IDEAS AND SUGGESTIONS FOR HARNESSING & TRAINING YOUNG INDIAN ENGINEERING TALENT FOR A DIGITALLY OUTSOURCED GLOBAL ECONOMY IN ARCHITECTURAL, ENGINEERING, CONSTRUCTION AND OPERATIONS (AECO) SECTOR

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ABSTRACT: This paper aims to bring to the fore the tremendous potential that India has, through its young engineering graduates, for delivering engineering services to the western world from India, specially to the USA, in the next decade, provided the industry and the government takes crucial steps at the current juncture. The issues faced by the engineering industry and its education system are various and those need to be tackled hands on, if India needs to benefit from an explosion of work that can come its way.

INTRODUCTION

A big beneficiary of the entire process of rejuvenating American infrastructure, specially old and decaying one- could be India as the amount of work at different levels, especially at the middle to lower end of the engineering spectrum will get transferred to India/ Indian companies provided they have developed skills enough to deliver. At the moment few Indian companies measure to the demands made by such work, and in large quantum. The point in consideration is that the amount of workflow could be huge and it could support a larger number of medium sized players in this field, in India, and many new niche level enterprises working on multiple up coming technologies and using new software application.

KEYWORDS

Outsourcing, remote working, engineering software, India, USA, training, learning and development, training institute, consulting, contracting

OBSERVATIONS ON THE BIGGEST A/E/C/ CONSTRUCTION –THE USA

On Tues., Aug. 10, 2021, by a vote of 69 to 30, including 19 Republicans and all 50 Democrats, the U.S. Senate passed a $1.2 trillion infrastructure package, known as the Infrastructure Investment and Jobs Act. Following passage, the proposed legislation was sent to the House of Representatives where further adjustments are expected. Should the bill pass before September 2021 end, and which will, in all probability, the House and Senate will need to consolidate their respective versions for a final bill to go to President Biden for his signature.

The above bill is one of two pieces of infrastructure legislation under consideration in the Senate. In addition to the $1.2 trillion bipartisan bill, a second $3.5 trillion Democratic proposal is in play.

On Aug. 11, 2021 the Senate passed the blueprint of the $3.5 trillion second bill on a party-line vote of 50 to 49.

On Aug. 24, 2021, the House of Representatives passed an identical budget resolution by a 220-212 vote, along party lines. This enables the Senate Democrats to attempt to pass the $3.5 trillion bill by a simple majority using the budget reconciliation process.

WHAT'S IN THE $1.2 TRILLION BIPARTISAN BILL

The 2,702-page bipartisan bill contains just $550 billion in new spending. The $1.2 trillion figure comes from including additional funding normally allocated each year for highways and other infrastructure projects.

The new spending consists of the following:

$110 billion for roads and bridges. In addition to construction and repair, the funding also helps to pay for transportation research at universities, funding for Puerto Rico's highways, and "congestion relief" in American cities.

$66 billion for railroads. Funding includes upgrades and maintenance of America's passenger rail system and freight rail safety, but nothing for high-speed rail.

$65 billion for the power grid. The bill would fund updates to power lines and cables, as well as provide money to prevent hacking of the power grid. Clean energy funding is also included.

$65 billion for broadband. Includes funding to expand broadband in rural areas and in low-income communities. Approximately $14 billion of the total would help reduce internet bills for low-income citizens.

$55 billion for water infrastructure. This funding includes $15 billion for lead pipe replacement, $10 billion for chemical clean-up, and money to provide clean drinking water in tribal communities.

$47 billion for cybersecurity and climate change. The Resilience fund will protect infrastructure from cybersecurity attacks and address flooding, wildfires, coastal erosion, and droughts along with other extreme weather events.

$39 billion for public transit. Funding here provides for upgrades to public transit systems nationwide. The allocation also includes money to create new bus routes and help make public transit more accessible to seniors and disabled Americans.

$25 billion for airports. This allocation provides funding for major upgrades and expansions at U.S. airports. Air traffic control towers and systems would receive $5 billion of the total for upgrades.

$21 billion for the environment. These monies would be used to clean up superfund and brownfield sites, abandoned mines, and old oil and gas wells.

$17 billion for ports. Half of the funds in this category would go to the Army Corps of Engineers for port infrastructure. Additional funds would go to the Coast Guard, ferry terminals, and reduction of truck emissions at ports.

$11 billion for safety. Appropriations here, are to address highway, pedestrian, pipeline, and other safety areas with highway safety getting the bulk of the funding.

$8 billion for Western water infrastructure. Ongoing drought conditions in the western half of the country will be addressed through investments in water treatment, storage, and reuse facilities.

$7.5 bill for electric vehicle charging stations. The Biden administration asked for this funding to build significantly more charging stations for electric vehicles across the nation.

$7.5 billion for electric school buses. With an emphasis on bus fleet replacement in low-income, rural, and tribal communities, this funding is expected to allow those communities to convert to zero-emission buses.

What's in the $3.5 Trillion Democratic Proposal as far as the work related to infrastructure engineering is concerned-

$135 billion for the Committee on Agriculture Nutrition and Forestry. Funding to be used to address forest fires, reduce carbon emissions, and address drought concerns.

$332 billion for the Banking Committee. Including investments in public housing, the Housing Trust Fund, housing affordability, and equity and community land trusts.

$198 billion for the Energy and Natural Resources Committee. This would develop clean energy.

$67 billion for the Environment and Public Works Committee. These monies would fund low-income solar and other climate-friendly technologies.

$37 billion for the HSGAC Committee. This would electrify the federal vehicle fleet, electrify and rehab federal buildings, improve cybersecurity infrastructure, reinforce border management, invest in green-materials procurement, and invest in resilience.

UNDERSTANDING THE POTENTIAL OF THIS BUSINESS IN THE NEXT ONE DECADE

How India should have benefited if we had trained our people well, but there's a lot to be done which is possible.

As per a recent **ENR** (Engineering News Record magazine)report for 2020, the total international consulting revenue for the Top 225 organisations was down 7.1% among surveyed companies, decreasing from $72.31 billion in 2019 to $67.14 billion in 2020. Even though revenue for many global firms fell last year, mainly due to Covid-19, many companies anticipate market conditions to get better in the near future. With nuanced differences, the Top 225 companies are refocusing their international reach to take on infrastructure recovery projects worldwide, designing pandemic-ready operations and responding to their respective markets in the process.

THE ANALYSIS FROM AN INDIAN PERSPECTIVE

While many things are self-explanatory about business in the report which is made by one of the top magazines of the world- ENR, here are some aspects that have to be considered too.
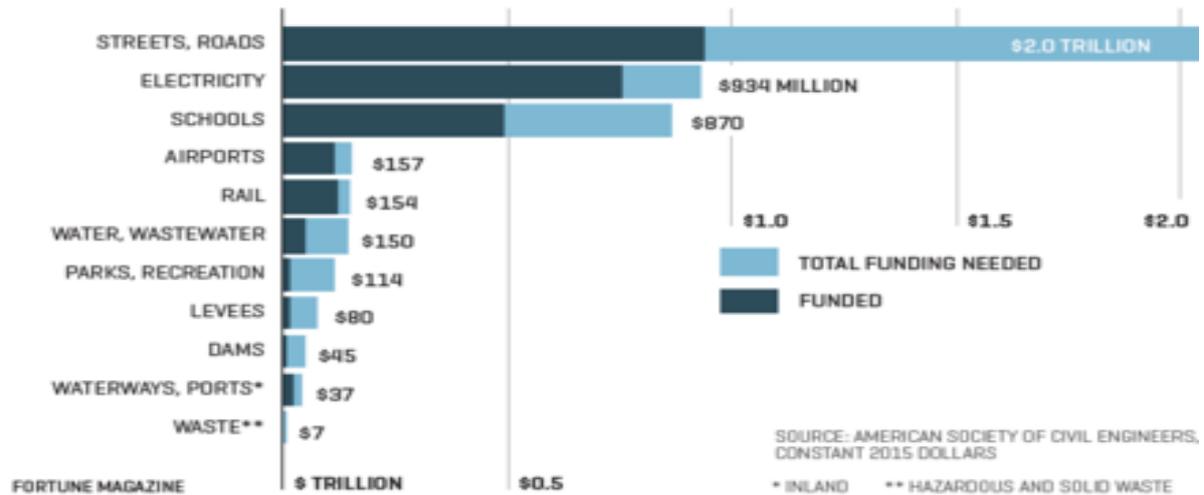
-Consulting revenue of Top 225 was down 7%, by say USD 5 billion. Translated into project/ materials /contract value etc.- this roughly can amount to USD 100 billion- that is a huge amount, which drives manufacturers, contractors and creates job openings.

-If the USA is going to pump in USD 1 Trillion in infra over the next few years or even more, (USD 1000 billion), it is theoretically 10 times the deficit created by the pandemic in 2020. The consulting revenue out of this works (at approx. 5%) of project cost will be USD 50 billion - again obviously 10 times of what the deficit in consulting was over a 9 month pandemic period of 2020.

-Is the consulting engineering business in USA ready for the surge? As it is, USA is short of specialised staff and if WFH (work from home continues as well), the efficiency and delivery will be a key issue. The point is, there could be a big surge of work for consulting companies in late 2021 and in 2022 (Big and small). Big beneficiaries will also be the subsidiaries of MNCs in the developing world like India which are eventually learning how to deliver the best, in time and with even 24x7 working. A lot of work could have also got passed on to local Indian companies and smaller vendors in India, provided we would have properly trained our engineers by now, to take on challenging work with best quality, that is the hallmark of the big and mighty multinationals. Maybe more MNCS will set up a backend in India in time to come, with their own internal training and secure work systems. However there is really a great scope now for tie ups and collaborations with Indian setups.

As per US Senators, the bill includes $550 billion in new infrastructure expenditure and $450 billion of funds that were approved previously. The bill proposes the highest spending of $110 billion on the construction of new roads and bridges across USA. Since the emphasis initially is USD 550 billion- in new infra spending for roads, bridges, and infra, one would focus on civil engineering software like Civil 3D, OpenRoads, etc., for which one doubts if India has a really good quantum of people for delivery, which will need quick action, as work can flow in pretty fast. Of course there are many other software, which are also are required in the process, but are having a wider and routine usage and also having availability of manpower.

U.S. INFRASTRUCTURE NEEDS OVER THE NEXT 10 YEARS

STREETS, ROADS	$2.0 TRILLION
ELECTRICITY	$934 MILLION
SCHOOLS	$870
AIRPORTS	$157
RAIL	$154
WATER, WASTEWATER	$150
PARKS, RECREATION	$114
LEVEES	$80
DAMS	$45
WATERWAYS, PORTS*	$37
WASTE**	$7

TOTAL FUNDING NEEDED
FUNDED

SOURCE: AMERICAN SOCIETY OF CIVIL ENGINEERS, CONSTANT 2015 DOLLARS

FORTUNE MAGAZINE $ TRILLION

* INLAND   ** HAZARDOUS AND SOLID WASTE

Nevertheless good marketing of India's services, an organised effort for capacity building and quality, is the need of the hour. Design and engineering of Infrastructure projects is difficult to outsource for multiple reasons, but can be managed with international business set ups. This is a great opportunity for big business in outsourced services at the higher end of the engineering spectrum, but seems already lost, except for some few MNCs as the beneficiaries. It will require some more time to master the requirements and to train people in India. Perhaps it is time India gears up in a very organised and systematic way by training its core engineers extremely well in all possible ways for work to be done for years, at the back end in India. The flip side is that we have a good quantum of people with basic engineering skills available and who understand English-which perhaps no other country has. It took 25 years for the software industry to reach current delivery levels- but that's a much wider field for outsourced work with changing technologies. An organised effort right away will make things change in a comparatively lesser time span. When there is obviously a huge market to be tapped, it is all the more reasonable to work towards harnessing and developing talent in an effective manner.

INFRASTRUCTURE AREAS WHICH WILL FALL UNDER THE PURVIEW OF UPCOMING WORKS

There are a lot of developmental works that fall in this category where the USA needs to develop new and improve on existing projects. Most of these are about Roads, Highways, Bridges, Railways, Water and Waste Water, Irrigation, Electricity & Distribution, Public buildings and Power Plants.

SOME SKILL SETS REQUIRED & SOFTWARES IN USE

The software in use globally are many, with similar or even identical outputs at time.

The typical skill set required is essential fundamental engineering knowledge of a domain and more importantly a sub-domain (e.g. Civil Engineering and Roads) and the ability to use the relevant software. For roads/ highways, the software could be OpenRoads, or Civil 3D.

Another example would be Architectural/ Engineering /Construction major domain with packages like AutoCad, Infraworks, and NavisWorks manage. Architectural packages would be 3DsMax, and SketchUp, for BIM i.e. Building Information Modelling, you have platforms like Revit and AllPlan.

For steel buildings construction related software it could be Tekla Structures or SDS2 or Advance Steel, all from different vendors or software developers.

It is easy to figure out from the software name, the application and usage of the same, so here is a list that again is not exhaustive, but mentioned for the benefit of young students.- AutoCad and so many offerings under the A/E/C package of Autodesk Inc. such as Revit, 3DSMax, Civil3D, Infraworks, Navisworks etc., and from others comapnies - Openrail, StormCA OpenRail, OpenRoads Designer, OpenSite, OpenBridge Modeler, WaterGEMS, SewerGEMS, StormCAD, CivilStorm etc.

While the above listed ones focus more on civil and structural engineering and architecture to some extent, (the AEC) domain, you have a number of software that are mechanical engineering oriented such as CREO, Fusion 360, SolidEdge , SolidWorks etc. As an example CREO helps everyone to utilize various parametric features such as 3D CAD solid modelling, 2D orthographic views, 3D direct modelling, schematic design, Finite Element Analysis and simulation, technological illustrations, and viewing and visualization. Then there are many niche/ activity oriented software/ tools in HVAC, Plumbing, Lighting etc.

By using this software designers/engineers can do product simulation, 3D mechanical design, analysis & testing, tool creation, design communication, and manufacture application.

A part of the overall skill requirements, needless to say, is the proficiency in the English language, as most of the companies work for international clients. However this awareness is generally missing in the student community, which is now largely distributed all over India and not just in the metro cities.

SOME COMPANIES WELL ESTABLISHED IN THIS SPACE IN INDIA

Some of the well known Indian names, specially larger in in the field working for international partners or clients in India are Pinnacle, Excelize, Neilsoft, Prothious, PanGulf, Techflow, CADeploy, Intec-Infra, Advenser, and there are others, spread across India. Some of these are mini MNCs/ Indian MNCs and have multiple offices in USA, Europe and the Middle East. This list is not an exhaustive one, as there are many other good companies around which fit the bill.

International consultancies operating from India using Indian talent in a big way for their overseas projects are AECOM, WSP, MOTT MACDONALD, STANTEC, JACOBS, DAR, BURNS & MCDONNELL, SNC LAVALIN (again, not an exhaustive list). There are many other international firms in India working on Indian projects /market for many years, but do not necessarily support their international offices. However with the huge quantum or surge that might happen with the new developments, many international firms might activate their Indian offices to outsource a large / larger quantum of work. This will need well trained design engineers familiar with international codes, and will also need a bigger staff supporting the overseas offices in terms of detailers, modellers, checkers, IT support, covering various levels of the engineering spectrum.

The emphasis in Indian companies has been mainly on buildings (residential and commercial) & industrial structures- and all aspects of engineering associated. However there is a huge market to be serviced, that is connected with public developmental works in a big way, that may need mastery of not the regularly used software, but software in the GIS / Geospatial domain, ground engineering, geophysical and environmental engineering domains. One example is Civil 3D. Talent development in these areas can create a far larger job creation.

WAY FORWARD

1. It is high time to set up organisation like those in USA: AISC (American Institute of Steel Construction), NISD (National Institute of Steel Detailing) in most relevant areas to India and make them highly active as far as training and certifications are concerned. These have to be initiated by the government to begin with, but run painstakingly by the industry. The bodies in USA are purely mentioned as examples of effective industry initiatives and skills improvements. There are several others in the respective work domains.
2. Professional connect between industry, colleges and private training institutes is a must. India has over 1 million engineering graduates passing out every year, and that is quite a number. If trained well/ systematically in this area of engineering / support services like using software to aid AEC/O operations overseas we will have a strong unbeatable force benefitting the country. AICTE (All India Council of Technical Education) is doing a pretty good job. Specially its new portal for finding internship opportunities internships. https://internship.aicte-india.org/ is a boon for the students and the industry. However from the industry side, there have to be managerial drivers to accomplish the overall objectives.
3. It is worth noting India's lead in this sector. China with 20% higher number of engineers passing out every year is nowhere in competition with India due to many issues including English proficiency. The lead India has established needs to be maintained.
4. One to One mentor – mentee training relation within companies/ colleges/ districts / towns is another initiative that can be taken up under the overall supervision of AICTE/ BYST/CII.

5. Distinct contribution in training new students from major industry software providers (some examples only: Autodesk, Trimble, Bentley, Nemetschek Group etc.) to companies/ institutes on a subsidised basis (fees/ license cost)

6. Free student versions of software to be organised by colleges and promoted to students

7. Organised teaching and certifications through organisations similar to those mentioned in 1 above.

8. An Evening / Night schools concept and organised on-line trainings with fee reimbursement by employers /companies and tax deduction on those expenses.

9. Highly effective Training Institutes within organisations to upgrade captive skills, and develop lower cost manpower resources.

10. For companies fully or partly into export of services, government should extend tax concessions / deduction of training costs incurred as a percentage of revenues.

11. Regular review at industry/ trade association level if we are building adequate capacity and   expertise of people available for quality work and new software handling.

12. Introspection whether the quality of staff/ training / and level of candidates are in line with the international demand.

13. Every degree level engineering course must have minimum training in basic packages like Autocad for semesters III & IV, but a higher level of elective / specialisation as part of the semester V & VI or even VII & VIII –like Tekla Structures / Revit / SDS2 / CREO / Archicad etc.- all dependent on the engineering stream and the choice of software from an employment angle, with some options for the students. The tax incentives mentioned in 9 above, will go a long in software industry /college collaboration automatically. This will also lead to guided or individually mentored training programmes. The engineering colleges should be allowed to hire private training institutes as well, as generally the staff of engineering colleges are not experts in the software arena.

14. Adequate improvement in spoken and written communication skills in English is a must for the delivery staff

15. While the MNCs will be able to support their backend Indian operations with regular work, sourced by their far flung and extensive business development operations in their parent nations, medium sized Indian companies may have to make a continuous effort in developing clients and sourcing new ones to support a regular growth or even survival. Astute marketing is the way forward for Indian medium sized players and new comers, which is one skill that is perhaps going to be as important as the project delivery skill, if not even more. With a lot of Indian students and professionals now settled in USA, business development is never the less becoming easier for Indian companies, as a local front assures clients of better attention during the business.

16. Indian companies with its large staff distributed across India managed to deliver results even during the difficult & extended WFH period, which is a sign of technical capability and human patience. Though those results weren't as good as working from office, it is a remarkable achievement on part of the management, staff and I.T. executives. This development is something which the international engineering majors need to consider while evaluating India as an outsourcing base for the future.

17. While margins in the business look very attractive, ups and downs in the inflow of work need to be considered, which keeps staff idle at significant intervals. Here is the time that organised training/ learning and development and skill up gradation comes in the picture.

STUDENT MIGRATION

Of late, many Indian students are moving to the west for higher level of studies in BIM and overall domain of construction management. These will eventually add value to an Indian backend that will be stronger over the years. There are some excellent companies that are set up as a back end in India, serving only one client in all their needs- both technical and administrative, encompassing project management, project purchases/ payments and even accounting. In simple words, Indian companies are scratching the surface of a big business that gives you an entry due to technical skills, but can lead to many connected assignments. Indians eventually will hold sufficiently higher level position in large A/E/C companies worldwide and work flows to Indian set ups are possible in a bigger way, in time to come. A large number of civil engineering and architecture graduates have moved to the USA for a masters in construction management that includes specialisation like BIM. Needless to say, for the longevity of that operation, eventually the onus will be on the people handling the India backend, where quality of delivery will play a great role. Leadership is an issue that is also of great importance here, as it will be a mix of multiple & people skills.

THE SUPPLY AND DEMAND SITUATION

India produces several hundred thousands of engineers, (1 million is an estimate on a lower side) from not so elite colleges, who are seeking an immediate job. The quantum of jobs in the traditional core engineering sectors are diminishing. As a result these engineers move into software development, eventually leading to a loss of a trained engineer. However a large number of candidates are available for the engineering services sector- be it design, development, modelling, drafting and site support. These engineers are satisfied to do these jobs, however most do not have an idea of the extent of work that is in the market. The supply is enormous and though this type of work does not mandate a very high level of fundamental engineering skills, yet the basics are in place for a massive take off.   The challenge is in grooming people into high quality professionals. All those companies which made internal effort to upgrade their staff, have excelled.

One of the reasons a lot of work is getting outsourced to India, is the quantum of people available for such work in India and a corresponding absence of people willing to do this type of work/ or even available for such work in the western world- including the USA. Cost of delivery is one factor, but not the primary one. Quality is another factor, but that has many aspects, which India is yet to master. Choosing of a right software and a right command and an intelligent shortcut , is again only one aspect of the business. India has done a good job so far of creating and supplying manpower for the outsourcing industry. It took 25 years plus for the Indian software industry to make a name for itself. This is a long time, and perhaps Indian engineering outsourcing industry may need 1/3rd of that time frame to excel, as work is well defined, and unlike the software industry, engineering fundamentals and usage does not change rapidly. However the quality considerations and delivery issues are immense in engineering.

THE CASE OF UPCOMING COMPETITION

To take up the case of competing countries in the west or east, the East European countries and even Russia have excellent software programming and related talents, but the issues of quantum of people available and the language- put up a barrier. Other low/ lower cost countries such as Bangladesh, Sri Lanka, and Philippines have fortunately the same issues, and educational issues, so we have an edge for a long time to come. However, we must ensure that quality remains a top priority, otherwise a lot of lower end spectrum work may still move on to these countries, the way medical transcription moved to the Philippines as an example in the BPO sector. In fact, Indian companies must explore the business of transferring skills as a consultancy to other nations or even set up subsidiaries there. Training is one way of long term survival.

There is another set of competitors around- that is the individual freelance remote worker. These remote workers generally work based on their previous experience in working in companies, know most of the work requirements but need to be updated on new work demands. Scaling up for these individuals is an uphill task, as generally in this industry. These individuals however do not come near the quality rating demanded and beat others on pricing, a not so healthy trend. Large companies outsourcing work in a big manner do not rely on them.

CONCLUSION

Supporting initiatives for growth in the engineering services field is an HR driven activity . While high end software and applications/ packages play a key role, these are common factors across the competition board. The difference comes in at the human level. To scale up businesses and output, the human element becomes extremely important to take on multiple tasks, ensuring quality output. Significant quantum of effort will have to go in skill up-gradation and quality output, also supported by improvement in fundamental engineering knowledge.

REFERENCES

1. **ENR** Magazine- THE TOP 225 report https://www.enr.com/toplists/2021-Top-225-International-Design-Firms-Preview

2. **NY Times** https://www.nytimes.com/2021/08/10/us/politics/infrastructure-bill-passes.html

3. **THE WASHINGTON POST:** https://www.washingtonpost.com/business/2021/08/10/senate-infrastructure-bill-what-is-in-it/

4. **INVESTOPEDIA**   https://www.investopedia.com/here-s-what-s-in-the-usd1-trillion-infrastructure-bill-passed-by-the-senate-5196817
5. **THE CONGRESS**
   https://www.congress.gov/bill/117th-congress/house-bill/3684/text#toc-H5DD9FDC17D0A401D9D34D822EDFA7D7F
6. **CNN** https://edition.cnn.com/2021/07/28/politics/infrastructure-bill-explained/index.html
7. **ASCE-**American Society of Civil Engineers- Chart on US Infrastructure Needs Over the Next 10 years

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