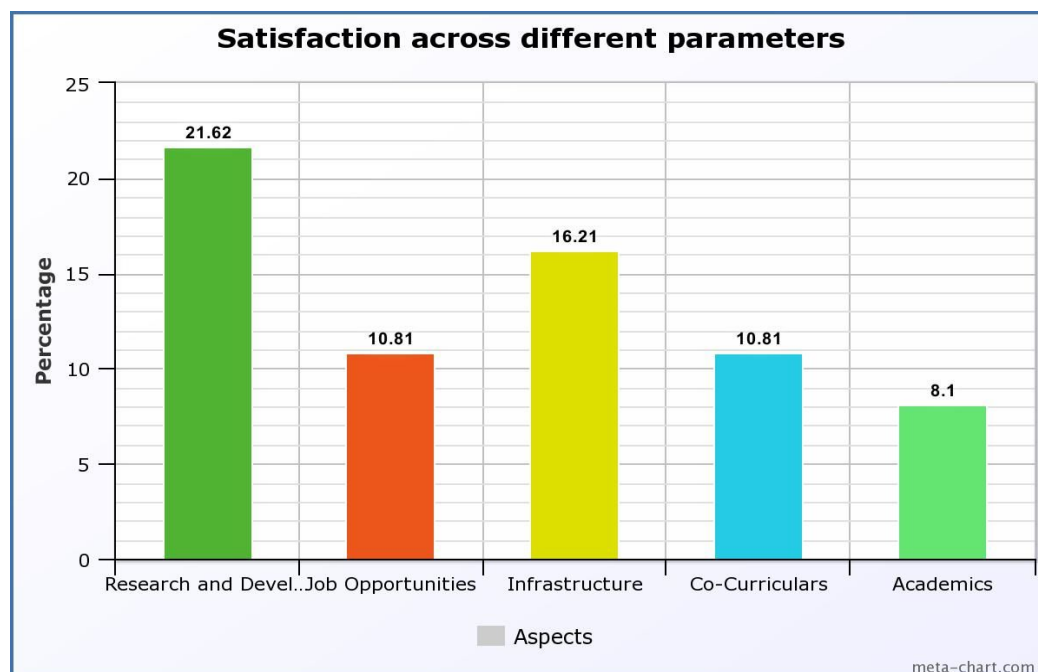
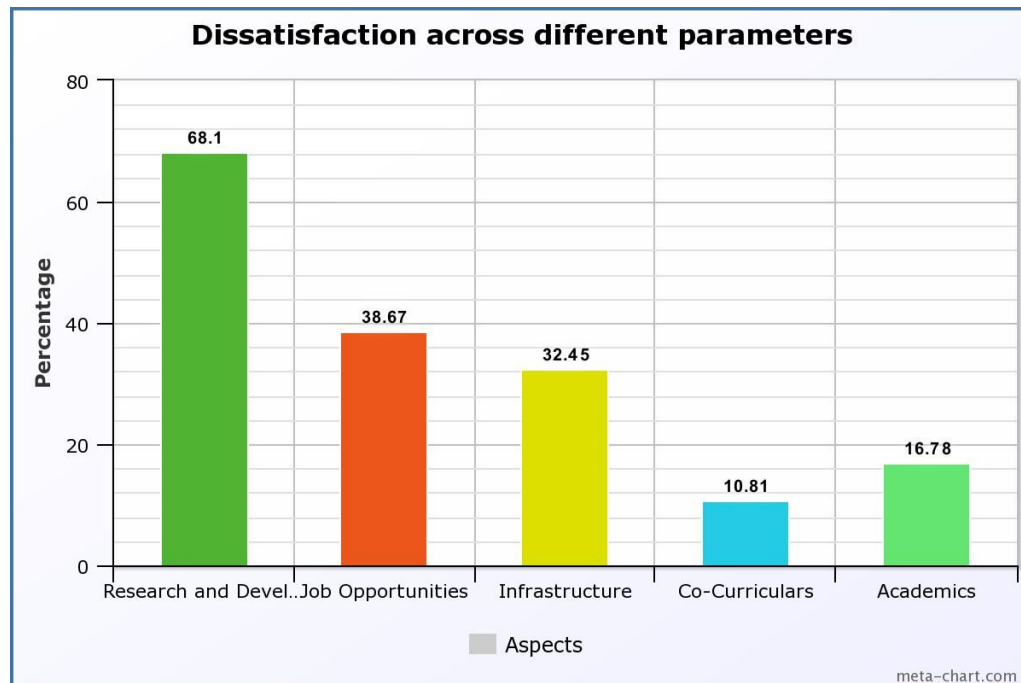


Figure 7: Key Recommendations stated in the survey



b.Cleaning and analysis:

Upon analysis of the data following recurring themes and factors were identified.

- 1. Research and Development:** R&D plays an important role in the scientific progress and overall technical improvement for any nation. Among all surveyors 68% were dissatisfied with the state of R&D in their institutes and expected it to improve considerably. A lot of other factors such as governmental funding, administration, general attitude were listed in the survey as prime reasons for the same. The results directly correlate with the generally agreed assumption that level of progress for any scientific institution is proportional to the amount of R&D done by it.
- 2. Job Opportunities:** Engineering is a profession with vast access to job opportunities and one of the prime drivers among high school students to make their career in the same. Yet, approximately 39% of the surveyors were dissatisfied with the amount of job

opportunities and related monetary positions offered by their institutes, with primary reasons being lack of proper training and exposure for the required industrial skills and the minute number of companies visiting the campus.

3. **Infrastructure:** The infrastructure standards of any institute positively determines the level of academic dedication and the facilities the institute provides for studies and other activities as well. Around 32.4% of all surveyors agreed that something had to be done to improve infrastructure of their institutes so that students may enjoy better learning atmosphere and facilities.
4. **Co-Curriculars:** The rapid growth of adaptation of western methodologies have in general, drastically improved the status of co-curriculars in Indian universities and institutes. Also, it is widely regarded that creative and extra stimulating activities provide the optimal amount of improvement and growth on academic front. In accordance to this, 10% of surveyors said that the levels of co-curriculars needed to be improved, which is less than , as compared to other vital factors.
5. **Academics:** Academic improvement directly relates to more thorough and elaborated research processes. Efficient and flexible academic structure is a vital aspect for any efficiently functioning educational institute. 17% of the surveyors concluded that the level of academics in their institutes was not as per their expectations and hence could be made more rigorous or lenient as per personal choice. One of the highlights was on how the current attendance and archaic syllabus hamper the preparation for placements.

b.Crux of the Survey:

The primary aim of the survey was to find out both the positive and negative aspects of the current status of the higher education scenario in engineering colleges. The varied responses meant that there were a number of areas that needed to be carefully looked after and considered for analysis. The following sections aim to highlight a few of the most major issues brought out in the survey and how are they holding the growth of students.

Chapter 2

Research and Development

a.Importance of investing in research and development

Innovation is the art of harnessing known facts and knowledge in pursuit of a possibly unknown outcome that holds the potential for transforming our society. And it is none other than research and development, that lies at the heart of innovation.

Adaptability and constant innovation is key to the progress for any nation. It is now a well established notion that technological changes and innovation activities are strong indicators of economic growth, and with increasing competition worldwide, it is but impossible for a country to realize sustainable economic growth without investing in r&d.

There have been many studies examining the relationship between R&D expenditures and economic growth with the acceptance of new growth theories on the technological change as being one of the most important factors affecting economic growth. Accordingly, results of the major empirical studies examining the relationship between R&D expenditures and economic growth are as below[8].

1. Park (1995), in a study covering 1970-1987 period and 10 OECD countries, has reached the conclusion that the local private sector R&D investments are important determinants for the increase in local and foreign factor productivity.
2. Coe and Helpman (1995), in their study covering 22 countries for 1971-1990 period, have examined the relationship between R&D

capital stock and total factor productivity. They have reached the conclusion that there is a significant correlation between total factor productivity and domestic and foreign R&D activities.

3. Freire-Serein (1999) has examined the impact of R&D spending on economic growth for 21 OECD countries during 1965-1990 period. It was concluded that there is a very strong and positive relationship between R&D expenditures and growth and 1% increase in R&D expenditures would increase real GDP by 0.08%.
4. Bassanini ve Scarpetta (2001), have examined the effect of R&D expenditures on economic growth via panel data analysis in 21 OECD countries. They have found out that the effect of R&D expenditures on economic growth is positive and a 1% increase in R&D expenditures increases the economic growth rate by 0.4%.
5. Yanyun and Mingqian (2004), analyzed the relationship between R&D expenditures and economic growth for 8 ASEAN (Association of Southeast Nations) countries and Korea, Japan and China for the period between 1994-2003 by using panel data set. According to the data obtained, there is an interactive relationship between R&D expenditures and economic growth.

Hence, there is an overwhelming conclusion of a positive correlation between economic growth and investment in R&D.

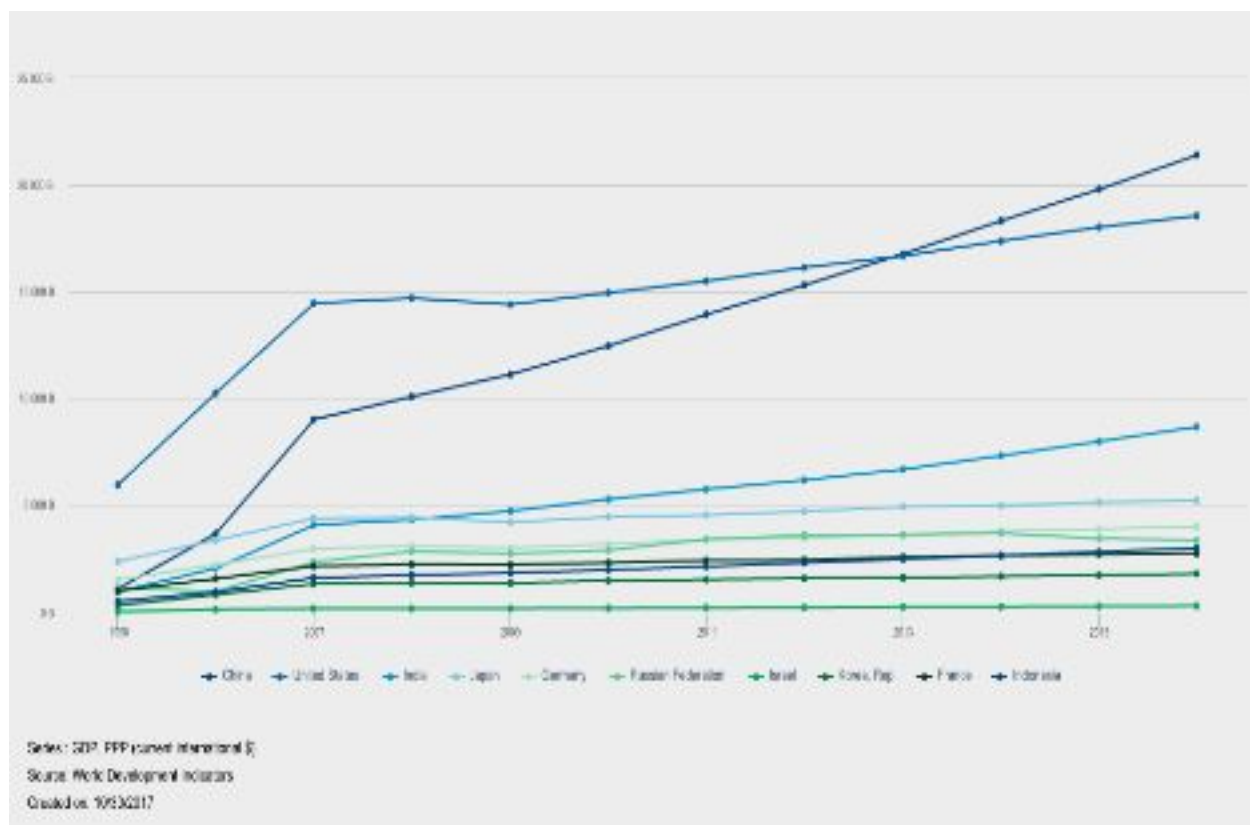
It was not until the 1980s that significant interest in understanding how innovation impacts the economy started to gather in economics[9]. Prior to this, the general consensus in economics was that innovation just “happened” and improved the economy through technological change, basically government policy had little impact on long-term economic growth. However, some economists started to realize that innovation could be shaped by public policy and that as much as innovation was critical for economic growth, we had a hand in shaping the driver of economic growth. Part of this realization coincided with a better understanding of human capital, or in other words, that workers could be

quantified by the sum of their accumulated knowledge. And such increases in knowledge meant workers could use technologies better and more efficiently, leading to higher productivity.

b. Conducting a statistical analysis

In order to gain insight on how investment is driven in the R&D sector, significant attention needs to be paid to a number of factors that play an integral role in determining investment in R&D in a country.

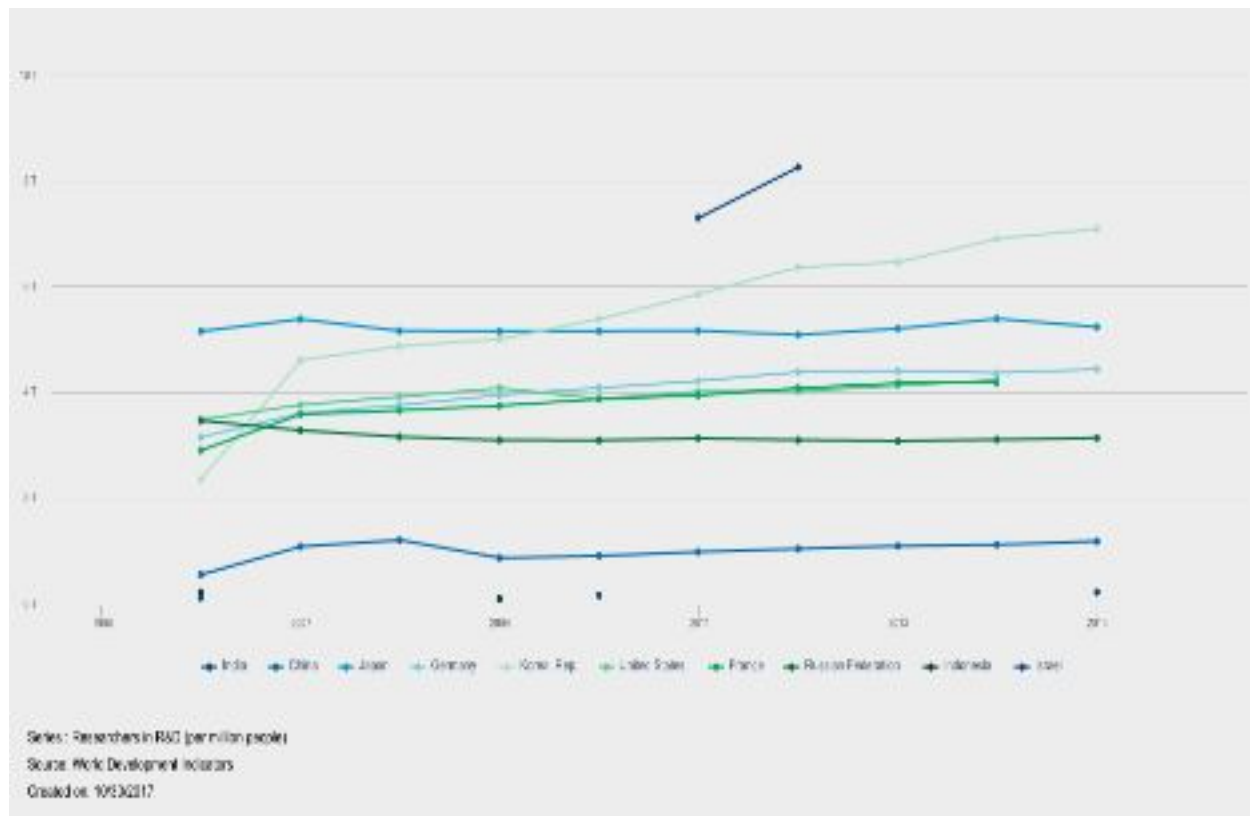
Figure 8: GDP adjusted for PPP by country



Source: World Bank

Currently India is the third largest economy of the world after US and China in terms of PPP. Figure-8 shows a snapshot of the trends in global GDP PPP rankings of leading countries.

Figure 9: Net Funding for R&D by country



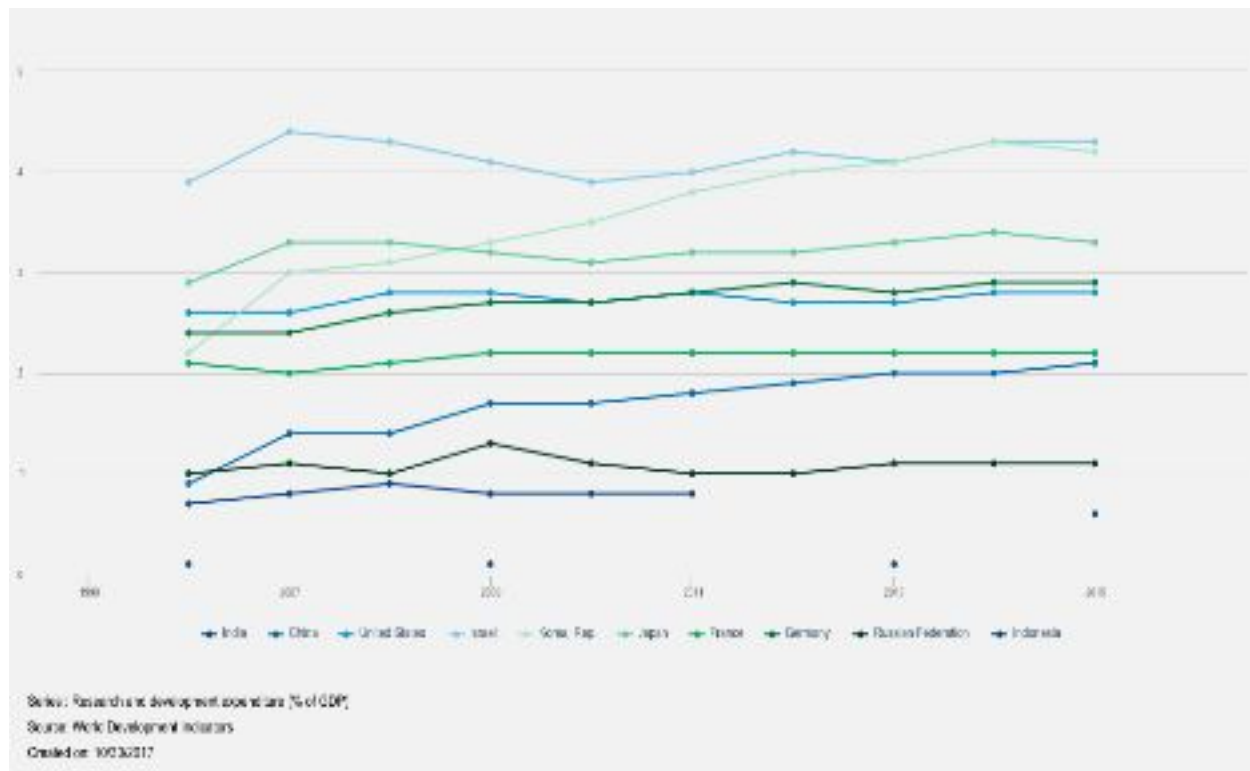
Source: World Bank

Also, analysing Figure-9, which provides a time series comparison of total R&D spending worldwide by various countries, we observe that India ranks sixth with a total of USD 66.5 billion, whereas US leads with chart with USD 472 billion followed by China at 409 billion.

Hence, studying the above two figures, one can arrive at the false hypothesis that India is currently a leading state in investment on R&D.

However, the findings provided by Figure-10 and Figure-11 bring out the actual reality.

Figure 10: Total Expenditure on R&D as % of GDP by country

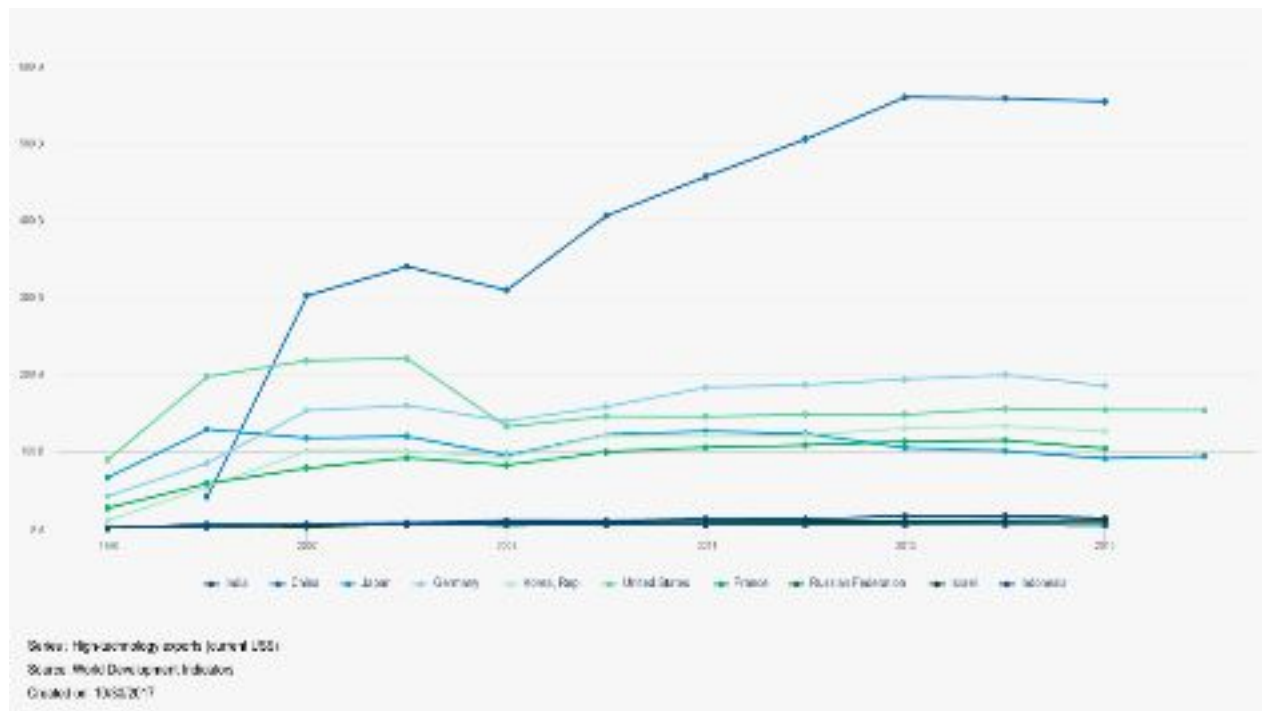


Source: World Bank

We can see that current spending of India on R&D as a percentage of GDP is merely 0.8%, which is even lower than many of the nations which are ranked lower in both in terms of GDP by PPP or total R&D spending.

Further, the stark contrast visible from Figure-11 in the rankings of High-technology exports. In Spite of being on the on the top of GDP by PPP and total R&D rankings, as well as producing one of the finest minds in the fields of science and technology, India sits way at the bottom when it comes to exporting high-technology products.

Figure 11: Net High Technology exports by country

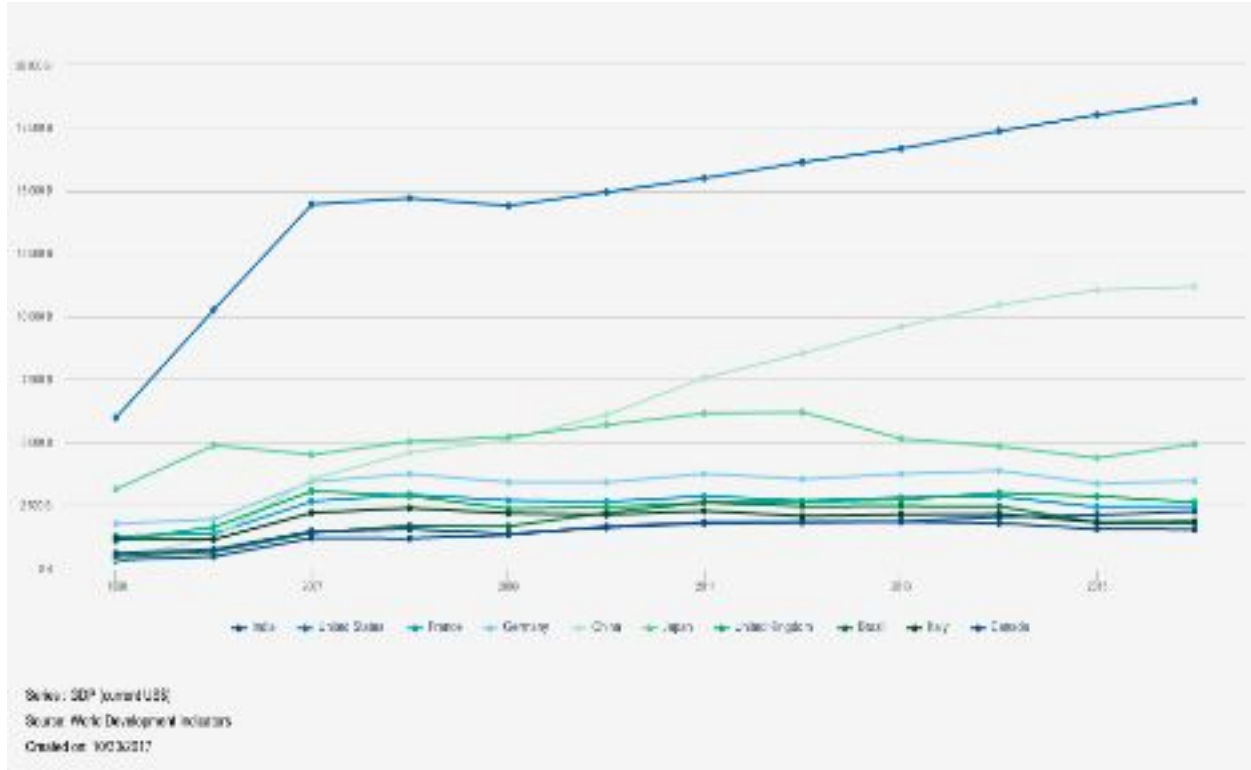


Source: World Bank

Another important indicator to notice here is the spending of R&D as a percentage of GDP.

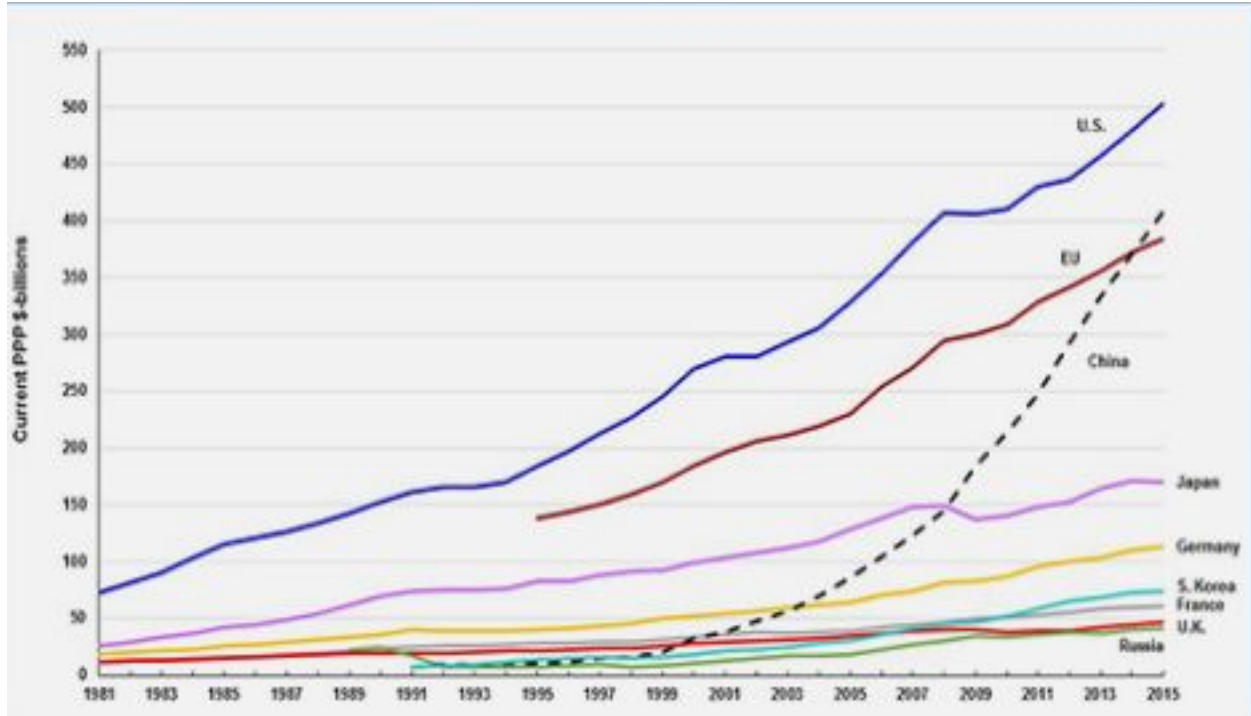
Let us analyse the Figure-12 and Figure-13. Notice how the rankings change when we switch from GDP to total spending in PPP\$. We observe strong spending by the business sector is an underlying factor for success. Many countries try to stimulate greater investment in both the private and public sectors by setting national targets for R&D spending as a share of GDP.

Figure 12: Top R&D expenditures as % of GDP by country



Source: UNESCO INSTITUTE OF STATISTICS

Figure 13: Top R&D expenditures in \$ billions by country



Source: UNESCO INSTITUTE OF STATISTICS

A further look into the percentage of spending in R&D by parties involved gives a clear conclusion that nearly 60 percent of R&D investment in India is driven by the government, and those by businesses stand as nearly 40% with universities doing with a meagre 0.8 %.Whereas nearly every other country in consideration has a far greater business and university investment as compared to the government. Hence this fact provides the justification for such a contrast in the rankings.

Moreover, where India's commitment in GRED(acronym for investment in R&D as %GDP) is near constant, China has managed to make significant leaps. In fact, India is far behind other BRICS nations as well other nations figuring in the top rungs for GRED and total R&D expenditure. This is a clear indicator as to the strength that Indian business display in terms of competitiveness against their foreign counterparts.

The low investment in R&D is an indication that India is still involved in activities that are not creating higher value at different levels. This assertion can be made as expenditure in research is an indication of commitment of a firm research organization to search for novel ways of producing creating new products.

And it is not just the businesses, in India majority of higher education, especially in the field of science and technology is dominated by government colleges. As we have pointed out earlier that majority spending in R&D in India is driven through government stimulus, and going by the fact that we are currently sixth overall in terms of overall R&D spending, the amount should more than compensate the requirements for academic purposes of research. For this we need to hear from the faculty :

c.Understanding ground reality: Faculty Speaks

In order to understand the ground reality we conducted a short survey of the faculty of Netaji Subhash Institute Of Technology.

Here is what we found out:

1. Producing papers, and of quality is primary in academic progress.
2. To make arrangements of funds for a particular research project, applications need to be submitted to the various departments, which scrutinize your application and then decide how much funds should be released for the same.
3. And this is where the system starts to break, the people who are supposed to review your application should in theory belong to the domain in which your research focusses. Given this requirement holds, can only they be in a position to judge the application and funding status. However, this government machinery is actually run through clerks and government officials who have basically zero understanding of the research topics.

Hence, in the end, if you are somehow even able to release a part of the funds for your research, the overall process from application, processing to reimbursement is so slow that it take a year or more, time long enough for someone to lose their will to even wet their hands in research.

Though the same is not true of institutes of national importance such as the Indian Institutes of Technology which enjoy a greater degree of autonomy, given that IITs house a mere percentage of the Indian Academic diaspora, this failure represents how desperately the whole governmental structure that makes contact with education is need of reforms.

Chapter 3

Administration

a. The role of Administration

The majority of colleges and universities operating in the field of engineering today are those operated by government. Given the significant rise in the number of applicants, with an explosive growth in number of applicants, the competition to make it into the top tier colleges has now become considerably high.

The government responded to this tremendous rise in demand by constructing numerous engineering institutes such as NIT's, IIT's, IISER's and IIIT's. However this quest to meet the needs for this new breed of engineers through the path of quick expansion meant that there was a compromise between quality and quantity.

The various reasons for this lack of quality and eventually the increased level of frustration against stagnation of improvement in these institutes have been discussed in various sections throughout this report. However there is but one thing that remains common in all these factors, which is administration.

The administration for the government colleges across India is, but an extension of the Indian bureaucratic system at large. Even though the sector of education is an area that should in theory be completely independent in functioning from the government administration to ensure impartial and transparent functioning, the reality is completely opposite.

This uncomfortably significant closeness to the government means the educational institutes have come to bear the weight of the opaque, abusing, slow and inefficient bureaucracy.

b.Shortcomings in carrying out responsibilities

In order to gain a deeper understanding of how exactly the institute administration functions, a number of actors ranging from the faculty to the administration were consulted. The abstract is as follows :

- 1. Syllabus Upgradation:** The administration of the college plays a key role in determining what curriculum is being taught and how regularly is it updated. In theory this would have functioned as check and validate system to ensure that students and faculty are exposed to up to date syllabus relevant to current industrial standards. In reality, only a minority of institutes such as the IIT's and a few universities operating directly under the authority of the MHRD enjoy this freedom to make regular changes to syllabus. The remaining colleges languish in the lack of communicational gap with the controlling university, meaning that students are caught with material years old. As an example, the syllabus of Netaji Subhash Institute of Technology remained the same for 27 significant years, despite presently being counted as one of the ten top ranking engineering college across India.
- 2. Funding and Development:** This is one of the most important sticking points responsible for the inertia in growth of the institutes. The expenditures incurred by the college ranging from infrastructure development, funding for libraries, lab apparatus, research grants, materials for classrooms is recorded by the administration. However, the key link that compromises this system is the method of allocation of funds. The key areas concerning the fund allocation are as follows :

- a. Infrastructure and Development:** In order to keep with the demand of ever increasing intake of students, the colleges need to ensure that they have enough resources to provide an enriching learning environment. This involves passing of required documents from various committees to justify the funding, to the allocation of funds from the respective bodies, obtaining necessary rights from respective agencies and finally passing of tenders for construction. However, in practise a majority of these reforms get caught up in bureaucratic hell, resulting in indefinite delays. When consulting a number of professors from various colleges it was found that most were suffering from delays running into years.
- b. Lab equipment and Research Funding:** The concerned administration people do not have enough experience, domain of expertise and the skillset to understand the technicalities associated with a branch of study, for which the funds are being requested. Consequently, the funding either takes too long to materialize or is done on an ad-hoc basis and not by proper critical and analytical evaluation which is necessary for research and development to prosper.
- c. Inefficiency in Fund Allocation:** As explained above, the lack of experienced trained personnel and communicational gap between the college and the state or national government means that proper and timely fund allocation to ensure growth and progress of the colleges remains in limbo.

c.Key Takeaways:

The above mentioned factors directly point to the various factors that acts a bottleneck in the proper functioning of administration and consequently result in the poor performance of the concerned educational institute.

It is widely regarded that all the regulatory and welfare reforms are meaningless if they are not implemented and just passed in papers.

Hence it becomes critically important that people in all areas of the hierarchy instill a sense of responsibility and high morals so that the flaws associated may ward off automatically.

The Indian government should reshape recruitment and promotion processes, improve performance-based assessment, and adopt safeguards that promote accountability while protecting from political meddling.

Chapter 4

Reservation

a.Understanding its impact:

The one core issue that seems to run through every functioning of government functioning. The question is how does the current system of reservation impairs government functioning and how it should be overhauled.

1. Presently reservation is awarded on the basis of caste based system. There is a fixed quota as to what percentage of seats are reserved. This means that irrespective of your economic status one is eligible for reservation schemes.
2. This results in a large percentage of unskilled people making their way into institutes and public sector jobs for which they have neither the experience nor the required skills.
3. The fact that there is no hard and fast rule to hold people responsible in the government machinery means that the reserved admits take their tasks for granted and are immune to strict actions or seriousness towards carrying out their tasks. Moreover, even if somehow one is able to expel an underperforming candidate, the seat is still reserved, which means the pattern continues.
4. To add to this, the government has a range of monetary schemes and discounts for the reserved class. And who pays for all this, the taxpayers who did not reap the benefits the reserved are enjoying.
5. If all of this was not enough, the current presence of caste based system means that when the reserved people have to make decisions for recruitment, they favour people of their own caste.
6. The end result is, if we compare two families of same income. Then the reserved people have easy access to education, job and monetary

benefits, while the general class has to spend loads on education to compete for the remainder, work hard day and night to get a seat in government institutes or public sector job, and also fund the government to support the reservation system.

b.How does it affect higher education:

1. Administration which is responsible for clearing all reforms and actions required for the functioning of the college is highly inefficient due to the bureaucratic divide between the working and non working.
2. Research proposals are cleared by personnels having absolutely nil knowledge of the material in question, meaning that the whole system here is broken.
3. A proportion of the hired faculty both in lab and theoretical courses is not at par the qualifications for the job.
4. In order to bring discipline among the whole batch, severe attendance rules are imposed to ensure that students gain enough academic experience. However, all leading foreign universities do not follow this criteria because they are aware that their whole batch is merit based and is capable enough to cover academics without the strict attendance rule. This gives time for students to explore various new areas, do projects, gain practical skills yet maintain their academic performance.

Chapter 5

Industrial Relevance

a.Statistical Gaps in knowledge of industrial skills

One of the prime mission of the engineering institutes it to prepare the students for jobs by providing necessary industrial skills and exposure. Amongst the most important skills in requirement are the IT skills. Yet most of the institutes fail to capitalize on training the students for this aspect.

An employability test was conducted by AMCAT[11], a leading IT company responsible for conducting recruitment examinations of companies. A total of 1.2 lakh engineers across India for IT services and related jobs participated in the study.

The analysis stated that though Tamil Nadu is considered an engineering hub, the State's engineering students' employability is only 8.33 per cent. Over 36,000 engineering students from IT related branches of over 500 colleges took a software development test and over two thirds could not even write code that compiles and only 1.4 per cent can write functionally correct and efficient code.

The employability percentage of graduates for various roles are as follows[10]:

IT ROLES

- Software Engineer - IT Product 3.67%
- Software Engineer – IT Services 17.91%
- Startup Ready – IT Services 3.84%
- Associate – ITeS Operations (Hardware and Networking) 37.06%

ENGINEERING ROLES

- Design Engineer – Non IT 6.56%
- Sales Engineer – Non IT 19.08%

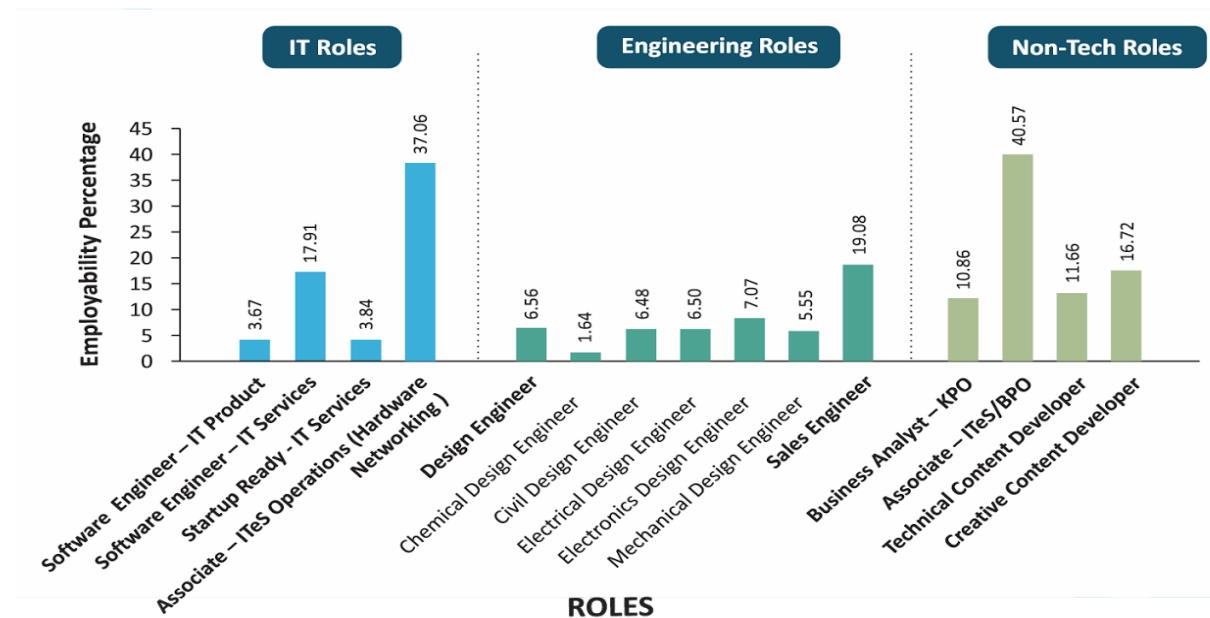
NON-TECH ROLES

- Business Analyst – KPO 10.86%
- Associate – ITeS/BPO 40.57%
- Technical Content Developer 11.66%
- Creative Content Developer 16.72%

DESIGN ENGINEER

- Chemical Design Engineer 1.64%
- Civil Design Engineer 6.48%
- Electrical Design Engineer 6.50%
- Electronics Design Engineer 7.07%
- Mechanical Design Engineer 5.55%

Figure 14: Employability percentage by Roles



Source: AMCAT Employability Survey

b. Disparity between skill set of freshers and the requirements of employers

The reason for such abysmal statistics could be blamed to the disparity between the skill set of freshers and the requirement. A number of surveys were conducted to get a better idea of the skill set gaps:

1. Types Of Skills Required:

The specific skills required by the employers can be grouped into three overall groups of skills: Core Employability Skills, Communication Skills, and Professional Skills.

Figure 15: Skills Grouped into Three Factors:-

(Core Employability Skills)	(Professional Skills)	(Communication Skills)
1.Integrity 2.Reliability 3.Teamwork 4.Willingness to learn 5.Entrepreneur Skills 6.Self-discipline 7.Self-motivated 8. Flexibility 9.Empathy	1.Use of Modern Tools 2.Math/Sci Engg know. 3.Creativity 4.Problem Solving 5.Contemporary issues 6.Customer Service	1. Comm. in English 2.Written comm. 3.Reading 4.Technical Skills 5.Experiments/Data Analysis 6.Verbal comm. 7.Basic computer 8.Advanced comp.

Source : AED Employers Survey.

2.Importance of Skills:

Although all three skills are important for employers, but as per numerous surveys conducted by independent organizations, on average employers have ranked Core Employability Skills as most important, followed by Communication Skills (Soft Skills) and Professional Skills at the third position. In Core Employability skills, integrity and reliability are deemed as most important and “should have” skills. In Communication skills, good written and verbal English skills are the most important ones, whereas in Professional skills, the knowledge of newer tools and technology is preferred by the employers.

Figure 16: Importance Level by Three Factor Skills:-

Core Emp. Skills	Mean	Prof. Skills	Mean	Comm. Skills	Mean
1.Integrity	4.48	1.Use of Modern Tools	4.08	1.Comm. in English	4.26
2.Reliability	4.42	2.Math/Sci Engg know.	4.07	2.Written comm.	4.07
3.Teamwork	4.41	3.Creativity	4.07	3.Reading	4.04
4.Willingness to learn	4.40	4.Problem Solving	3.93	4.Technical Skills	4.02
5.Entrepreneur.Skills	4.35	5.System Needs	3.84	5.Data Analysis	4.01
6.Self-discipline	4.26	6.Contemporary issues	3.83	6.Verbal comm.	4.00
7.Self-motivated	4.22	7.Customer Service	3.51	7.Basic computer	3.95
8. Flexibility	4.15			8.Advanced computer	3.97
9.Empathy	3.92				
Average:	4.27	3.91		4.01	

Source : AED Employers Survey

3.Satisfaction Of Employers:

To which extent does the Skill set of Engineering Graduates meet demand?

Overall, 64% of employers are only somewhat satisfied or worse with the quality of engineering graduates' skills. 3.9% of employers rate the skills as "Not at all satisfied", 16.1% as "Not very satisfied", and 43.9% as "Somewhat satisfied".

Figure 17: Satisfaction Level by Three Factor Skills:-

Core Emp. Skills	Mean	Prof.Skills	Mean	Comm. Skills	Mean
1.Integrity	3.50	1.Use of Modern Tools	3.15	1.Comm. in English	3.95
2.Reliability	3.20	2.Math/Sci Engg know.	3.23	2.Written comm.	3.22
3.Teamwork	3.46	3.Creativity	3.08	3.Reading	3.08
4.Willingness to learn	3.37	4.Problem Solving	2.87	4.Technical Skills	3.13
5.Entrepreneur Skills	3.44	5.System Needs	2.95	5.Data Analysis	3.02
6.Self-discipline	3.37	6.Contemporary issues	2.95	6.Verbal comm.	3.17
7.Self-motivated	3.12	7.Customer Service	2.65	7.Basic computer	3.34
8. Flexibility	3.29			8.Advanced comp.	3.03
9.Empathy	3.15				
Average:		3.30		2.98	3.24

Source : AED Employers Survey

4.Skill Gaps of freshers:

In which important skills are the engineers lagging?

This section combines the analysis of the importance ratings and the satisfaction ratings to identify the specific skills that are in high demand (high importance), but satisfaction rates are low. These are the skills gaps that are most urgent to address.

Skill Gap = Importance Level – Satisfaction Level.

Figure 18: Skill Gaps for the three factors:-

Core Emp. Skills	Mean	Prof. Skills	Mean	Comm. Skills	Mean
1.Integrity	0.98	1.Modern Tools	0.93	1.Comm. in English	0.31
2.Reliability	1.22	2.Math/Sci Engg know.	0.85	2.Written comm.	0.85
3.Teamwork	0.95	3.Creativity	0.99	3.Reading	0.96
4.Willingness to learn	1.03	4.Problem Solving	1.06	4.Technical Skills	0.89
5.Entrepreneurship Skills	0.91	5.System Needs	0.89	5.Data Analysis	0.83
6.Self-discipline	0.90	6.Contemp. issues	0.88	6.Verbal comm.	0.83
7.Self-motivated	1.10	7.Customer Service	0.85	7.Basic computer	0.61
8. Flexibility	0.86			8.Advanced comp.	0.68
9.Empathy	0.87				
Average:	0.98		0.92		0.77

Source : AED Employer's Survey

5.Highlights of the table:

1. The Survey finds that institutions are doing very well meeting the demand for English skills The skill gap in English communication is by far the smallest among all the skills (0.31).
2. Core Employability Skills remains the factor with the largest skill gap particularly Reliability(1.22) and Self-motivation(1.10).
3. A Closer assessment of the skill gaps tentatively suggest that the skill gaps are largest within higher-order thinking skills, and smallest among the lower-order thinking skills.
- 4.A Very High skill gap in the Problem Solving ability(1.06).

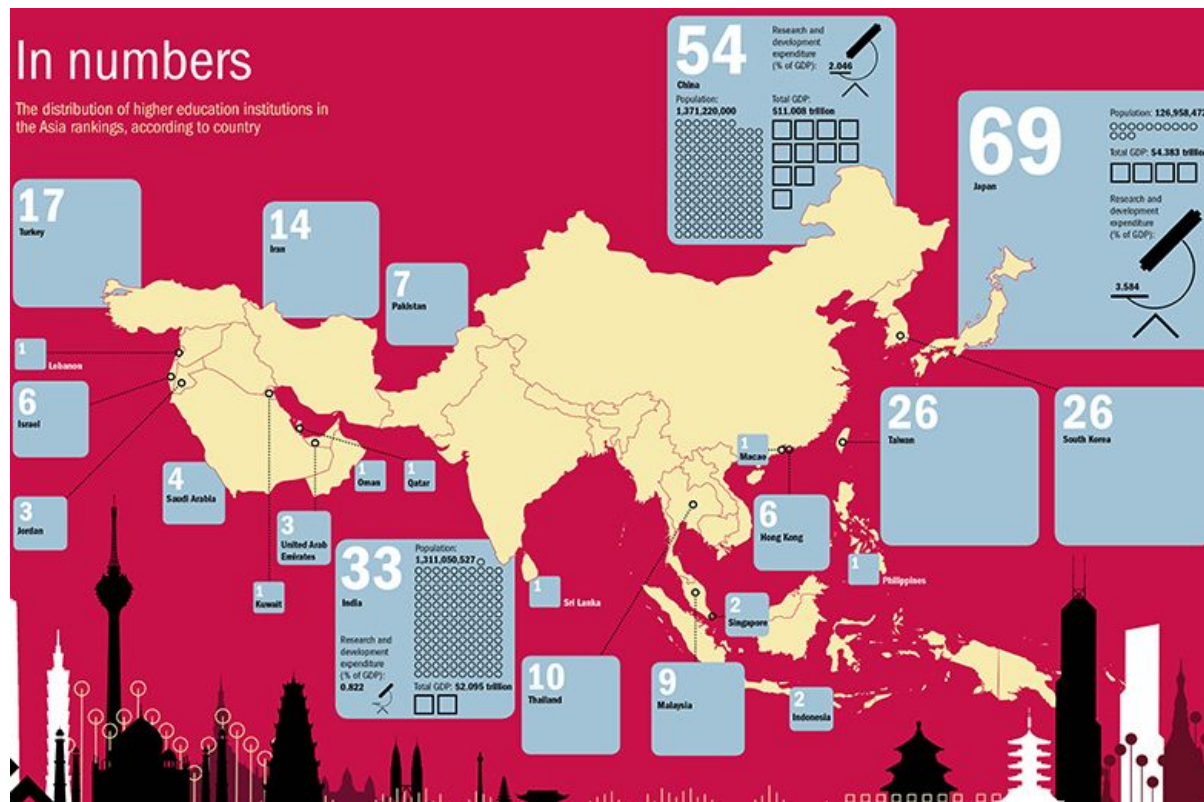
Chapter 6

Implementation in Leading Universities Worldwide

a. Learning through examples:

1. The foreign universities and colleges in the Central Eurasia and the US follow a more systematic, organized and well developed course structure spanning over a vast multitude of courses offered in the same college. Their courses focus on holistic development in acquiring practical skills along with theoretical knowledge.

Figure 19: University rankings in Asia



Source: Times Higher Education

2. These institutions provide world class research facilities and laboratories inside the campus. They also have tie ups with certain private sector companies which provide students an opportunity to work on real time projects and gives them a glimpse of how things work in the industry.
3. The teaching styles encountered and the study techniques required are very different. Adding onto this the courses offered here are more flexible and easily manageable from different and remote geographical domains.

b. Western University, Sydney

1. **Flexible Course:** The courses offered in full time, part time, flexible and external modes. The full time courses are similar and teaching these require physical presence of the enrolled students in the campus.
2. **Examination Methodology:** The exams conducted are semester based along with periodic assignments and tests based on tutes (tutorials available as a part of the course structure on the student homepage. The part time mode refers to a study load of two units (subjects) per teaching session. International students enroll in these courses since this mode is not domain specific. The flexible mode allows majority of the course to be taken off campus. However the students enrolled are required to attend some mandatory workshops. External mode allows the complete course to be taken off campus but students are provided with the option of attending workshops, lectures and tutorials as per their wish. For all off campus courses study is conducted by mail, email and/or the Internet with course materials supplied by these methods.
3. **Reaching out:** The University also offers a number of courses in a variety of countries overseas which involve attendance at lectures and tutorials.

c.National University Of Singapore,Singapore

1. **Strong Industrial Connection:** NUS is constantly looking for new ways of learning and teaching, despite being Singapore's oldest university. These include opening University Town (UTown), home to Singapore's first residential colleges, partnering universities in the United States to create new models of learning, and setting up overseas launch pads for budding entrepreneurs. Constant innovation has enabled these institutions to still attract the majority of high-potential students despite greater local and regional competition. The NUS UTown opened in 2011. It lets students live and learn alongside professors, and take multidisciplinary modules in small classes. It exhibits a well-designed complex creating many new possibilities for academic and experiential learning". All the successful institutions have incorporated skill development alongside theoretical knowledge testing.
2. **Global Ties:** The NUS has also tried and successfully established global links. For instance, it has expanded the NUS Overseas Colleges, sending about 300 NUS students to eight overseas colleges in the US, Europe and Asia. Since its launch in 2002, the programme's alumni and students have set up more than 250 companies, 18 of which have been sold. Mandatory courses in critical skills like how to think have been introduced in the undergraduate program to prepare students for the changing nature of work. Students learn in a potentially powerful way as they get the opportunity to apply what they have learnt. This gives the students a sound exposure to the industry standards and make them aware of the kinds of equipment used.
3. **Examination and Assessment:** Assessments in these institutions are not cumbersome and are not mostly based on rote learning. Assignments given are periodic for better understanding and absorption. Oral-practice communication of ideas through presentations take place after every subtopic Examinations are formal end of semester examinations coupled continuous assessment through the semester. Written assignments/essays, field projects etc.

d.University Of Science and Technology,China

1. **World Class Equipment:** USTC is one of the most important innovation centers in China. It is the only university in China operating two national labs: the National Synchrotron Radiation Laboratory and the Hefei National Laboratory for Physical Sciences at the Microscale. It also jointly operates two national “big science” facilities along with CAS institutes: the Experimental Advanced Superconducting Tokamak and the Steady High Magnetic Field of the High Magnetic Field Laboratory. USTC-IAT focuses on fostering technological innovation and technology transfer in the IT industry, as well as microelectronics, health care, new energy, new materials and quantum information, etc.
2. **Learning through cooperation:** USTC actively participates in international cooperation in various ways. It has engaged in joint research and educational activities with internationally acclaimed organizations such as the International Thermonuclear Experimental Reactor (ITER), the European Organization for Nuclear Research (CERN), the Max Planck Society, Oxford University, Heidelberg University, Stanford University, MIT, Princeton University, the University of California, Berkeley, and Yale University, etc. For example, it established a training program with ITER and initiated the SUM program, a summer camp for students and an academic forum for professors from Stanford University, USTC and MIT. All these major achievements have only been made possible by breaking the stereotypical methods and doing away with the archaic syllabus. Incorporating practical approach and focusing on Research and development.

e.Key Takeaways

1. **Flexible Academics:** The key feature of leading universities is to provide a flexible learning environment through a credit based system. This ensures that students can change their area of studies anytime in between with passing criteria being determined through net number of credits annually. This also means that students can choose subjects of their own interest and are not made to study a rigid academic syllabus.
2. **Updated Syllabus with Industrial Relevance:** The universities stay in constant touch with the constant changes in the market and make sure that the content being offered to their students is always updated and relevant.
3. **Examination and Grading:** The current practise is not focussed on rote learning and learn and forget methodology. Papers are prepared after thorough research and it is ensured that the aim is to test the logical skills of the candidate.
4. **Efficient funding and State of the art labs:** Providing laboratory and apparatus to supplements studies and ensure the students gain practical experience as well.
5. **Exchange of Ideas:** Collaborations with other reputed universities to bring in constant innovation in learning and also provide exposure to students.

Conclusion

Even though the current system has a lot of grey areas, yet with significant resolve and attention, significant changes can be made to the current state. We should take lead from many other successful foreign universities on how they efficiently implement their academics. Efforts will also need to be made to overhaul current deficiencies

In recent times, many institutes are seeing a fresh jump in their global rankings. Driving on the strength of strong alumni network and a significant presence of industries the academics have finally started to pick up the pace to respond to this newfound demand.

With the success stories of ISRO, pharmaceutical industry, automotive and tech industries in India the road ahead seems to only get more exciting for engineers.

However, this last push to take the GenX to the next level can only be achieved through timely reforms and efforts.

Recommendations

a. Research:

Students, Scholars and Professors engage in the field of scientific study to search for answers to questions and expand their knowledge, and while the government does aim to facilitate this motive, the current way of achieving the same is what is holding our progress.

The process for reimbursement of funds for research should be

1. Free from bureaucracy:

The whole funding process should not be subject to meddling by third parties. Construction of a single portal should be done to provide ease of reimbursement of the funds spent on research initiatives.

2. Governed by people who have knowledge of the domain to scrutinize the applications:

It is of significant importance to ensure that people who play a part in making decisions for clearing the funds are the ones who can understand the value proposition of the project, and be able and educated enough to decide whether or not should the project be funded and if yes then how much should be allotted.

3. Make it fast and efficient:

Currently the whole procedure takes up time spanning to months, and even in some cases years. This is a reflection of how inefficient the current system. Study should be conducted into why the whole process takes up so much time, and on how to overcome this weakness.

4. Ease of Application:

To add to this, the whole procedure should be simplified. Instead of making multiple letters and applying to a hundred different parties, the presence of a single portal for application processing should be made.

This will ensure that applicants are more focussed on their research project rather than the funding and clearances.

5. Integration into academics:

To instill a feeling of academic seriousness and interest, the curriculum should be structured in such a way that it promotes team work and spending time on projects relating to the core syllabi being taught in the course. This shall also help in gaining practical experience necessary to carry out real world tasks.

b.Academics:

- 1. Lack of Discipline:** One major and key factor that is responsible for delays in the functioning of governmental administration is the lack of control, order and discipline in the workforce. On a statistical basis, an average working governmental employee is not answerable to seniors. This is primarily because the implementation of the checking mechanism has its own inherent flaws and is not strictly enforced. This lack of fear means that most of the employees do not carry out their duties diligently, resulting in inefficiency.
- 2. Lack Of Autonomy:** The current model of functioning in colleges is that they come directly under the purview of a university. This means that in order to pass any administrative, academics or other reforms or orders, the college has to obtain necessary clearances from the controlling university. In theory this would be a requirement to ensure that colleges diligently follow the framework and that students are not graduated without gaining the required skills and academic rigor. But the reality is that the presence of slow government processes and many a times vested interests come in between the framework. The end result is that every reform comes to as standstill.

- a. The syllabus is not revised on time
 - b. Infrastructure development comes to a standstill
 - c. Funding is not sufficiently channelised. Changes in ledgers is so time consuming that senior faculty gives up trying.
 - d. Everything takes a lot of time, since it has to gain clearance from a central authority.
3. **Communication Gaps:** Moreover, as the number of functional entities increase system, delays and pauses are bound to happen. This directly relates to poor administration and faulty and inefficient implementation of welfare and reforming schemes as they are subjected to repeated and mostly unnecessary rounds of scrutiny by various levels of authority in the hierarchy.

c.Reservation:

1. The only questionable criteria here is **caste**. In a country which derives its stand on democracy, dividing people on the base of castes only furthers this divide. Instead of calling everyone Indian, here we divide each other by names of caste.
2. In reality, reservation is not for the worse, only the current reservation criteria is. People should not be awarded reservation based on caste, but on the **basis of their economic status**.
3. All the citizens will be happily support a scheme that supports people who do not have access to money for education, food or basic resources. It is our job to ensure that people in poverty get to enjoy the basic rights to education and job security.

d.Industrial Relevance:

1. Employers across India ask for the similar set of soft skills. Soft Skills (integrity, reliability, teamwork and willingness to learn) remain the important ones. The policy implication is the need to improve the Soft Skills of graduates.

This could come about by:

- 1) Colleges and teachers recognize that **Soft Skills** are important and include soft skills as part of the desired teaching objectives.
 - 2) The **Teaching-learning** process could be adjusted to include more project-work in teams and possibly received grades as a team.
 - 3) Introduce specific courses providing students with opportunities to enhance their **English skills, Communication skills.**
2. Graduates seem to lack **higher-order thinking skills** (analyzing, evaluating and creating). The employers think that graduates fall short when it comes to the more complex tasks such as application of appropriate tools to solve a problem, and analysis and interpretation. Our recommendations to improve higher-order thinking skills are following:
 - 1) Reshape assessment methods, to assess higher-order thinking skills and not measure memorized knowledge.
 - 2) Promote **teaching-learning sessions** where students are actively learning and developing their own analytical and evaluating skills.
 3. Employers ask for different **Professional Skills** depending upon their economic sectors:

To illustrate, IT companies in general demand strong **system design skills** while the knowledge of mathematics, science, and engineering are less important.

On the other hand, the infrastructure firms prioritize graduates with strong ability to use modern tools and the knowledge of mathematics, science, and engineering, but focus less on creativity and system design skills.

This leaves an important role for institutions to prepare their graduates to meet the demand for skills from different sectors.

- 1) Institutions therefore have to increase their **interaction** with various kinds of employers.
- 2) **Internships and training sessions** would also help students to deepen the understanding of demanded skills and respond well to particular demanded skills.

References

- [1]OECD.*Economics Survey : India* .[Online].Available from:<http://www.oecd.org/eco/surveys/INDIA-2017-OECD-economic-survey-overview.pdf>. [Accessed 13th October 2017]
- [2]IBF.*Indian economy growth and statistics*. [Online].Available from:<https://www.ibef.org/economy/indian-economy-overview>. [Accessed 13th October 2017]
- [3]Ministry of Statistics,India.*Youth In India*. [Online].Available from:http://mospi.nic.in/sites/default/files/publication_reports/Youth_in_India-2017.pdf. [Accessed 15th October 2017]
- [4]PWC.*India - Higher Education Sector*. [Online].Available from:<https://www.pwc.in/assets/pdfs/industries/education-services.pdf>. [Accessed 8th October 2017]
- [5]MHRD.*University and Higher Education overview*. [Online].Available from:<http://mhrd.gov.in/university-and-higher-education>. [Accessed 8th October 2017]
- [6]Roshni Chakroborty.*India Today*. [Online].Available from:<http://indiatoday.intoday.in/education/story/engineering-employment-problems/1/713827.html>. [Accessed 8th October 2017]
- [7]Student Academic Feedback Survey[September,2017]
- [8]Erdil Şahin B.*The Relationship Between R&D Expenditures and Economic Growth: Panel Data Analysis 1990-2013*. [Online].Available from: http://www.ekonomikyaklasim.org/eyc2015/userfiles/downloads/_Paper%202017.pdf. [Accessed: 9th October 2017]
- [9]John Wu.*Fueling Innovation: The Role of R&D in Economic Growth*. [Online].Available from <https://www.innovationfiles.org/fueling-innovation-the-role-of-rd-in-economic-growth/>. [Accessed 11th October 2017]
- [10]Amcat.*National Employability Report*. [Online].Available from <http://www.aspiringminds.com/sites/default/files/National%20Employability%20Report%20-%20Engineers%20Annual%20Report%202016.pdf> [Accessed 16th October 2017]

Appendix

Survey Analysis Form :

Feedback on current state of education in engineering colleges across India

Motivation: To this day, we look forward to foreign universities for inspiration. The question is why are Indian Universities/Colleges still not at par ?

Aim: To bring forth the issues that are plaguing the engineering institutes of India.

Constraints: You can mention about any aspect involving syllabus, teaching style, faculty, methods of testing/examination, infrastructure, administration, hostel etc. Address the issues in the order of priority.

Request: This is a sincere effort to address a suffering common to all students. Please refrain from writing entries not true to the purpose.

Name of Engineering Institute *

Areas where you feel that your institute is doing well or making efforts to improve the same *

Areas where the Institute needs to improve *

Suggestions/Improvements that should be carried out by the Institution/Government *
