

Importance of Lithium-Based Energy Storage in Achieving India's Climate Goals

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Abstract

Energy storage is the key for the effective integration of the upcoming stochastic renewable energy systems with the electricity grid and accelerating the adoption of electric vehicles. In order to meet the emission targets in 2030, the Indian electricity and transportation sectors require ~ 1650GWh of lithium battery based energy storage during 2020-30. With the present advancements in the technologies of Lithium-Ion battery, the transformation involving US\$ 150-200 billion, requires ~330 kilotons of lithium, policy decisions in favor of investments in battery research, mass manufacturing capabilities, foreign collaborations, recycling facilities for environmental sustainability and purchasing of lithium assets abroad.

Introduction

With the objective of reducing the greenhouse gas emissions to an average of 5% below pre-industrial levels, the global investment in the clean energy technologies has reached US\$ 2.6 trillion. Subsequent to the foundations of the United Nations Framework Convention for Climate Change (UNFCCC) under the Kyoto protocol, the Copenhagen and the Cancun agreements, the 2015 Paris convention has set countries' minimum obligations, stronger transparency and accountability that hold the respective government accountable for their commitments. India has committed to increase its cumulative installed non-fossil-fuel-based electricity generation capacity in the national electricity generation portfolio to 40% by 2030 and reduce the emissions intensity by 35% from the 2005 levels, considering economic growth priorities, energy security and cleaner environment [1]. The increased use of renewable energy and early transition to electric mobility helps in achieving emission targets and reducing hydrocarbon imports. During the forth coming decade, the use of the lithium batteries are expected to play a major role in the realizing energy storage systems (ESS) in the energy sector, especially, in the power and transportation segments.

Lithium battery technologies

Subsequent to the foundation of the Lithium-ion (Li-Ion) battery laid during the 1970 oil crisis and introduction of the first commercial Li-Ion battery in 1985, Li-Ion battery technologies have developed and attracts significant attention in the energy storage applications because view of their superior energy density of 75-200Wh/kg, specific density of 150-315 Wh/l, cycle stability, efficiency and reliability (Table.1). Li-Ion battery technologies have made a strong footprint in portable electronics, renewable energy, smart electric grid, transportation sector, including road vehicles, green ships, aircraft and in niche segments, including space and subsea applications involving time-critical applications [2][3][4]. The Li-ion cells use lithium transitional metal oxides as cathode, graphite as anode and non-aqueous carbonated liquids as the electrolyte. The charge and discharge of the cell occurs through intercalation and de-intercalation of the lithium ions. During the charging process, lithium ions are transferred across the electrolyte from the anode host structure to the cathode electrode. The performance of the lithium cells vary significantly based on the electrode chemistry.

Table.1. Comparative details of the electrochemical batteries [2]

Type	Maximum size (MW)	Cycles at 80% DoD (x1000)	Expected useful life(Years)	Round-trip Efficiency (%)
Vanadium RFB	10	10-13	15-20	75-85
Zn-Br-RFB	2	5-10	5-15	72-80
Lead-acid	20-70	2-4.5	5-15	65-90
Li-ion	10	1.5-4.5	5-15	85-95
NaS	8	2.5-4.5	10-15	75-90

According to the World Intellectual Property Organization (WIPO) patent database, materials for energy storage are one of the most-researched areas. The matured materials for the cathode include lithium-nickel-manganese-cobalt (NMC), lithium-nickel-cobalt-aluminium oxide (NCA), lithium- manganese oxide (LMO) and the lithium iron phosphate (LFP). Graphite with improved structure is used as anode to enable faster charging rate and the lithium-titanate (LTO) is used in heavy-duty applications because of its capacity to extend cycle life. The use of solid polymer as the electrolyte and lithiated-carbon has greatly improved the safety of the li-ion cell [5]. The features of the matured Li-based cell technologies are shown in Table.2. The reliability and safety of the presently operating li-ion batteries are ensured by using battery

management systems (BMS) that continuously monitor the health status of the individual cells including voltage, temperature and the charge status.

Tab.2. Matured Li-based technologies for this decade [5]

Feature	NMC-Graphite	NMC-LTO	LFP-Graphite
Specific weight	200 Wh/kg	100 Wh/kg	140 Wh/kg
Cost/kWh	US\$ 150-200	US\$ 450	US\$ 320
CDC	2500 @ 1.5C with 80% DoD/ 500 @ 3 C	10,000@10C	

The recent developments in cathodic materials such as LiFePO_4 and $\text{Li}_4\text{Ti}_5\text{O}_{12}$ are expected to reduce the cost and increase safety. Reduction of cobalt content in the existing cathode chemistries aims to reduce cost and increase energy density, in combination with other anode technologies. The upcoming lithium metal cathodes are expected to improve the performance without relying on cobalt in combination with anodes made of silicon composites. Even though, research in Li-air and Li-sulphur battery are fast progressing, their technology readiness level is low, and hence may not be commercially available before 2030 [6].

Lithium batteries in the power sector

In the power sector, ESS are required for effective management of the demand shifts, peak reductions, frequency regulation, voltage support and renewable resources integration (Fig.1). The global investments in the ESS installed in the power sector has reached ~ US\$ 1 trillion in 2019.

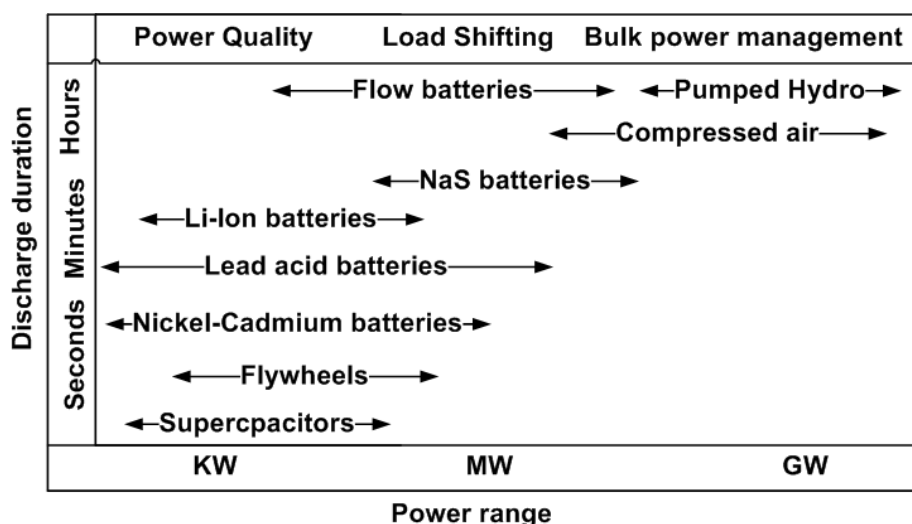


Fig.1. Categorization of ES technologies based on application

The capacities of the ESS (excluding pumped hydro) that are installed globally are shown in Table 3, in which the share of the electro-chemical based ESS is the highest. The United States tops the list with a cumulative installed capacity of ~570 MW distributed in 292 projects, followed by South Korea, Japan and Germany with 300, 250 and 120 MW, respectively [4][7]. The share of the different chemistries in the electro-chemical segment is shown in Fig.2.

Table.3. Global developments in ESS (non-pumped hydro) [7]

Technology	Number of projects	Combined capacity
Electro-chemical	1056	4GW
Thermal storage	225	3.7 GW
Electromechanical	74	2.6 GW
Hydrogen storage	14	21 MW
CAES	2	5 MW

Globally, Na-S, Li-Ion, Lead acid, Ni-Cd and flow chemistries share 59%, 21%, 13%, 5% and 2% of the electro-chemical based ESS capacities. However, the share of chemistries varies with the country based on the nature of the power system demand, domestic availability of the raw materials and prevailing policies. In China, Li-Ion, lead-acid and flow batteries share 74%, 17% and 9% respectively. In Japan, Na-S, Li-Ion, flow and lead-acid batteries share 48%, 38%, 8% and 4%, respectively. Li-Ion has a dominant position in China, whereas Na-S batteries are dominant globally, including Japan [8].

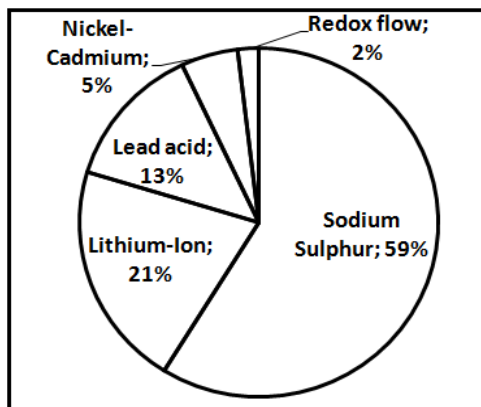


Fig.2. Share of different chemistries in electrochemical segment

In the Indian power sector, ~11% of the ESS is used for renewable firming up, 16% for power quality management and 73% for overcoming power blackouts and brownouts [9]. Under the determined effort scenario, (with a GDP growth rate, share of manufacturing in GDP and urbanization rate of 8.7, 1.13 and 0.7%/year, respectively), using NITI Aayog simulator IESS 2047, the cumulative renewable energy installed capacity, including wind and solar is expected to increase from ~60 GW in 2020 to 175 GW in 2030 (Fig.3). Simulation results indicate that the cumulative ESS capacities of ~55 and 45 GW are required to bridge the gap in the energy and power requirements, caused by the increased integration of the stochastic renewable energy sources, including ~10,000 renewable distributed mini and micro-grids. Based on the predicted load profile, ~50GWh of energy balancing will be required by 2030 [10][11].

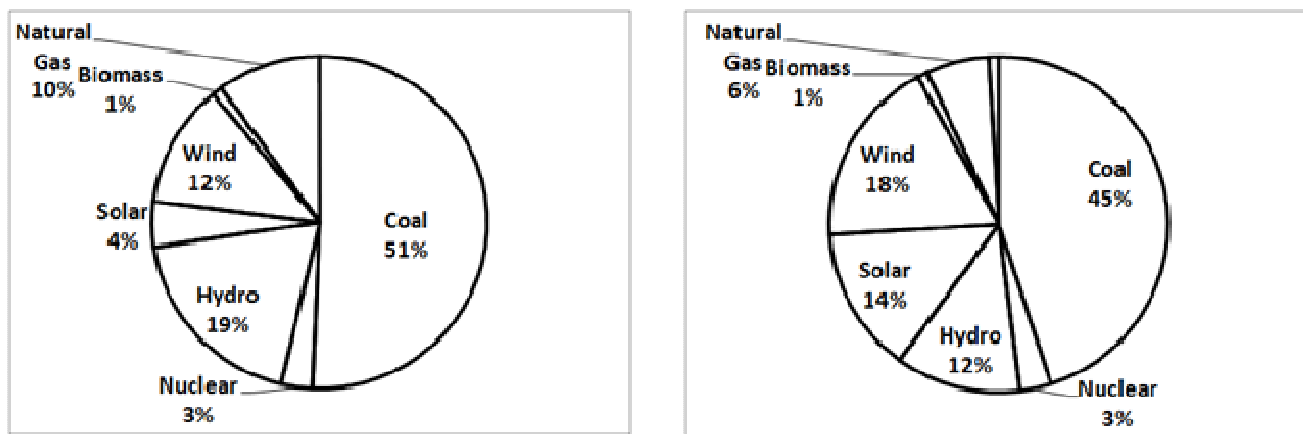


Fig.3. Electricity generation portfolio in 2019 and 2030

The cost-effective electro-chemical ESS is determined through, analysis using the World Energy Council cost model. The cumulative investments required till 2030 if the entire ESS is realized using specific electro-chemical batteries are plotted in Fig.4. The lead-acid batteries are found to be cost-effective, but lack efficiency, volume and weights. The Li-Ion chemistry is expected to be cost-effective compared to Na-S and Redox chemistries, till 2030.

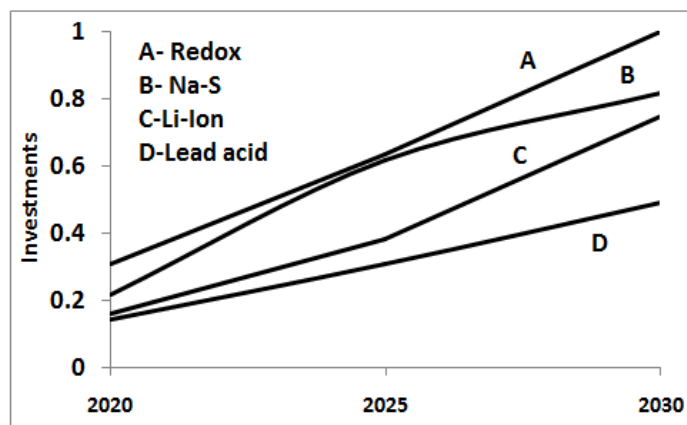


Fig.4.Cummulative investments for electro-chemical ESS

Lithium batteries in electric mobility

Considering the advantages of the electric mobility due to reduced emission, increased energy security and higher reliability because of reduced parts over ICE-based vehicles, the support and commitments from the policy makers and automotive industry is steadily increasing. Table.4 shows the share of the electric vehicles (EV) and the charging infrastructure in 2019. Further, promising growth could be expected from the prevailing zero emission vehicle (ZEV) mandates, fuel economy standards, fiscal incentives (upto 40% in several countries) and the regulations that are being enacted for establishing the charging infrastructure. The country-specific power generation mix and the carbon intensity of vehicle manufacturing determine the CO₂ intensity of the EV. According to the observations of the International Energy Agency (IEA) on the European automobile sector, the EV wheel-to-wheel (WTW) emissions were ~50% less than gasoline and ~40% less than diesel cars. Globally, in 2017, the EV-avoided emissions were ~30 MtCO₂ [12] Presently, the Shenzhen city in China has transformed its urban bus fleet of 16359 buses to all-electric models.

Tab.4. Electric mobility by country in 2019 [12]

Country	Percentage of global		
	Electric car stock (out of 3.1 million)	Slow chargers (out of 0.3 million)	Fast chargers (out of 0.11 million)
China	40 %	41 %	74 %
USA	24%	12%	6%
Japan	7 %	7 %	7 %
UK	4%	4%	2%
Germany	3%	7%	2%

In 2030, with the present EV policies in place, the projected share of the EV in China, Japan, US, Canada, India and global aggregate shall be 50, 37, 30,30 29 and 22 %, respectively. A number of local administrations have pledged to implement restrictions for prohibiting the access of Internal Combustion Engine (ICE-based) vehicles in certain areas. The global forecast for light duty EV, associated fuel saving, emission reduction and electricity demand by the battery charging systems on the electric grid, under the New Policy Scenario (NPS) and determined EV30 scenarios are shown in Table.5. By 2025, heavy duty electric trucks >15t that are announced for commercialization are expected to have a range of ~800 km [12].

Tab.5. Global forecast of light duty EV by 2030 [12]

Scenario	NPS	EV30
Sales	23 million	43 million
Stock	130 million	250 million
Fuel saving in 2030	2.5 MB/day	4.3 MB/day
Electricity demand	640 TWh	1110 TWh
Emission reduction	170 MTCO ₂ eq	240 MTCO ₂ eq

According to the World Health Organization (WHO), India is the home to 14 out of the 20 most polluted cities. Efforts to reduce the concentration levels pollutant to a safe level through the adoption of the EV has been initiated. The EV policies of India such as National Electric Mobility Mission Plan (NEMMP) 2020, Faster Adoption and Manufacturing of Hybrid & Electric Vehicles (FAME) and the National E-Mobility Programme targets 30% penetration of EV by 2030. The targets are defined considering the planned economic development, energy resource endowments, technological capabilities and political prioritization of responses to the climate change [13]. The forecast of the EV penetration in India and the battery capacity requirements in different modes of mobility are shown in Table.6.

Tab.6. Forecast of electric mobility in India by 2030 [13]

Mode	Number of vehicles	Average Capacity/Vehicle	Total (GWh)
2 wheeler	200 million	1.8 kWh	360
4 wheeler	40 million	15 kWh	600
Bus	3 million	212 kWh	630
Total			1590

The key challenges for India in quick transition to electric mobility are the higher vehicle cost, lack of battery technology know-how, higher battery import cost, less local availability of the battery materials and the possible implication on the battery charging infrastructure in the electric grid. The establishment of charging infrastructure requires due attention for the existing conditions in India , which is evident from the global experiences, where 33% of all EV sales take place in only 14 cities where charging infrastructure are established. Accelerating the availability of necessary infrastructure for battery manufacturing and charging is reported to bring down the costs of ownership of the EV to be on par with ICE by 2025.

Strategic trends in lithium battery manufacturing

According to the global data on battery manufacturing, the raw materials, cell manufacturing and battery packaging contribute 40, 30 and 30%, respectively. In the electric mobility sector, as per the NPS, based on the most probable cell chemistry portfolio of 10% NCA, 40% NMC 622 and 50% 811, the global requirements of Cobalt, Lithium, Manganese and Nickel upto 2030 are estimated to be ~170, 155, 105 and 850 kt/year [14]. At present, the global nickel supply is ~2000 kt/year and is mainly used for high-grade steel production. Batteries forms a small fraction of the total demand mix. During 2018, ~ 6% the total demand of cobalt and 9% of the total demand of lithium has been reported from m the EV industry. The spot prices of the cobalt and lithium increased by 2.5 and 4 times since 4 years, which is mainly due to speculative stockpiling and strategic sourcing [14]. Lithium is called the “white petroleum” because of the growing economic importance. Moreover, lithium and cobalt resources are concentrated only in a few countries (Fig.5).

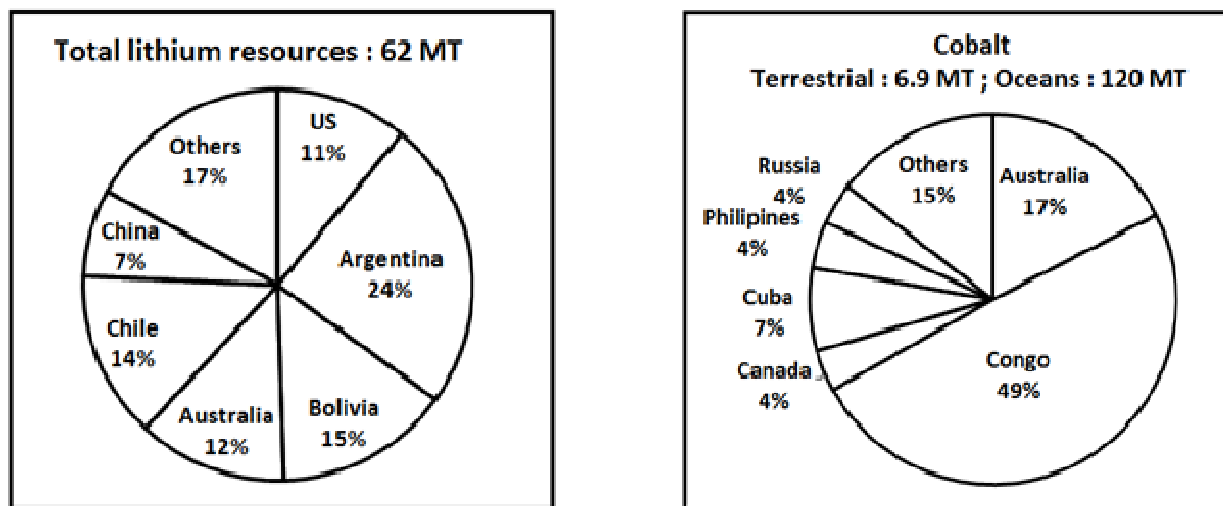


Fig.5. Global distribution of Li and Co resources [15]

Based on the lithium requirements of ~0.2 kg/kWh, till 2030, ~330 kilotons of lithium shall be required to realize 1650GWh of energy storage capacity. The existing battery factories have production capacities of up to 8 GWh/year, whereas factories announced to come online after 2025 are expected to have capacities of up to 35 GWh/year. The lithium battery technologies and manufacturing for the electricity and mobility applications target global investments up to US\$ 125 billion, which includes establishment of 30 Giga factories for realizing cumulative battery capacities of 3.5 TWh by 2030 [16].

A feasibility study made for the Government of India indicate that for a Li-Ion battery production plant of 5 GWh/year capacity established in India with 66% of the battery cost towards raw materials, the battery production cost shall be US\$ 148/kWh. The production facility requires an investment of US\$ 5 billion and an establishment time of ~ 3 years. The battery production cost is reported to be as low as up to US\$ 84 for a manufacturing capacity of 200GWh/year, indicating the economies of scale [17].

The spent lithium batteries, when left untreated in the ecosystem leads to health and environmental hazards. Moreover, the environmental and economic benefits of the li-Ion cell recycling are significant. According to global reports, recycled lithium and cobalt will reach 9 and 20 % of total lithium and cobalt used in the batteries supplied in 2025[17]. In India, li-ion battery recycling market is estimated to be ~US\$ 1 billion by 2030 [18]. Efforts are underway to streamline and automate the recycling process, in which companies recycling lithium-ion batteries are to be tied up to work with the battery makers to adopt easily dismantled product designs, and uptake the recently developed recovery processes of all valued battery components.

Conclusion

Indications from the recent assessments on the battery technologies suggest that lithium-ion batteries are the preferred choice in the energy storage applications during the forthcoming decade. Ensuring conducive policies for the increased deployment of energy storage in the power sector and electric mobility by means of domestic manufacturing and innovation, incentives for bridging the price gap between conventional and electric vehicles, deployment of charging stations, standardisation, maximizing the economic value of the lithium batteries by recycling for environmental sustainability are essential for achieving India's ambitious climate goals. At the same time, a smooth transition with minimal impact on the present legacy internal combustion based supply chain is required from the economic and employability perspectives. The announced investment in large-scale battery manufacturing facilities confirms further reduction in the cost of the batteries. Surveying for lithium resources within India, and at the same time making strategic investments in the international mines are essential.

Acknowledgements

The authors gratefully acknowledge the support extended by the Ministry of Earth Sciences, Government of India for supporting this study.

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About the authors



Dr. N. Vedachalam is Scientist-F at the National Institute of Technology (NIOT), Ministry of Earth Sciences, Chennai, India. His 25 years of experience covers industrial power, process, offshore, and subsea domains. The technical exposure includes development of multi-megawatt power electronic converters, control systems, and energy storage for the long step out deep-water enhanced hydrocarbon recovery systems; ocean renewable energy systems including ocean thermal energy conversion (OTEC), wave energy systems and subsea grids for tidal energy farms; subsea intervention systems including deep-water work class remotely operated vehicles; and industrial power generation, utilization and boiler control systems. He was the Secretary of IEEE Ocean Engineering Society- India Chapter, Executive Member of Marine Technology Society- India Section and Senior Member- Bureau of Indian Standards. He has about 70 publications in science citation indexed journals, holds one international and two national patents in the areas of subsea robotics and process. He received National meritorious invention award in 2019 for the development and usage of underwater vehicle for shallow water biodiversity studies.



Dr. G. A. Ramadass is a Scientist-G in National Institute of Technology (NIOT), Chennai. His research areas include Deep Sea Technology, Underwater Acoustics and Marine Instruments. At NIOT he is the head of the Deep Sea Technology Group. In 2010 he won the National Geoscience award under the Exploration of Oil and Natural Gas category and National meritorious invention Award – 2019 by Government of India for the development and usage of underwater vehicle for deep sea mineral exploration and shallow water biodiversity studies. He led NIOT team during the 34th Indian Scientific Expedition to Antarctica in February- March 2015. Polar Remotely Operated Vehicle (PROVe), developed indigenously at NIOT, was used for exploration in the lake and shelf area of Antarctica during this expedition. A doctorate from Indian Institute of Technology, Madras he handled technology development programmes leading to products and patents. He has been the Chief Scientist of 15 cruises and scientific explorations on-board various research vessels His recent work includes publications in the international journals, international conferences and four international patents.



Dr. M.A. Atmanand, currently the Director of National Institute of Ocean Technology has done pioneering work in the area of deep sea technologies in India. He took his undergraduate degree in Instrumentation & Control from University of Calicut, Master's and doctorate degrees from Indian Institute of Technology, Madras. He led a team of engineers for the design and development of underwater crawler for deep sea operation which was tested at a depth of 5200 m and India's first Remotely Operable Vehicle which was later tested at a depth of 5289m water depth. He has also guided various indigenization programmes for Ocean observation and under water systems. He has published about 100 papers including International Journals, International conferences, National Conference and authored multiple book chapters. He received IEEE Oceanic Engineering presidential award in 2016, National Geoscience award 2010 from Ministry of Mines and the International Society for Offshore and Polar Engineers (ISOPE) Ocean Mining Symposium award in the year 2009. He is an Associate Editor of IEEE Journal of Oceanic Engineering. He is the founder Chair of IEEE Oceanic Engineering Society in India. He has served IEEE Madras Section in various capacities.

Best slogans for energy conservation

Save Today. Survive Tomorrow
Today's wastage is tomorrow's shortage.
Energy can't be created but it can be destroyed. Save it!
Spare a Watt; Save a Lot
Switch off to keep INDIA switched on
Energy conserved is energy produced.
Don't make your child ask... "What was oil?"... Conserve today!0
More energy conserved, more the planet life is reserved.
Energy misused cannot be excused.

Norbert Wiener and his Impact on India

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"As in the case of my earlier experiences in China and Mexico, so in my Indian trip my motive was more than restlessness or idle curiosity. More and more Indian authors are publishing in our scientific journals, and we need the Orient more and more to supplement a West which is showing the intellectual and moral enfeeblement following two World Wars." - **Norbert Wiener, "I Am a Mathematician", MIT Press, Pp339, 15 August 1964**

Professor Prasanta Chandra Mahalanobis, the father of the statistical movement in India, founded [1931] the Indian Statistical Institute [ISI], initially at the Presidency College, Calcutta, to carry on research in the theory and applications of statistics in India. The ISI was the first institute of its kind anywhere in the world devoted mainly to the study of statistics. For seven months from late 1955, Norbert Wiener worked at the Indian Statistical Institute [ISI] at the invitation of Prasanta Chandra Mahalanobis. Prasanta Chandra Mahalanobis visualised statistics as a technology applicable in diverse fields of the natural and social sciences and believed that statistics could grow well only in an environment where active quantitative research in its various domains of application went on side by side with research in statistical theory and methodology.

During Norbert Wiener's visit to ISI, Gopinath Kallianpur received training from him in the field of prediction theory for which he expresses his "profound scientific debt" to Wiener. Wiener managed to secure a two-year leave for Kallianpur from ISI to facilitate a long-term collaboration between them in the area of nonlinear prediction theory. However, this project did not materialize as Kallianpur suffered a prolonged illness soon after reaching the US. Nevertheless, he notes that, even though his work on nonlinear filtering theory (for which he is well known) began as a collaboration with C. Striebel at the University of Minnesota, motivation for it came from Wiener. Kallianpur later returned to ISI to become its first Director in 1976 under its new Memorandum of Association. It was due to his efforts that the Bengaluru campus of the Institute was established.

In 1990, P.R. Masani wrote a biography of Norbert Wiener. This biography not only depicts Wiener the mathematician, but also describes his personality to some extent, detailing his interests in many other fields such as cybernetics, economics and also the philosophy of religion. Cybernetics, an interscientific discipline concerned with "communication and control in the animal and the machine" (as defined by Wiener) interested Masani, and he published papers in this area. Both Wiener and Masani had a much broader perspective on cybernetics which even included the philosophy of scientific methodology, rather than the narrow approach of machine learning which many take it to be

Both Gopinath Kallianpur and P.R Masani are ranked in the top five statisticians in India.

Norbert Wiener lectured in India for seven weeks in 1953 at:

- Atomic Energy Institute, Bombay
- Indian Academy of Sciences, Ahmedabad
- National Chemical Laboratory, Pune
- All India Science Congress, Hyderabad
- Indian Academy of Sciences, Bangalore
- Tata Institute of Fundamental Research, Bombay
- Indian Statistical Institute, Calcutta
- National Physical Laboratory, Delhi

The 21st Century Norbert Wiener Conference with the theme: "Being Human in a Global Village" is the third in a series of conferences initiated by the IEEE Society on Social Implications of Technology (SSIT), following events in Boston (2014) and Melbourne (2016). The 2020 event invites us to consider how we – as policy makers, parents, citizens, business owners, researchers, humans – need to be proactively preparing for a new world in light of the challenges coming our way

in the form of artificial intelligence, or machine learning. For instance, young people need to be flexible and adaptable as the workplace in 20 years' time will be very different from today.

This conference will have three general themes:

- The state of technologies initiated by Wiener.
- The social impact of those technologies.
- Wiener's 1950s engagement and travels in India.

Since 2010, the Computer Society of India [CSI], the IEEE India Council and other sister Institutions have been organizing India events to support the series of conference on Norbert Wiener by the IEEE SSIT. We are thankful to Devi Ahilya Viswavidyalaya, Indore, Indian Statistical Institute, Kolkata, Indian Institute of Information Technology, Allahabad, CR Rao Advanced Institute of Mathematics, Statistics and Computer Science, Hyderabad, Indian Institute of Science, Bengaluru, Central University of Rajasthan, Kishengarh, Rajasthan and Indian Institute of Technology, Mumbai.

Anna University has been taking the lead in all the events in this series through forstoring research in the area of "Cyber Physical Systems". We thank the Board of Governors of IEEE SSIT for fully sponsoring the 3rd 21st Century Norbert Wiener Conference scheduled at the CEG Campus, Anna University between 23 – 26 July 2020. This conference is a part of the 225 years celebrations of the CEG Campus of Anna University. Please visit the Conference Website at <http://21stcenturywiener.org/>

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"Progress imposes not only new possibilities for the future but new restrictions"

- Norbert Wiener, *The Human Use of Human Beings: Cybernetics And Society*, Houghton Mifflin, USA, 1950

Use of IOT in Container and Shipping Industry and its impact on Global Trade

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As per the United Nation's report titled " World Population to 2300 " over 8 billion people will inhabit the earth by 2030. That's more than a billion more in 2010 and 95% of this increased population will be born in developing and emerging markets . According to a PWC report titled " The World in 2050 " only 23% of the world's population will live in Europe, North America and Australia. Thus, the Global economy is being reshaped , and so is the distribution of wealth and Global trade in goods and services is also likely to rise more than threefold to US \$27 trillion by 2030. Trade is also going through some volatile conditions. Consumers are increasingly adopting an anything, anytime, anywhere expectation, while products to be shipped are becoming more sophisticated and diverse. At the same time workforce shortage and regulations impose pressure and obligations. To cope with these conflicting demands logistics and supply chain needs to become more efficient, automated and analytics driven.

The world trading systems has always been shaped by technological progress. As per the World Trade Report 2018 International trade costs declined between 1996 and 2014. The report predicts that trade could grow by nearly 1.5 to 2% more until 2030 as a result of the falling trade costs. Leveraging Disruptive digital technologies like AI, IOT, 3D Printing and Blockchain will help to further reduce trade costs. Not only is technology a determinant of trade costs , but it also defines what kind of products can be traded across international borders. New digital technologies leverage the Internet to process and analyse data . Computer systems , automation and data analytics are coming together in an entirely new way that is transforming the global economy and global commerce. One of the significant effects of digital technologies is the extent to which they reduce trade costs , such as transport and logistics costs , the costs of crossing borders ,information and transaction costs and costs of cross border payments. As per the World Trade Report 2018 , Transport and Logistics costs combined account for more than half of the variation in trade costs in agriculture and manufacturing, and for more than 40% of the variation in trade costs in services . The Application of AI, IOT and Blockchain to reduce transport and logistics costs are likely to have the largest effects on overall trade costs.

Intelligent Shipping Containers

As the logistics and transport sectors join the Industry 4.0 revolution , shipping containers leveraging the power of IOT technology are set to play a very big role in ensuring new levels of efficiency, safety and transparency. Building intelligence into shipping containers (both refrigerated and dry) will create new opportunities for container manufacturers and expand their offerings to the end customers. By integrating reliable and secure Global connectivity and traceability with the sensors and tracking devices within containers , they are able to provide an improved customer experience. On an average , shipping containers have utilization rates of only 20% because companies often ship merchandise to many locations. Tracking each container using IOT technologies could improve container utilization by 10 to 25% and reduce annual spending on containers by nearly \$13 Billion by 2025 as per a report by Lund and Maynika of Mckinsey released in Jan 2016.

Shipping containers are the most widely utilized transport method in the world as they are responsible for more than 80% of global transportation of trade goods . There are an estimated 30 to 32 million containers travelling around the globe today and approximately three million containers are produced and deployed each year. As more and more of these containers traverse the high seas, it becomes increasingly complex to keep track of individual containers and the condition of assets inside them. There is the added pressure on manufacturers and retailers to improve their margins through better supply chain visibility through better stock control and prevention of losses.

For eg, the Pharma industry which is highly regulated need to ensure that the high value pharmaceuticals which are very temperature and humidity sensitive are being safely transported in cold chains .

Today , using the power of Internet of Things (IoT) technology, Shipping liners are in a position to track and monitor the condition of refrigerated containers with perishable goods. In the past , onsite supply chain managers would spend time manually checking the condition of each container. The shipping lines now can obtain near-real time visibility into the conditions of each refrigerated container at almost any part of its journey during the supply chain. Their shipping supervisors can monitor mechanical performance to help ensure the equipment is in proper working condition. IOT technology can help them to improve the level of services they provide and also ensure they are optimized and arrive in the proper condition – no matter the length of the journey.. This can help companies better manage their delivery process and offer service their customers can depend on. Shipping liners can keep its customers informed about the location and condition of each shipment, helping them operate more efficiently and giving them peace of mind about their cargo.

To track these containers, container devices can be architected and designed with a 2G/3G/4G High Temperature and heat tolerant SIM card, a GPS unit, any short range wireless solution like a ZigBee radio and antenna, and multiple interfaces for connecting into the refrigerated container's controller. The Container device can operate with two-way connectivity from just about anywhere in the world. Once the containers are traversing the high seas and lose cellular connectivity, the container device can connect via a Satellite network to ensure continuous connectivity throughout its journey. The solution can reduce labor costs, decrease loss, prevent thefts, help in risk management and mitigation and also help in Audit efficiency



Automation reduces cost and enhances container visibility across the entire supply chain. Enterprises and their end customers can now centrally track their intermodal containers, trailers and other unpowered industrial assets as they are transported globally, from the production location to the final destination. IOT devices attached to these containers are sensor rich with high precision GPS engine using a solar panel for charging and IP67 rated.

Digital and Connected Ships

Having addressed the importance of the need to leverage IOT technology to track Shipping containers, I would also like to stress the importance of leveraging the power of IOT and AI to monitor and manage the Shipping vessels which carry these containers. The next generation of ships will be electric, digital and connected that maximize the full potential of vessels and enables safer, more efficient and sustainable ship operations. There is the increasing need to connect the ship's crew with their technical and nautical departments. Within a shipping vessel there is the constant need to monitor energy production and consumption, improve vessel motion forecasting in changing weather and loading conditions, decision-making support while operating in different weather conditions, optimize mapping energy flows, measure fuel consumption, measure energy and power savings of products such as drives and motors and send the data to a Cloud platform. By using IOT and AI, it would result in increased availability, safety and efficiency for all types of vessel operations, ensure environmental compliance and recommend actions to optimize vessel performance throughout vessel operations or voyage.

Remote diagnostics of equipment like propulsion systems, electrical systems like generators, Switchboards, Power transformers, drives for marine applications, high voltage marine motors and turbo chargers inside shipping vessels is extremely important. Preventive & predictive continuous monitoring and combining online with manual monitoring is necessary. Prediction and remote services are taken to the next level by adding predictive analytics algorithms and cloud technologies. It is important to be able predict failure by delivering predictive analytics algorithms which are implemented both onboard the vessel and in the Cloud. With ever developing cloud technologies it is possible to provide highly advanced and embedded analytics on the collected data, whether it is at the equipment, system or fleet level. This can go a long way in reducing maintenance cost by continuously monitoring equipment health status, reduction of production stops due to machinery failures and to optimize planned maintenance activities according to operational requirements, reduction of labor costs by automating data collection and enabling operators to focus on understanding the data and system status and reducing the need for the service engineer to be onboard.

Condition based maintenance of equipment inside a shipping vessel that would help in prediction of equipment failure modes and risks related to potential failures is possible by attaching the relevant sensors to the equipment and using reliable and secure connectivity to send the sensor data to an IOT platform that is cloud hosted. This would provide the relevant advice as to when to perform maintenance actions based on actual equipment condition and performance monitoring, advice whether maintenance and repair can be delayed to a later point. The benefits are Increased equipment reliability, Reduced maintenance cost as not all maintenance tasks are performed according to time-schedule and Increased availability of vessel as maintenance is done when operations allow for maintenance without disturbing business critical operations

Future trends

The rapid adoption of digital technology by tech savvy consumers can significantly impact shipping assumptions. The growth of the shipping industry is largely dependent on the GDP growth trends of countries, however there are other factors like increased urbanization, environmental factors like higher levels of pollution, climate change and most importantly the disruption of the logistics industry with disruptive technologies like AI, IOT etc. that has been having a huge impact on the economics of transportation of goods from one place to another.

Higher urbanization impact shipping routes; electric vehicles can have an effect on the shift to marine e-mobility; and, as the driverless automobile becomes a reality in the future, parallels with automation within the ships can be easily drawn. Car OEMs are increasing their R&D investment in making electric cars, whose design and manufacturing is far more simpler with fewer moving components, ease of control and updating and lower level of losses in energy conversions when compared to the conventional ICE engines.

Marine Electric- mobility

The imperative today is to optimize the usage of battery power and achieve higher levels of automation and autonomy. However the real value can be derived when it results in improved operational efficiency or enhanced safety, or both. The debate around autonomous ships and navigation has been going around for sometime. However most of these deliberations have not considered the fact that the drive and power trains of the ships also need to evolve over time to accommodate the needs of an increasingly automated shipping business. Ships need to be able to self-heal and be able to continue to sustain its operation when faults are identified. With Electric systems, the ability to diagnose and do a reconfiguration securely can be done remotely. Increased levels of automation may be required where ships are operating on shorter distances close to shore and along routes that are repetitive, but that does not necessarily mean that these ships are not manned. Instead, a fully electric propulsion system, featuring batteries that can use the power at the shore side for recharging would definitely result in the need for continuous maintenance (for eg filter changes), which could be remotely supported by an over the air update or by ad-hoc visits by the service crew. The displacement of crews inside ships is not imminent as you would still need the crew for maintenance of machinery, day to day administration, communication calls etc. While navigation safety is extremely important, in the context of a fully digital technology enabled connected ship the focus should be on how Electric propulsion can automate certain aspects of the functionality of ships that will lower operating costs, improve safety and has no negative environmental impact.

Electric platform for Connected and intelligent ships

We are already seeing the increased use of IOT sensors connected to the various subsystems within a shipping vessel, and are generating a lot of data to help optimize operations within a vessel and help achieve just-in-time delivery with much lower energy consumption. The use of powerful Cloud-based analytics tools and AI and Machine Learning algorithms to help in preventive maintenance, predict equipment failures and more importantly rectify remote equipment problems exists today. With IOT sensor deployment costs coming down significantly, it is anticipated that use of Robotics and 3D printing for lifecycle management will enable automatic and autonomous service operations in the not so distant future.

Technologies like LIDAR (Light Detection and Ranging), Computer Vision, and powerful positioning data captured by high resolution satellite imagery can help in accurate navigation and thus providing a very precise 360 degree view of the shipping vessel in a real world scenario similar to the Advanced Parking assistance systems we see today. This ensures the elimination of blind spots and prevent accidents that can cause significant damage.

In the near to immediate term, the use of these disruptive technologies will help the crew in achieving faster turnarounds within a port and also allow for lower speeds to the next destination that will improve fuel efficiency, help in faster regulatory compliance and improve business impacting ship functions such as maneuvering and mooring. The use of these technologies will augment support crews in their role as guardians enabling to intervene whenever efficiency, safety or environmental responsibility is compromised.

Conclusion

In conclusion, I would like to state that the pressure to digitally optimize processes, using IoT solutions is coming from everywhere – Politics, Press, Shareholders, Customers and Suppliers. The key differentiator in a highly competitive market is improved customer experience and hence getting the right product to the right customer at the right time, right place and right condition in the right quantity and at the right cost (*the famous 7Rs of logistics*) is absolutely imperative. The Shipping and Container Manufacturing companies have to come to the realization that using IOT technology is a strategic necessity for their very survival and growth.

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About the author



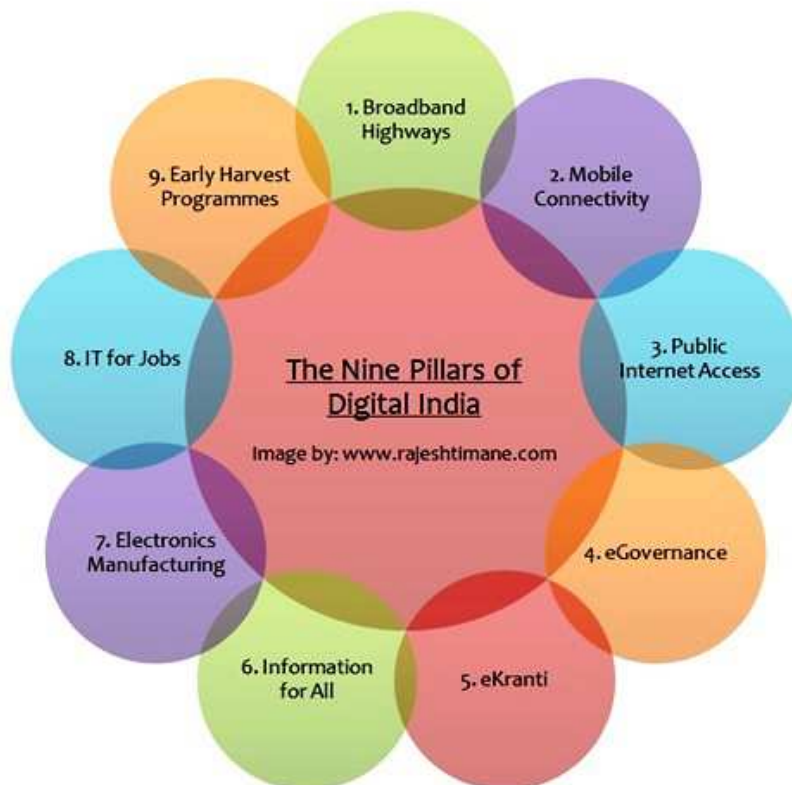
Sunil David has 26 years of experience in the IT and Telecom industry and is currently the Regional Director (IOT) for AT&T India , and is based in Chennai. He is responsible for building the IOT strategy for the India and the ASEAN regions.

Sunil was recognized by the World Marketing Congress in Nov 2017 as one of the 50 Most Influential Digital Marketing Leaders across India . Sunil has spoken at more than 50 Industry forums in India and abroad organized by leading industry bodies like COAI, CII, IAMAI , Cyber Media, NASSCOM , ASSOCHAM ,Geospatial , IET , Singex , Konnect Worldwide etc) and Educational institutions including IIM Shillong, IIT Delhi , IIT Madras, SITM Pune , in the past 2 years on topics related to IOT , AI , Cyber Security , Digital Transformation etc . Sunil has also written articles related to Digital Transformation , Disruptive Technologies, 5G, IOT Security for leading B2B publications from ADI Media and CIO Review that has a wide circulation among the CIO community in India.

Apart from his responsibilities with AT&T , Sunil is also a Honorary member of the FICCI TN Tech Panel and CII TN CTO Forum working on initiatives to drive Digital Technology adoption within the Industry . unil is also in the Advisory board and an Investor in a Start up based in Chennai that is focused on Skills development and Cyber security training and consulting. He is also part of the NASSCOM Diversity and Inclusion (D&I)Council, TN chapter.

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The Nine Pillars of Digital India



Deep Learning meets Coding Theory

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Introduction

The success of modern information age hinges on reliable digital communication and the central issue thereof is the design of codes that allow transmissions to be efficiently and robustly decoded under noisy conditions. This is the discipline of coding theory whose inception can be traced back to the birth of information theory [1]. Since then, for the past 70 years or so, much effort is galvanized in the scientific community to design near optimal codes such as turbo codes [2], low-density parity check codes (LDPC) [3], polar codes [4] on AWGN Channels.

The following have remained as the long term goals in coding theory:

Goal A : to design **better decoders** for the existing codes which are **robust and adaptive** to varying channel conditions,

(Robustness implies the following: when the system is trained for AWGN channel, the test performance with no re-training on a different channel (such as ATN and Radar) should not degrade much. Adaptivity allows the system to learn a decoding algorithm on a different channel by retraining from enough data even in absence of a clean mathematical model for that channel.)

Goal B : to design **new codes** with emphasis on **robustness, adaptivity** and other features such as **low latency**,

Goal C : to design **new codes for multi-terminal settings** as well as other scenarios such as the feedback channel, the relay channel and the interference channel.

However, history has witnessed quite slow progress with respect to realizing these long term goals. This is because the two-step traditional process of communication algorithm design, which is (a) begin with clean mathematical analysis, and follow it by (b) stacked heuristics on top of the optimal algorithms, has remained largely sub-optimal insofar as the guarantees of optimality do not extend to cover the various practicalities not included in the first step. However, this two-step method still has been successful in the point-to-point setting. For the next generation communication system design which involves wireless systems such as autonomous mesh networks, industrial IoT, ultra-dense networks - that pose many challenges such as interference management, non-stationarity of channels, non-AWGN noise, interactions with other technologies - these principles of traditional design break down. This is due to (a) *algorithm deficit* - the gap between the optimal algorithms on this simplified model and the known computationally efficient algorithms on this model, and (b) *model deficit* - the gap between the realistic model and the simplified model.

Areas of computer vision [5] and natural language processing [6] amongst others, have witnessed a hockey-stick growth with the advent of deep learning, which promises learning complicated non-linear algorithms from observational data. For channel coding problems, there is unlimited training data available, so can *deep learning* aid in accelerating the rate of discovery here in realizing the goals above?

This short paper is a survey of some key results in this direction where the authors of this article were involved. In what follows, each section highlights a contribution in realizing the above goals. It finally concludes with a discussion about the exciting road ahead.

MIND : Model Independent Neural Decoder [8]

Deep learning based decoders outperforming the standard Viterbi decoder were proposed in [7] for convolutional and turbo codes. The main design principle was to train Recurrent Neural Networks (RNN) for a given AWGN channel for they closely mimic the structure of convolutional and turbo codes. These neural decoders show robustness and adaptivity properties. However, compared to the traditional decoding methods, neural decoders exhibit huge data requirements for training as well as large computational complexity to adapt to the new channel.

To add robustness and adaptivity properties to neural decoding along with the desired property of minimal training, we proposed Model Independent Neural Decoder (MIND) which builds on the top of neural decoders [7] and equips them with a fast adaptation capability to varying channels. This feature is achieved via the methodology of Model-Agnostic Meta-Learning (MAML) (for details cf. [9]). In nutshell, here the decoder: (a) first, learns a ‘good’ parameter initialization in the meta-training stage where the model is exposed to a set of archetypal channels and (b) updates the parameter with respect to the observed channel in the meta-testing phase using minimal adaptation data and pilot bits.

MIND admits fast adaptation with few shot adaptation data utilizing the gradient-based training. Compared to the adaptive neural decoders which require large amounts of gradient training steps and data to adapt to new channel settings, MIND can adapt to a new channel with small amount of pilot bits and few gradient descent steps (cf. Figure 1 [8]).

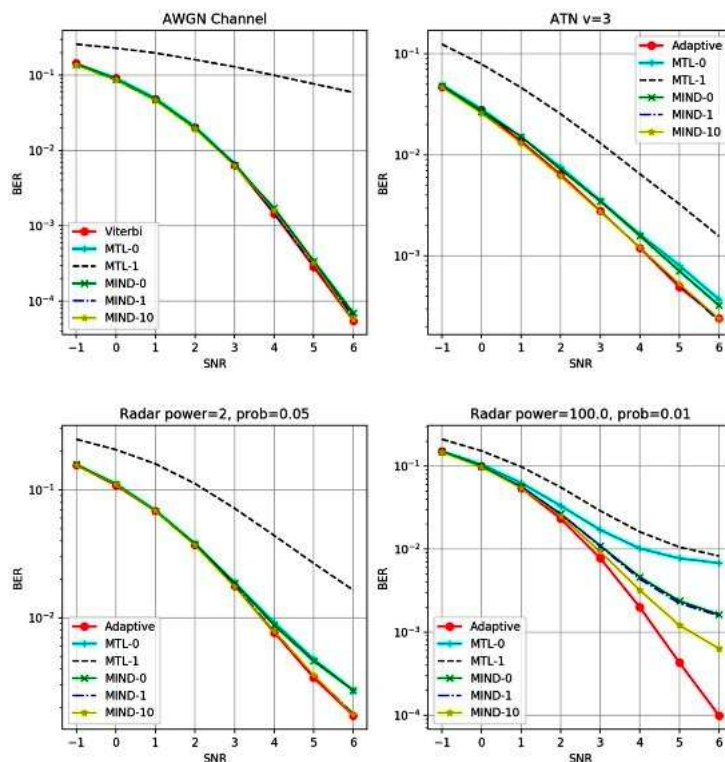


Figure 1 : Compares MIND’s performance with only few gradient steps with other state of the art Neural Decoders trained on different channels. The decoders compared are (a) Canonical Viterbi decoder, (b) Adaptive Neural Decoder on non-AWGN Channel with infinite data, (c) MTL-K or multi-task learning based decoder with K-step gradient descent and finally (d) our proposed MIND-K with K gradient update steps.

LEARN : Low-latency Efficient Adaptive Robust Neural Codes [10]

Figure 2 shows the structure of a Channel Autoencoder (ChannelAE), which combines a stochastic channel with the standard Autoencoder architecture. This naturally fits into the standard communication channel and coding theory paradigm. However, so far developments have been sparse to harness this structure with deep learning training techniques to get unique and new codes for communication systems (jointly trained encoder and decoder). We handled this question in part by jointly training ChannelAE in low-latency regime (short blocklengths) to outperform the state of the art tail-biting convolutional codes in this regime [11].

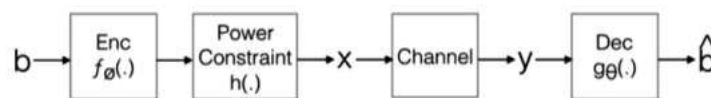


Figure 2 : Channel Autoencoder

The designed Low-latency Efficient Adaptive Robust Neural (LEARN) code applies learnable RNN structures (cf. Figure 3) for both the encoder and the decoder with an additional low-latency constraint. To the best of our knowledge, this is the first work that achieves an end-to-end design for a neural code achieving state-of-the-art performance under low latency scheme (cf. Figure 4 [10]).

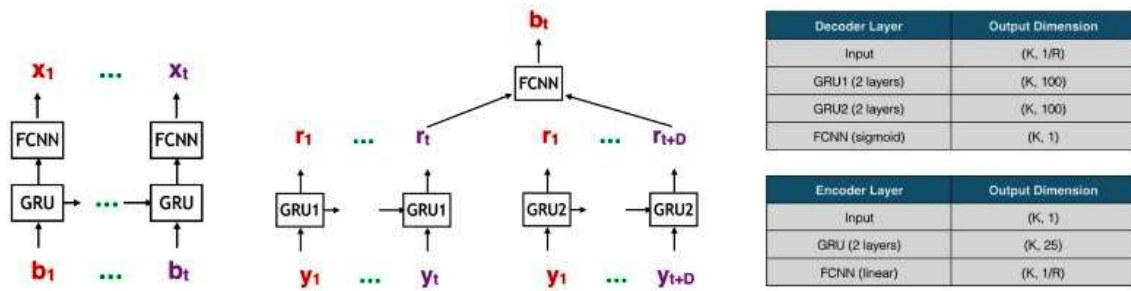


Figure 3 : LEARN encoder (left), LEARN Decoder (middle) and Network features (right)

However this is possible only with an improvised training methodology as has been stated in [10]:

- Train with a large batch size.
- Use Binary Cross-entropy (BCE) loss.
- Train encoder and decoder separately. Train encoder once, and then train decoder 5 times.
- Add minimum distance regularizer on encoder.
- Use Adam optimizer.
- Add more capacity (parameters) to the decoder than the encoder.

Furthermore, when the channel conditions are varying, LEARN codes show robustness (ability to work well under unseen channel) as well as adaptivity (adapt to new channel with enough training symbols), showing an order of magnitude improvement in reliability over canonical codes (cf. Figure 5 [10]).

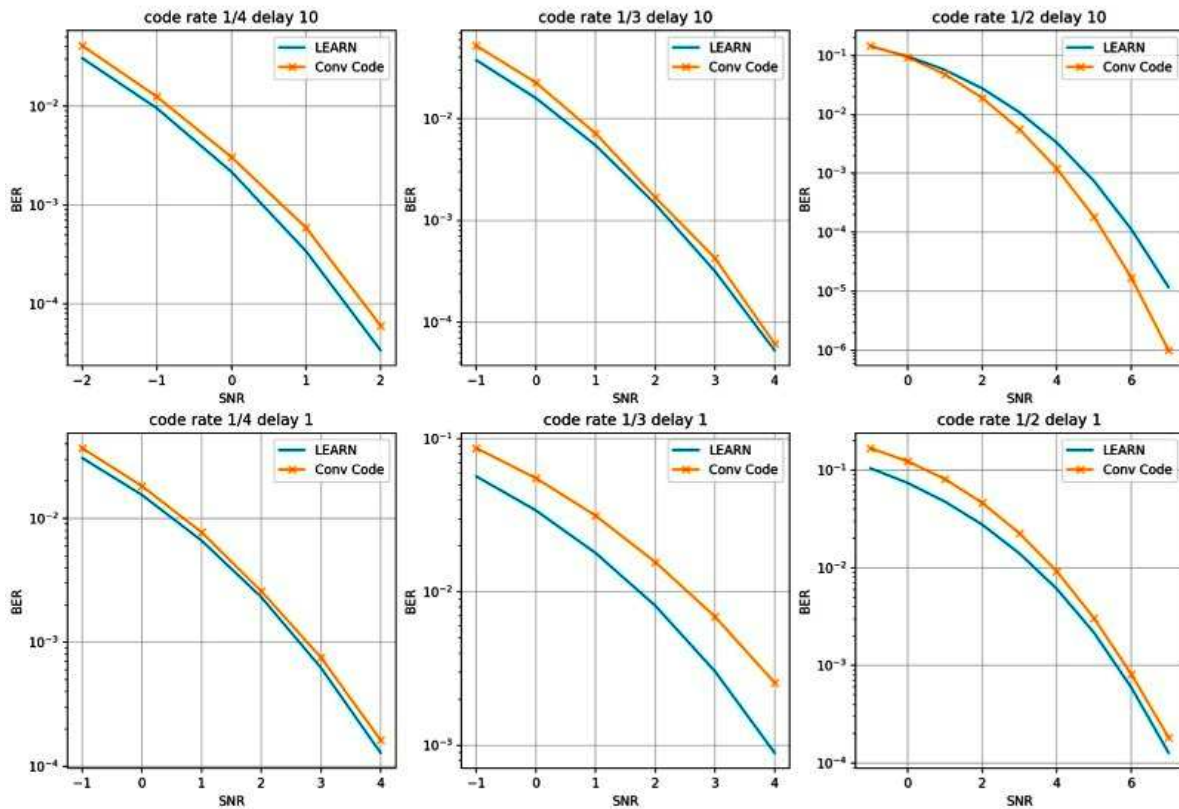


Figure 4 : Comparing BER for LEARN Code and the State of the Art Low-latency Convolutional Code under AWGN Channel for different rates.

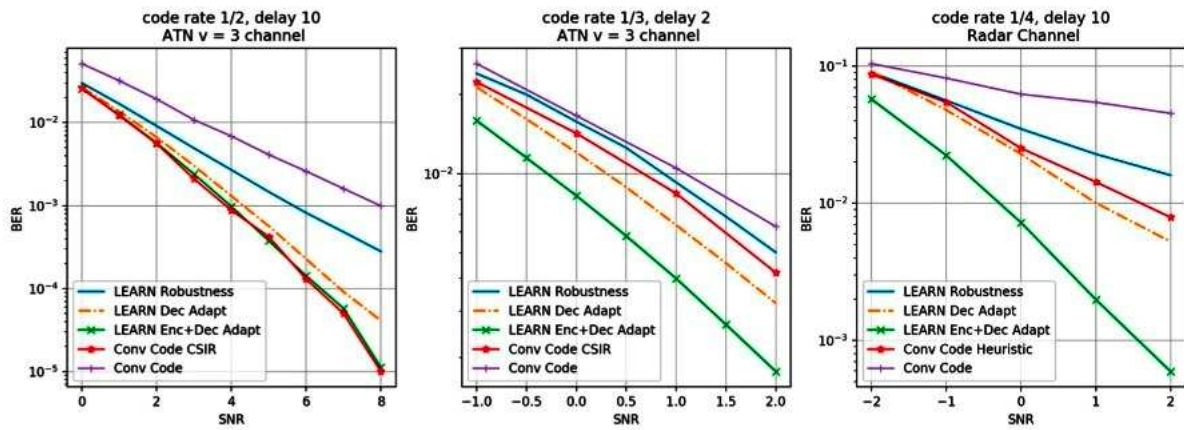


Figure 5 : LEARN exhibits robustness and adaptivity. Here LEARN Codes with either robustness or with encoder and/or decoder adaptivity are compared with convolution codes with and without CSIR (channel state information at the receiver)

TurboAE : Turbo Auto Encoder [12]

We want to relax the low-latency assumption of the previous section and investigate if we can further achieve state of the art performance in moderate block length regime. In this direction, we design TurboAE, a neural network based over-complete autoencoder parameterized as Convolutional Neural Networks (CNN) along with interleavers (permutation) and deinterleavers (de-permutation) inspired by the *turbo principle* of the turbo codes [13]. Formally, interleaver and deinterleaver shuffle and shuffle back the input sequence with the a pseudo random interleaving array known to both encoder and decoder, respectively (cf. Figure 6, 7 [12]).

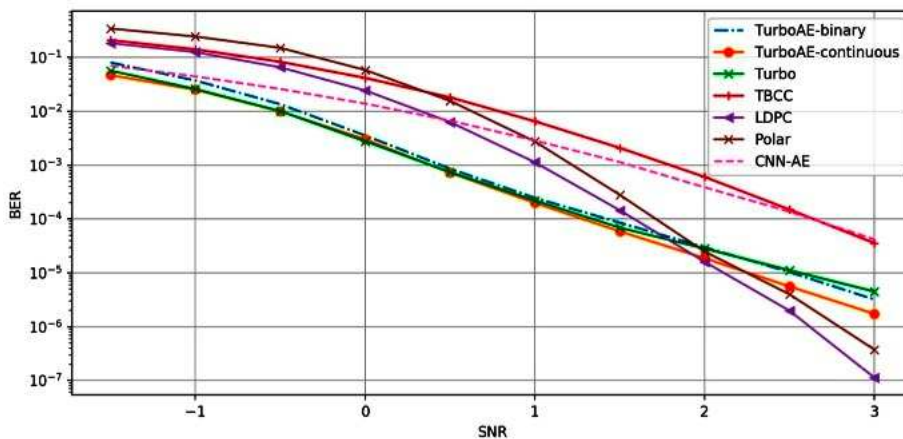


Figure 6 : Visualization of Interleaver and de-interleaver.

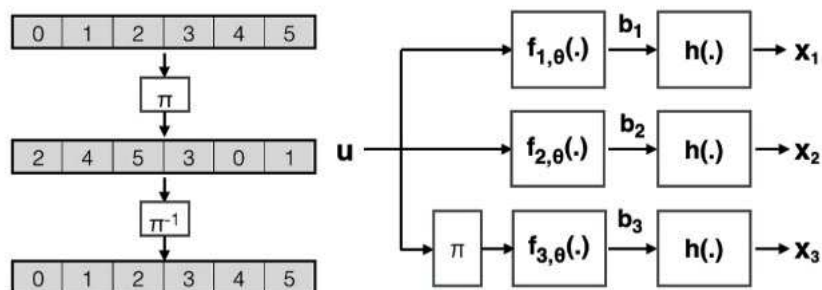


Figure 7 : TurboAE iterative decoder on code rate = 1/3

The benchmarks on block length 100 is shown in Figure 8 [12] with widely-used LDPC, Turbo, Polar, and Tail-biting Convolutional Code (TBCC), generated via Vienna 5G simulator [14] [15], with code rate 1/3 on AWGN Channel and Figure 9 [12] shows results on non-AWGN channel.

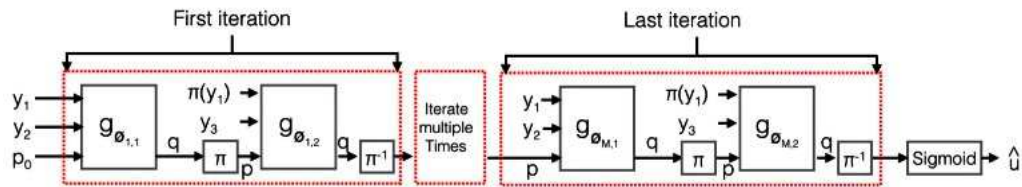


Figure 8 : Comparison of different codes with TurboAE. TurboAE-binary represents the case where encoder input is binarized as is the case with wireless communication systems.

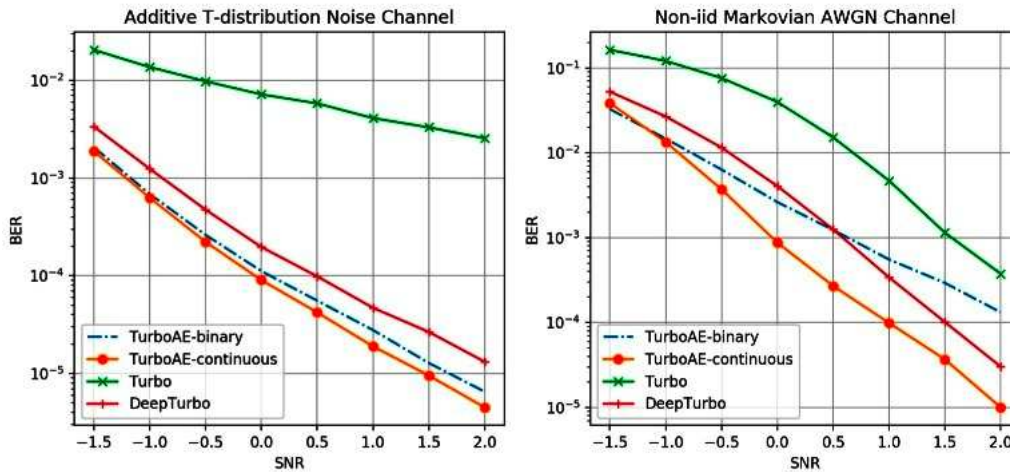


Figure 9 : TurboAE on iid ATN channel (left) and on-iid Markovian-AWGN channel (right)

Conclusion

In summary, we presented here a small buffet of the results as the current state of the art in applying *deep learning paradigm* to accelerate discovery of new codes and decoding algorithms in several scenarios of interest in wireless systems. These included adaptive decoders, new codes for low-latency, and state of the art codes for moderate block lengths. These codes also show robustness and adaptivity properties. All these bring interesting research directions to design channel coding algorithms via separate or joint encoder and decoder design.

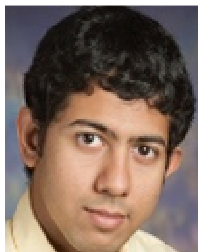
The terrain is vast open. Can we design the codes for multi-terminal settings where there is scarcity for good codes? Another interesting venue is to comment on the explainability and interpretability of these codes.

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He have spent two summers at Qualcomm Corporate Research and Development, San Diego, and another wonderful summer at Microsoft Research, New England, Cambridge, MA with Prof. Madhu Sudan. He has also been a visiting researcher for several months each at Stanford University, University of Southern California, Indian Institute of Science, Bangalore and Indian Institute of Technology, Kanpur.

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He received his Ph.D. in Electrical Engineering Department in 2014 from Stanford University, working under Professor Tsachy Weissman, where he was a Stanford Graduate Fellow. Following his graduate studies, he worked in Ericsson Silicon Valley as a System Architect for couple of years, focusing on designing next generation networks with emphasis on network redundancy elimination and load balancing. Driven by a deep desire to innovate and contribute in the education space, with the aid of technology, he quit his corporate sojourn and got involved for a while in his education startups (where he currently holds Founding Advisor role) to bring the promise of quality education in vernacular languages in underdeveloped and developing countries - places which do not have access to English, Internet and Electricity.

Moving on then, from industry and entrepreneurial world back to the academia, before joining TIFR, he worked as a Research Associate in Electrical and Computer Engineering Department at University of Washington, Seattle. In the past, he has also held visiting faculty appointments in the Electrical Engineering Department at Stanford University and Electrical Engineering Department at IIT Bombay. He was the recipient of Best Paper Award at MobiHoc 2009 and was also the finalist for Student Paper Award in ISIT 2011, Saint Petersburg, Russia. Prior to that, he received his B.Tech. from IIT Bombay in 2009 and M.S. from Stanford University in 2011, both in Electrical Engineering.

Rolls-Royce built a new tool called Quips, which uses AI and 'voice banking' to learn the unique way its user talks, essentially helping people with Lou Gehrig's disease or ALS (Amyotrophic Lateral Sclerosis). Rolls-Royce and its R² Data Labs created Quips with help from Motor Neurone Disease Association and companies including Intel and Microsoft. However, it's still early in developmen

Disrupting Primary Healthcare Industry with Artificial Intelligence, Computer Vision, and IoT Enabled Engine

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Healthcare industry is rapidly evolving and quality of healthcare has been improved significantly compared to the last century. However, the primary healthcare industry is still not evolved much. We are still relying on human judgement while identifying diseases. Many times, wrong diagnosis leads to loss of life [1].

Problem

As per the WHO report [1], wrong diagnosis can occur because of many factors such as the knowledge, experience and skill of primary care providers as well as the resources available to them. Not all primary care providers are trained and gained experienced on all the diseases. And often, the lack of knowledge may lead to misinterpretation of the symptoms of the patients. Wrong diagnosis also cause delay in the actual treatment or completely miss the opportunity to provide a proper care. All these problems lead to one common factor and that is human judgement. If we eliminate this factor, we will be able to identify the right disease and treat properly on time.

Another challenge is the lack of availability of medical facilities in many parts of the world and especially rural areas where not many doctors are willing to work. This problem is not much in the metropolitan cities, however the quality of service may not be equal. In a third world country like India, the problem is more stagnant since the majority of the nation's population belongs to the rural areas. People literally have to travel over 100 KMs to get good medical facilities. The available medical facilities are obsolete; there is often a shortage of medicine and medical professionals in such areas. Even the present medical professionals often need to handle thousands of patients every day. People living in the remotest part of the world are more affected as they never receive any proper medical facility. These people are often compelled to rely on primitive medical solutions and superstitions. Any epidemic virus means guaranteed death or mass extinction. People from these areas wouldn't even get enough time to get diagnosed in the first to start any kind of treatment.

Solution

Eliminating the human involvement is essential in reducing the wrong or missed diagnosis problem. This is only possible with the use of technology. Artificial Intelligence can play an important role in performing diagnosis at the primary healthcare level. Researchers have started thinking of using AI in medical diagnosis for decades [2] but yet the implementation at the primary level is not ubiquitously available in the market. Efforts are under way to diagnose various diseases using expert systems like coronary artery disease [3], breast cancer [4], etc. All these efforts can be combined and brought into an interface which can act as a primary healthcare portal which will be installed physically in various parts of the world. This will specially be useful in the rural part of the world which will help to save millions of lives.

The implementation

The implementation requires the following three parts to work together,

1. Machine learning and computer vision based application to perform analysis and give diagnosis
2. IoT powered user facing application to feed data to the machine learning and computer vision based application
3. Medical coordinator application (middleware) to work with hospitals, medical service providers, doctors, pharmaceutical companies, and related organizations as well as medical devices

Machine Learning and Computer Vision based Application

Artificial intelligence is making it possible to mimic human thinking abilities to do repetitive or complex tasks. AI-enabled programs can obtain information, use logical policies to analyze or process data. This helps the AI bots to recognize and fix mistakes. Machine learning is another important component of Artificial intelligence, it is a form of learning in which the machine can learn by itself without having the need of being programmed by humans. This is a long process, but in the end, the machine is smart enough to learn by itself. The system can be improved with experience. Machine learning and artificial intelligence are playing a major role in the healthcare sector. Instead of replacing the existing workforce, AI is making the medical experts work more efficiently. Both are helping medical equipment makers to develop better healthcare products and improve overall patient care.

Machine learning-enabled machines are more efficient, affordable, faster and able to manage larger workloads than humans are. The best thing about machine learning is that it keeps improving itself from experience. The day is not far away when

we will have absolutely no errors in the medical industry. Machine learning is seeing a gradual acceptance in the healthcare industry around the world. In fact, Google has also developed a machine-learning algorithm to discover cancerous tumors.

Machine learning is helping the healthcare industry by analyzing various data sets and advise outcomes, risk scores, resource allocation, and other applications.

Diagnosing diseases and ailments are one of the primary applications of machine learning in healthcare. This diagnosis includes diagnosing critical diseases like Cancer during its initial stages. It also assists humans in the early stages of the drug discovery process. With machine learning, we may find alternative ways for therapy of multifactorial diseases. It is also causing a major breakthrough in another technology called computer vision. Data sources from varied medical images will soon become part of this AI-driven process. The machine will be able to see and understand almost everything that we could.

Documentation and maintaining up-to-date health records by using vector machines and machine learning-based OCR are slowly coming into the mainstream. Google's Cloud Vision API as an example of machine-learning-based handwriting recognition technology is gaining great popularity in the healthcare industry. Machine learning is also proving to be a great boon in the field of clinical trials and long researches. Usually, it takes a lot of time and resources to conduct clinical trials. Utilizing machine learning with predictive analytics can significantly help the researchers to draw conclusions from a huge variety of data points. AI and ML are enabling us to ensure real-time monitoring of the trial participants, discovering the best sample size for testing. Scientists and researchers are also using AI and machine learning for monitoring and predicting epidemics around the world. A large amount of data is collected from satellites, social media, website information, etc. This information can be consolidated together to predict anything from cholera outbreaks to severe chronic viral diseases. Predicting the epidemics could be really helped especially in third-world countries. These countries usually lack important medical infrastructure and organized education systems.

As mentioned earlier, computer vision can assist in analyzing images like X-rays, MRIs, or even patients' symptoms' images like screen rashes. Combining these three technologies can drastically improve the quality of the diagnosis. Hence, we are working on SYMPTO engine (<https://www.everythingtech.co/open-source-projects/sympto/>).

SYMPTO is an open-source project that aims to develop a machine-learning algorithm to diagnose medical diseases based on various symptoms, medical history and other conditions of the patient. SYMPTO can work with any project as it takes input of patients' vitals, recent conditions, symptoms or health issues, and patients' medical history. It also considers various images like X-rays, MRIs, and symptoms images like rashes, etc. Based on this, it analyzes and output diagnosis with confidence level. High confidence level signals the possibility of accuracy and medium to low level signals the lack of data or input to come up with proper diagnosis. For medium to low diagnosis level, further processing is necessary. SYMPTO engine is a standalone engine which can be plugged into any medical IoT system. Hence, it is widely applicable to many existing products. In this paper, we will discuss a case study of ZPOD [5][8] as an user facing medical IoT system. We will discuss about ZPOD in more details in the next section.

IoT enabled User Facing Application

IoT made it possible to create a world of interconnected objects that can communicate through the internet. We can use hardware components like RFID tags, actuators, sensors, mobile devices, etc. to develop an interconnected world. Most of the medical IoT systems will have a similar architecture in which sensors are connected to a central module and communication takes place among sensors. Some healthcare organizations have already adopted the different form of IoT enabled medical devices to handle the shortage of medical professionals in remotest areas [6]. So this type of setup is successfully working and helping individual patients. IoT medical devices can help to drastically reduce the time of diagnosing and providing treatment to the patients. Usually, these medical devices are equipped with a fast processor and a feature-rich operating system interface, which makes the work much easier and faster. Cloud computing has enabled these devices to store diagnosis data of each patient to conduct in-depth analysis and provide a better diagnosis [7].

ZPOD is also a similar system. ZPOD comes in a form of a kiosk which looks like an ATM machine or also come in a variant of briefcase style case which contains all the required sensors. ATM style machine is a standalone kiosk which is equipped with various sensors to measure blood pressure, blood sugar, weight, body temperature, ECG, ultrasound, blood test, pulse rate monitor, X-ray, urine test, and even eye check. With ZPODs in place, people won't need to travel hundreds of kilometers to get proper error free medical diagnosis and with extended ZPODs get basic treatment. Extended ZPODs are the pods or kiosks which have more equipment and a few health support staff personals to assist patients. The idea is to provide primary healthcare facility remotely without having the physical presence of the medical professionals on the site. This will eliminate the human error as the diagnosis will be carried out by AI modules and coordinated by a middleware application. The kiosk will be equipped with all the necessary sensors and basic medicines. As mentioned in the ZPOD patent, in some cases, medicines will be delivered via drone to the remoted parts of the world. Life expectancy in rural areas can be greatly improved by this invention.

The SYMPTO engine powers ZPODs' hardware modules to collect the vitals of the patients and acquire patients' medical history through the ZPOD's cloud storage to perform the diagnosis. ZPOD kiosk contains a touchscreen interface for users to interact with the system. For a common user, the interface is very simple and user-friendly to operate. It is just like any regular touchscreen device. The ZPOD kiosk will ask user credentials like username/password or biometric authentication

like retina scan or finger scan before starting the diagnosis. Users may need to utilize the sensors attached to the ZPOD kiosk in order to send the vital to the system. This means that a regular patient may need to provide urine/blood sample, check blood pressure or blood sugar, conduct X-ray/ Ultrasound/ECG, etc.

The user inputs then get sent to the middleware application "SYMPTO Connector" which communicates with the SYMPTO engine to analyze the patients input and come up with diagnosis. Based on the SYMPTO's diagnosis middleware application then communicates with the ZPOD kiosk. If the prescription came from SYMPTO is readily available in the ZPOD kiosk's storage, the middleware application sent a message to deliver the medicine upon the required payment. Upon successful payment, medicines will automatically be dispensed if they are available in the kiosk. Otherwise, they will be delivered from the nearest warehouse via an automated vehicle, drone, or human driven vehicle.

The user-facing application will be very simple to use. In fact, it would require the minimum qualifications to operate. ZPOD aims to provide the user experience in multiple languages instead of just plain English. This will help people in the remotest areas who are not familiar with English. Instead of having plain text, the interface will also show symbols and lights to guide the user through the diagnosis process. There will be easy tutorials to provide guidance to the new users. These tutorials will be created with large icons and interesting animations to help users.

The ZPOD is the only remotely controlled machine with such a huge variety of sensors and technologies. Following are some of the most innovative features of the ZPOD:

1. Remote-controlled X-ray: ZPOD comes with an X-ray module attached to the machine. Doctors can remotely control to move the X-ray module and make adjustments for the patients looking for an X-ray scan. This eliminates the need for a medical professional who needs to be physically present on the site to operate the X-ray module. The people from the remotest locations do not get the chance to get an X-ray, ultrasound, ECG, etc.
2. Remote-controlled ultrasound: An ultrasound belt is also present in the ZPOD machine and it can be controlled remotely. Doctors or medical professionals can adjust the ultrasound belt remotely according to the patient. To obtain the best ultrasound images from the patient's body, doctors can control the pressure.
3. Advanced Interface: The device will be equipped with a microphone, speaker, fingerprint scanner for authentication, retina scanner, camera, printer, and a touchscreen. This provides 360-degree communication and security measures. Any communication gap is also eliminated and video calling narrows down distances.

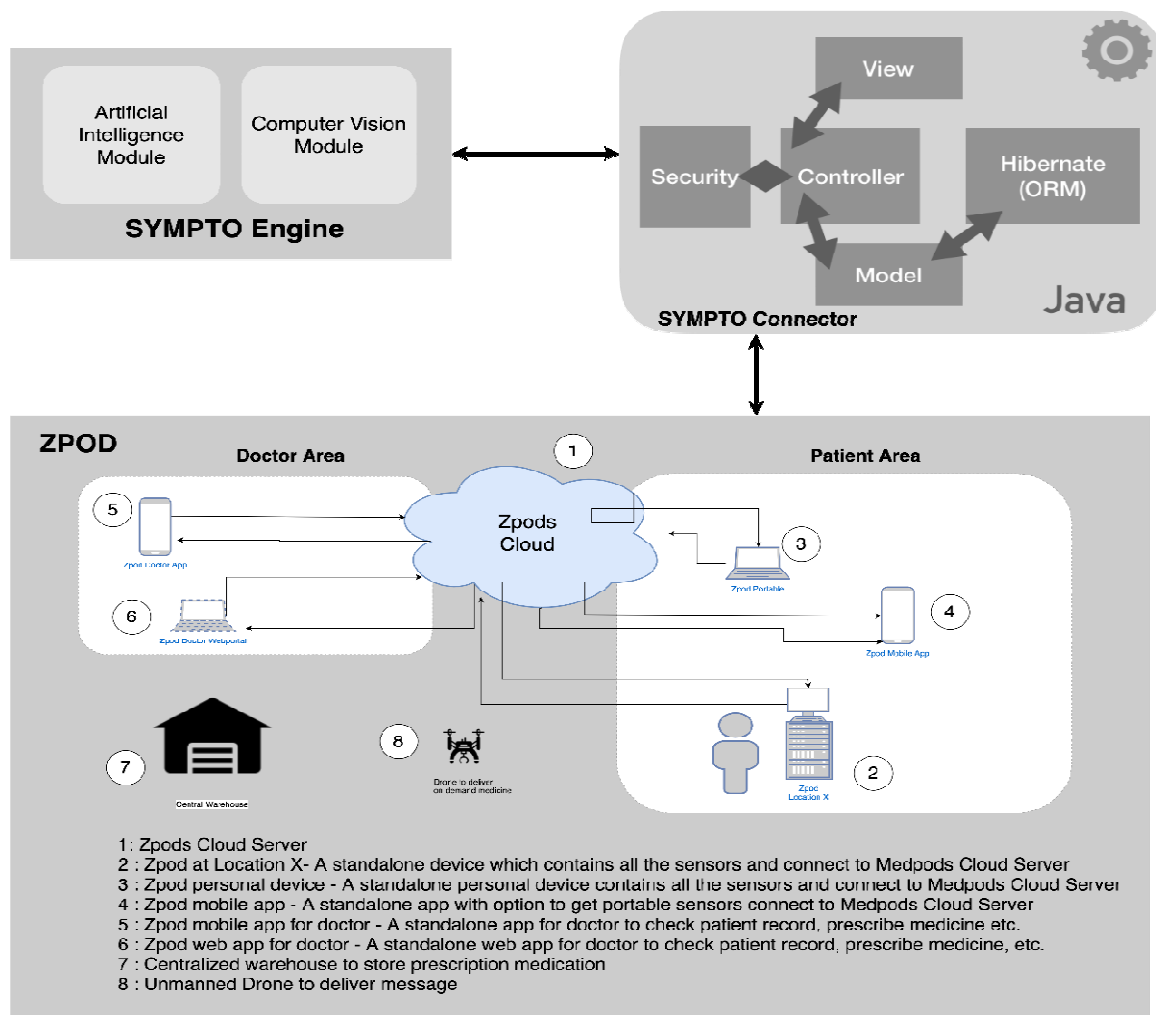
Medical Coordinator Application (Middleware Application)

The SYMPTO engine comes with a middleware application called as "SYMPTO Connector". SYMPTO Connector uses Java, a programming language developed by Sun Microsystems in 1991. This language stands as class-based, object-oriented and developed to have minimum implementation dependencies. Using Java means we can develop modular programs that could be used in any operating system. Due to this great compatibility, more than 3 billion devices are running Java. Java consists of a compiler, an execution engine and a bunch of libraries. These rich standard libraries make it easier to code with Java. This is why the team of SYMPTO has chosen Java for the middleware application.

SYMPTO Connector communicates with SYMPTO engine, user facing IoT application like ZPOD, and external medical institutions and devices like hospital beds, etc. It provides various interface APIs to enable data exchanges among the entities involved. SYMPTO Connector is modular in nature and can be extended by external developers via APIs.

The future of Project SYMPTO

The project SYMPTO has very ambitious objectives and aims. It could become one of the greatest revolutions in the medical industry. People from the remotest areas will be able to take the best benefits of SYMPTO powered machines to receive proper healthcare facilities. The patients will be diagnosed and, in some cases, treated remotely without even having any doctor's presence at the device site. This could be a great achievement for an instant response during an epidemic. Medical professionals would not have to risk their own lives and visit the place. SYMPTO powered IoT machines can help patients, prescribe medications and recommend IoT medical centers like extended ZPODs to provide treatments. People wouldn't need to go anywhere for the medicines since the machine itself could dispense medicines. In case, of a medicine shortage, the nearest warehouse can deliver medicines to the machine or doorstep of the patient.



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About the author



Mayur Ramgir has more than 18 years of experience in the software industry, working at various levels. He is a Sun Certified Java Programmer and Oracle Certified SQL Database Expert. He completed his MS in computational science and engineering from Georgia Tech, USA, and M.Sc. in multimedia application and virtual environments from University of Sussex, UK.

He is a fellow of The World Technology Network, which is a curated membership community comprised of the world's most innovative individuals and organizations in science and technology. Other members of WTN are Elon Musk, Tim Berners-Lee, Emmanuel Macron, and Xi Jinping.

He was honored with the Champions of Change award in 2018 by Mr. M. Venkaiah Naidu, Honorable Vice President of India. He was also awarded the Pride of The Nation award by Mr. Rajnath Singh, Honorable Home Minister of India, at the Vijay Diwas Celebration 2018.

Mayur Ramgir was featured on various TV and printed media including Fox News, NBC News, CBS News, Fox Business, Bloomberg International TV, Forbes, Inc. magazine, Daily Mirror, and The Huffington Post. He is a contributing author of the New York Daily Newspaper, Software Development Times magazine, Newsmax Finance, and Singapore's top entrepreneurship magazine Young Upstarts.

What's New?

Computational Storage

Computational storage is an information technology (IT) architecture in which data is processed at the storage device level to reduce the amount of data that has to move between the storage plane and the compute plane. The lack of movement facilitates real-time data analysis and improves performance by reducing input/output bottlenecks.

In many respects, a computational storage device may look just like every other solid state drive (SSD). Some products have a large number of NAND flash memory devices that actually store the data, a controller that manages writing the data to the flash devices and random access memory (RAM) to provide a read/write buffer. What is unique about computational storage devices is the inclusion of one or more multi-core processors. These processors can be used to perform many functions, from indexing data as it enters the storage device to searching the contents for specific entries to providing support for sophisticated artificial intelligence (AI) programs.

Computational storage products and services are starting to appear on the market and the ability to integrate them is still in the early stages of development. However, with the growing need to store and analyze data in real-time, the market is expected to grow very quickly. As of this writing, computational storage can be implemented by using one of two key products currently being defined by the Storage Networking Industry Association (SNIA) Computational Storage Technical Working Group (TWG):

More at <https://searchstorage.techtarget.com/definition/computational-storage>

Conversational Commerce (Voice Commerce)

Conversational commerce is the process of interacting with a brand or buying a product or service through non-traditional channels, such as voice assistants, SMS text and online and social media chat. Usually powered by artificial intelligence, a combination of technological advances and consumer preferences paved the way for conversational commerce to gain traction, primarily in B2C retail. It works by consumers choosing a non-traditional, one-to-one channel to interact with a business and to complete a purchase at their own speed and on their own time.

More at <https://searchcustomerexperience.techtarget.com/definition/conversational-commerce-voice-commerce>

Passwordless Authentication

Passwordless authentication is a verification process that determines whether someone is, in fact, who they say they are without requiring the person to manually enter a string of characters. Authentication methods include biometrics, security tokens and piggybacking off of another application, service or device which has already authenticated the user.

Passwordless authentication is commonly used on mobile devices such as smartphones, tablets or laptops and applications such as Slack or WhatsApp. The benefits of using passwordless authentication include:

- Improved user experience (UX).
- Faster login times into applications or devices.
- Less maintenance of passwords required for IT staff.
- Reduced chance of phishing attacks, password re-use or password leaks.

More at <https://searchsecurity.techtarget.com/definition/passwordless-authentication>

Digital Transformation

The New Oil: Refineries and Engines to Tap into this Source of Power

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Introduction to Digital Transformation

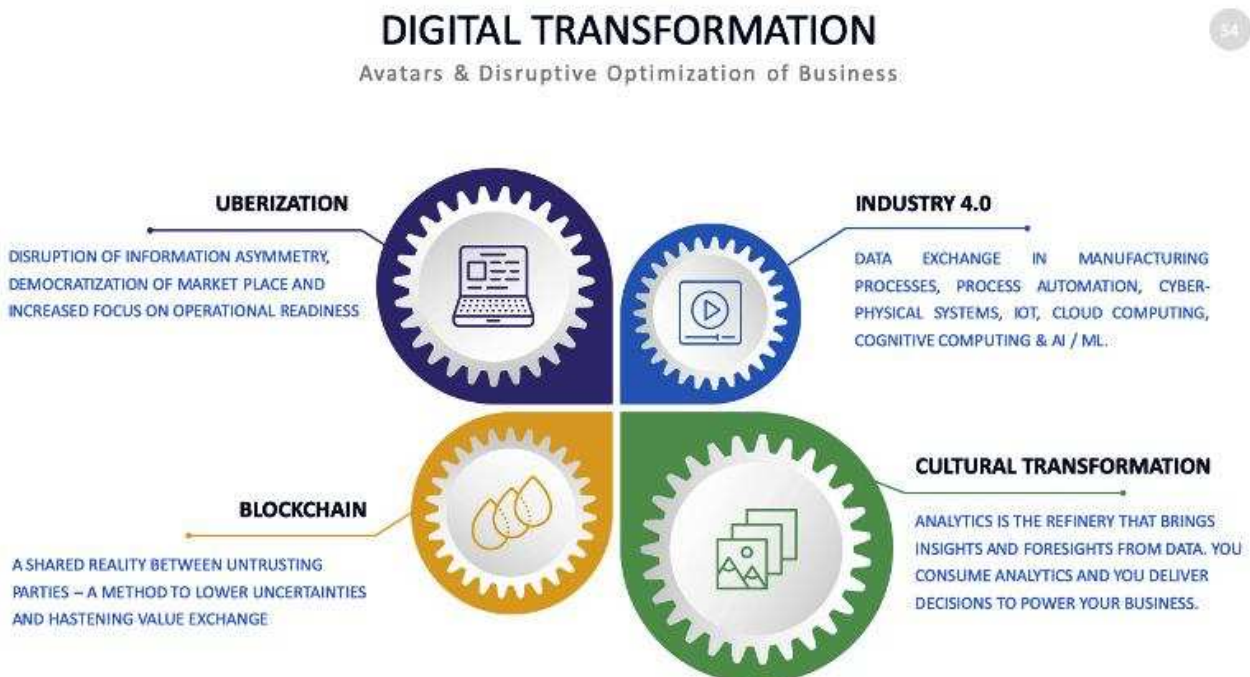
Let's start off by acknowledging that there is no unanimously accepted definition of Digital Transformation. Internet searches for a definition of Digital Transformation bring us to some common themes: reinventing business processes, bringing about a cultural change and cloud computing. This is a good enough premise to get started.

Let's get the fundamentals right and the boundaries defined:

- Why reinvent a business process? Clearly, to deliver greater value to the customer. Why? Is our customer suddenly demanding more value – Yes, they are. How? Isn't it just another phase of negotiation – No, the customer is armed with information now.
- What is the cultural change? It is the much-needed people transformation – digital fitness is becoming a mandatory section in all resumes, highlighting new set of skills needed to survive, flourish and lead businesses as data becomes ubiquitous.
- How much of it is driven by technology? IoT, Big Data, Machine Learning, Analytics, Mobility and Cloud Computing – what is the right mix of technology for success.

Digital Transformation – It's Many Avatars

Digital Transformation manifests differently in different domains. Disruption of information asymmetry, upskilling blue collar, demanding white collar to be cognitive and creative, delivering permission-less decisions, bridge islands of digitalization, Industrial Internet of Things (IIOT), Industry 4.0, Living-breathing data systems, Single Source of Truth (SSOT), Provenance of Data and more.



Let's explore some real-life transactions and see how they are being transformed:

Use Case	As-Is	To-Be
Condition Monitoring	Hourly patrol with a digitized measurement device checks vital parameters and writes in a log book. Diligence is often compromised and justified as operator instincts. Lack of reliable data makes root cause analysis a charade.	Sensors beam data to a historian server – the log. Machine learning differentiates common cause and special cause. Special causes become tickets or alerts based on severity, recurrence and time elapse.
Food Safety	Samples are picked at different stages as food moves through the supply chain to check for contamination.	GPS and Telematics generate live data about transport conditions and route. Live data streams are disintermediated into blockchains and, smart contracts enforce shipment rules.
Set up approval	At the start of a production batch, a sample quantity is produced, put through inspection, and report is approved before full scale production starts, simultaneously creating production losses.	Computer integrated manufacturing can log machine condition, production settings and product parameters. These can be transported across a network for live analytics and setup approvals and for production patrol.
Tool life cycle	Tool utilization is measured as elapse time or number of parts produced. Expensive tools may have life left behind depending on a number of correlated parameters.	Live monitoring of critical to quality product parameters can monitor and predict tool life cycles, extending utilization and also preventing defects.
Traceability	Digitalization has created data disconnected data islands. Traceability requires manual stitching together of data across process value streams, incurs time.	Lot level traceability if not piece level traceability on demand with logs compiled across process value streams and stored in big data archives.
MIS	Paper logs are data entered to spreadsheets and analyzed offline. Report generation incurs time and effort.	Industry 4.0 technologies create integration of data across manufacturing processes, use cognitive computing and deliver insights and foresights in capsules. These capsules are context specific and can be delivered in devices.
Reports	Most commonly seen as prints of logs, often accompanied by analytics capsules in the form of slides.	A Voice Assistant powered by machine learning and percolation algorithms, presents insights, foresights and trends.

While it took us twenty years in India, from our first e-commerce store to the Billion Dollar Days, we abandoned our beloved landlines for smart phones almost in a flash.

Information Asymmetry and Uberization

Information Asymmetry is when one of the two parties in a value exchange has an unfair advantage on account information that the other party does not have access to. In market place models, popularly referred to as Uberization of a business, transformation is about disruption of information asymmetry. The Digital Market place – the platform, enables democratic distribution of information bringing fairness, increase adoption and optimization to value exchange.

Let's use the most popular Digital Market Place – Hail a Cab services to take a closer look at Digital Transformation.

The consumer is now armed with data on number of cabs in the area, typical cost to reach the destination and offers from competitive providers. The provider has clues to be present at the right catchment areas at the right time. Uberization is not to be confused with market places which have existing forever, in that, market places brought competitive offers to the buyer's consideration without addressing information asymmetry. These competitive offers were often window dressed back stage.

The consumer was paying a premium for being on the wrong side of the information symmetry. As a consequence of transformation, the provider must now focus on operational efficiencies to stay relevant. Operational inefficiencies are not a mere setback, they decimate.

Trade unions that protested standardized rate structures proposed by the government, that opposed metered cabs and rickshaws have been washed over by economics – they too have been uberized. You can now get your 'bed and breakfast'

at proximity to your business location at a fraction of the price you paid your preferred 'hotel'. Customer loyalties belong, albeit fluid, to providers of information more than providers of products and services.

Where do you stay? Oyo. Where do you eat? Swiggy. How did you get here? Uber.

Data is Ubiquitous – How did We Get Here?

It all started with **Digitization**, which is, conversion of data from analog to digital bits, driven largely by electronics, for example, a digital micrometer.

It evolved into **Digitalization**, which, is transforming a business process to be conducted in a digital environment – aka, a computer, a smart phone and more recently, a voice assistant. For example, e-commerce, social media and payment gateways.

Digitization and Digitalization have been around for a while. Programmable Logic Controller and Automotive Manufacturing gave birth to PLC and the original streams of large data back in 1968. In the subsequent 40 years we kept harvesting new sources of data and woke up to data-gold being strewn all over.

Big data and blockchain, are both more than 10-years old. Computing power and the advent of affordable big data triggered large scale adoption of data driven services, revenue streams and business models.

It is now the era of **Digital Transformation**, larger in its reach than Digitalization because it includes cultural transformation. Digital Transformation touches upon most aspects of the 'People – Process – Technology' matrix.

Often, when business leaders talk of Digitalization and Digital Goals, they are referring to Digital Transformation.

Machine Learning & Workforce Transformation

It is said, the so-called golden era, of the evolution of Artificial Intelligence ended as early as 1974. Dialing back a decade or two, many anticipated that AI and robots would be common sight by 2020. In reality, we have some fuzzy logic in our washing machines, some dishwashers have sensors, some cars know how to stay the track, robots can pick and place, machines are getting better at understanding natural language. It seems, AI is not here as promised!

Whereas, Machine Learning, a subset of AI is more accessible and is an active ingredient in Digital Transformation of business. ML can be often seen as hardware and software working in tandem. ML is the ability to receive varying sets of data, and have adaptive algorithms that can continue to make sense of changes in the process. A lot of what we see as AI today comes down to Machine Learning. And, Machine Learning sets the stage of next gen Artificial Intelligence. More than technology, people, more than ever before, are getting ready for AI.

In Machine Learning, the role of a blue collar is transformed from, being a monitor of processes and transporter of data to, an agent of permission-less decision making. Let's look at monitoring in the context of Machine Learning in greater detail.

Google has defined monitoring, in the context of DevOps, to comprise of and operate in three layers: event logs, tickets and alerts. Logs are evidences of functioning of a process, a ticket pertains to an abnormality that does not warrant immediate corrective action whereas, abnormalities that need instant interventions are alerts. These three layers of monitoring are relevant for all kinds of monitoring – from traffic to production, quality and financial markets.

System	Log	Ticket	Alert
Traffic Control	Constable's daily report back at the station	Riders found without helmets	5-car pile-up during peak hour at an arterial route
Quality Control	Inspection check sheets or a log book	In process: Parameter outside of control limits	Critical to Quality parameter is unstable

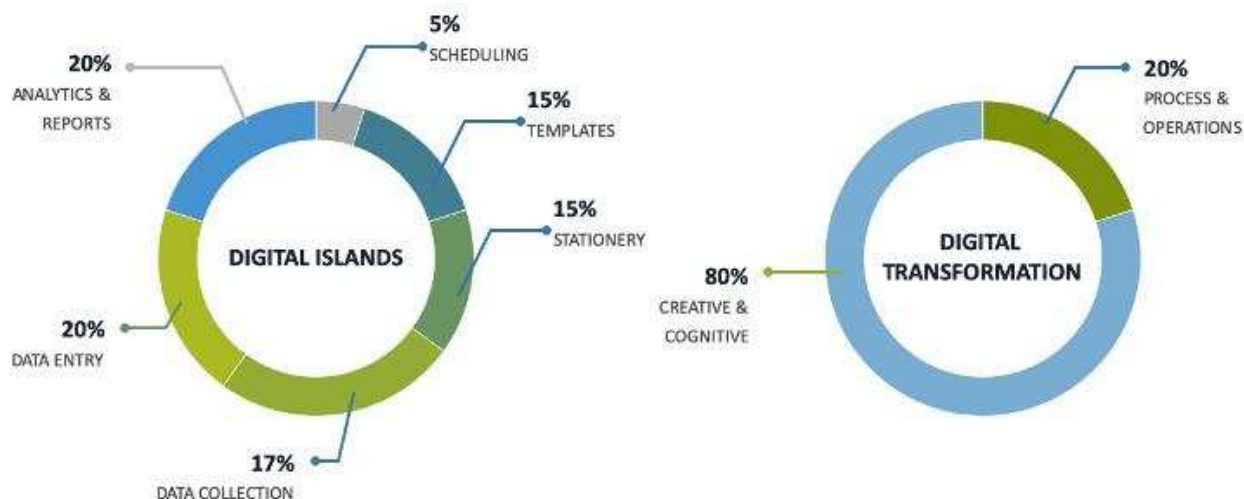
As-Is: Monitoring is manual, bets on human diligence and reliability of data output is questionable. Ticket generation is often a random exercise and driven by personal judgement. Inspectors may not have statistically validated attribute agreement and measurement systems may not comply with repeatability and reproducibility standards. Alerts are after the fact escalations, and for many firefighting has become business as usual.

To-Be: The log book in monitoring is automatically generated. Machine Learning generates the tickets and Workflow automation brings in an escalation matrix and throws up alerts.

Operators are not required to monitor machines and bring an hourly log of time and temperature data to a supervisor. Telemetry would do that. Connected cameras generate data driven alerts to transform traffic policing, making it more impersonal and smarter.

Workflow automation also delivers an additional benefit by diminishing the ‘arbitrary’ in favor of standardization and bringing up exciting possibilities of permission-less decision making. Workforce is now upskilled to decision making and is comforted in the fact that Machine Learning can reliably differentiate a given data pattern as a ticket or an alert.

Creative, Cognitive White Collar, Featuring AI



A consequence of partial Digitalization, data underlying process value streams exist as disconnected islands. 80% of a manager’s time could be consumed by process and data life cycle, leaving the manager 20% of time to apply creative – cognitive capabilities to deliver improvements.

Through Digital Transformation, machine learning, business process automation, an empowered blue collar is freeing up white collar space. White collar has to move from processes and operations to creative and cognitive. White collar has to start forging partnership with Artificial Intelligence. AI engines will be diligently learning from white collar, can white collar make it vice versa. If yes, that would be the beginning of our evolution to stay relevant in the era of Artificial Intelligence. This journey of transformation can take after e-commerce adoption – 20 years, or the smart phone adoption – in a flash.

In the end, these transformations are less about technology and more about us – the people. How successful your enterprise Digital Transformation lies in how People transform themselves.

Data is the new oil. Amongst arguments against this analogy, we should see there is a deeper context. Like oil, data is crude, it needs to be refined to become information, knowledge (insight) and wisdom (foresight). Refined oil, a source of energy, is only as efficient as the engine that consumes it. Refined data can become a source of energy only for a Digitally Transformed human mind.

Analytics is the refinery that brings insights and foresights from data. You consume analytics and you deliver decisions to power your business. The big story of machines taking over turns out to be about people.

Industry 4.0

Industry 4.0 by definition, encompasses data exchange in manufacturing processes, process automation, cyber-physical systems, the internet of things (IoT), cloud computing, cognitive computing and artificial intelligence. In terms of multi-disciplinary uptakes and scope Industry 4.0 could be among the biggest Digital Transformation exercise taken on to-date.

The biggest challenge for Industry 4.0 is pre-existing sources of digital data in our value streams. Manufacturing value streams are characterized by:

- Human Machine Interfaces that impose restrictions on network-based data transfer,

- Analog measurement systems,
- Non-standard production design across value streams delivering similar output,
- Dearth of network infrastructure – WLAN or Internet connectivity
- State of edge computing devices
- General misgivings about hosted servers and cloud computing

It is impractical to aim for complete transition from islands of digitalization to 100% Digital Factory. Unlocking all your machines to transmit condition monitoring streams, tagging all your process parameters to sensors, telemetric capabilities, IoT enablement of all your measurement systems takes budgets, effort and time. Digital Transformation can be a long road, all the more because it involves people transformation more than any other aspect of business.

While, Digital Transformation can be taken up step-by-step, some ingredients are time critical and foundational:

- Data in your value stream is your asset, when you make investment decisions, choose products or services that do not entail additional costs for data access. This a surprisingly common industry practice that leaves a value stream with islands of data. Integration of data streams becomes a challenge.
- Verify if machines adhere to industry standards such as MT Connect – these standards ensure that data access is seamless. MT Connect, for example, enables data transfer from machines using a standard network port and supports TCP/IP, not very different from our standard internet connectivity.
- Ensure your value stream has a sturdy network (WLAN) provision – this forms the backbone of your Digital Transformation. With a backbone in place, old assets can be digitalized and new IIOT assets added with ease.
- Take informed decisions towards cloud computing – specifically, work through notions that data stored locally is somehow more secure than use of cloud services. Resistance to cloud computing adds to costs of digital transformation.
- Before investing in analytics products, take stock of your databases – any analytics engine is only as good as the database that it feeds into
- Analytics projects are like banyan trees – as against crotons that can live in constrained spaces. Success of analytics is characterized by evolving scope, in terms of more data points, expanding user base and user driven need for new data models and visualization.
- When you set goals for Digital Transformation, ask this important question: Are our expectations of Industry 4.0 appropriately calibrated: is it going to be like e-commerce adoption of many years or is it going to be like smart phone rapid adoption?

Modular nature of enterprise IT systems allow for Industry 4.0 to be a step-by-step exercise in transformation, akin to physical fitness. The first step of course is becoming paperless.

Paperless Transformation is a No Brainer

Going Paperless is a fair trade off between current state and 100% Digital Factory. Paperless is a good first step towards complete Digital Transformation and is soaked in the reality of pre-existing investments in analog devices.

Most manufacturing value streams are on an unhealthy diet of paper, there are check sheets, log books, printed reports all piling into archives that block seamless flow of a business process. Paper sheets are born as templates, crawl around as stock stationery, walk around as check sheets, grow into log books, graduates to spreadsheets, go through analytics, become slides, are printed again as posters, live in a record room for many years waiting for traceability. Fully loaded, an A4 sheet equivalent could incur INR 1000 as total life time costs.

A mid-sized value stream could consume:

- Push managers against cognitive and creative into processes and operations
- Keeps businesses firefighting as against continuous improvement
- Incur a person month of effort in data management each calendar month
- Create delays when traceability is needed for after sales support and warranty

Part service warranties, Automotive recall and the larger tightening up of warranty laws mean new components of risk. OEMs and large-scale manufacturing companies are rolling out risk mitigation strategies, wherein Tier 1, Tier 2 and Tier 3 suppliers are required to support evidences and traceability requirements. A paper-based environment does not support reliable – immutable evidences of quality and makes traceability a pain. Whereas, a paperless environment enforces adherence to standard operating procedures and collapses time and effort needed to support traceability.

Paperless transformation as step-1 can deliver key benefits including:

- Transform quality functions from generators to consumers of data
- Shifts focus from inspection to continuous improvement
- Elimination if not eradication of non-value adding activities around data management

- Enforce time value of data, improve reliability
- Support business process automation

Paperless transformation and upskilling workforce are both key result areas of Sustainable business practices. If you are in exports, especially into Europe, your customer is likely to look out for and appreciate Sustainability ingrained in your business culture.

Blockchain

Blockchain, the technology behind crypto currencies such as bitcoin, is powering digital transformation in its enterprise avatar. Blockchain brings about disruptive optimization of enterprise business processes – especially those that involve highly distributed value streams. Blockchain creates a shared reality between *untrusting* parties – a method to lower uncertainties and hastening value exchange.

It is here that blockchain stands differentiated from ecommerce market places. In market places, the value exchange is still between the provider of the market place such as eBay and a buyer, whereas, in Blockchain, technology enables value exchange between untrusting parties.

In Governance, Blockchains will accelerate collapse of institutions and enforcements. The land registry of the future will not be a government department but a blockchain. Blockchain is emerging as a technological institution that will push human intervention (reference to permission-less decision making) to the edges.

Blockchain is a distributed database that will have its tentacles into pre-existing information systems such as ERP, CRM, supply chain management, and payments bank among others. Blockchain architecture delivers these key benefits:

- Transactions are securely encrypted and replicated across many computers in multiple copies of a ‘ledger’.
- Transactions approved by Smart Contracts are held together as chains: For example, an order for monthly fulfilment is connected to the annualised purchase order, price, budget approvals, supplier’s quality control, shipment tracking, through to gate pass, incoming material approval, good receipt, invoice and payable. These chains of commands are defined as Smart Contracts and cannot be broken. Reconciliations are inbuilt and ingrained.
- Completed transactions become blocks and are committed to the chain – they become immutable. To make changes to a completed transaction, one does not go back and edit a block, instead we create a new transaction as an update.
- Owing to the architecture, once data is written it becomes nearly impossible to change, making it a very secure system for storing digital assets (value).
- A blockchain might be implemented publicly, within a consortium of participating partners, or as an enterprise solution within a single organisation acting as a custodian.

Technologically, much of what blockchain brings to the table has already been in use: data clusters, replication, rule engines, interfaces with different data structures, application interfaces have all been in use for many years. Innovation in blockchain distills down to its capabilities as a distributed database – ledger system that has enviable performance capabilities and, its highly secure encryption. Much of the Digital Transformation brought about by adaptation of blockchains is the how we do business.

Smart contracts are computer programs that can execute business contracts. In essence, they monitor and derive data points from pre-existing information systems. Rules respond to events and trigger successive events. Smart Contracts create secure records and can be built to support third party verification.

For example, a Smart Contract for vendor payment may be visualized as follows

- Supplier side pre-dispatch inspection certificate creates a shipment notification
- Logistics partner responds by sending a truck to pick up the shipment
- Customer responds by getting ready for incoming inspection
- Digital gate pass permits entry of shipment at a stipulated time at the right location
- Incoming inspection clears the lot
- Good received note is issued
- Supplier generates invoice
- Payable is created in the system

Here is a “Hello World” rendition of Smart Contract from Solidity, an open source program to author and run Smart Contracts for enterprise blockchains:

```

pragma solidity ^0.4.16;

contract HelloWorld {

    uint256 counter = 5; //state variable we assigned earlier
    address owner = msg.sender; //set owner as msg.sender

    function add() public { //increases counter by 1
        counter++;
    }

    function subtract() public { //decreases counter by 1
        counter--;
    }

    function getCounter() public constant returns (uint256) {
        return counter;
    }

    function kill() public { //self-destruct function,
        if(msg.sender == owner) {
            selfdestruct(owner);
        }
    }
}

```

End Note

This article is written from a practitioner's point of view. Digital Transformation is not an "if" or a "when." It is NOW. It is enchanting to see how large and small enterprises are thriving and succumbing to different Digital Transformation initiatives. It is not about size. It definitely is not about technology. If there is just one take away, focus on people and cultural transformation and do not make it yet another exercise of fancy nomenclature and Information Technology fads.

About the author



Venkat Krishna is the Principal Consultant – Digital Transformation & Analytics, and co-founder of PQSI Digital Private Limited.

Before founding PQSI Digital, I have worked with and, co-founded IT services companies in areas such as ERP, CRM, Global Outsourcing, eCommerce, Content Management, Machine Learning, Analytics, Service Excellence, Backoffice and Education. I have been IT partner – Transformation agent to many a startup and had a worm's eye view of many failures and the rare success.

In the last 4 years I have transitioned to be a specialist in Digital Transformation for Manufacturing companies and have delivered over 35 blueprints for a variety of manufacturing value streams: Ashok Leyland, CEAT, Pidilite, Murugappa Group, Rane Group, TVS Group, Ministry of Defence and a multitude of MSMEs. I also had the privilege of building a Blockchain blueprint for disruptive optimization of bill of exchange for Ashok Leyland.

At PQSI Digital, we deliver Industry 4.0 – Analytics for Manufacturing with practice areas comprising Edge Computing, IIOT, Big Data, Machine Learning, Analytics, Statistical Process Control, One Touch Dashboards and Mobile Apps.

What is Gig Economy: A gig economy is a free market system in which temporary positions are common and organizations contract with independent workers for short-term engagements. The term "gig" is a slang word meaning "a job for a specified period of time" and is typically used in referring to musicians. Examples of gig employees in the workforce could include freelancers, independent contractors, project-based workers and temporary or part-time hires. More at <https://whatis.techtarget.com/definition/gig-economy>

What is 6G: 6G (sixth-generation wireless) is the successor to 5G cellular technology -- 6G networks will be able to use higher frequencies than 5G networks and provide substantially higher capacity and much lower latency. One of the goals of the 6G Internet will be to support one micro-second latency communications, representing 1,000 times faster -- or 1/1000th the latency -- than one millisecond throughput. More at <https://searchnetworking.techtarget.com/definition/6G>

Enterprise Master Data Strategy

Deprived Master Data & Remedies

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Abstract

Master data has played a significant role in improving operational efficiencies and has attracted the attention of many large businesses over the decade. Recent academic reviews have also found a significant growth in the practice and research of managing these master data assets.

MDM is a technology-enabled practice through which businesses oversee master data assets and ensure the accuracy and accountability of the enterprise's shared data. Enterprise MDM calls for the use of centralized governance and collaboration, also called the master data HUB system.

Focusing on solutions to conceptual and real-world obstacles and enhancing the management process can contribute to deepening its applications and creating secure and profitable entrepreneurial communities.

Attention

Thus, the following article will demonstrate examples of good and bad practices of master data management and the possible consequences of both practices. The purpose of this article is no to endorse any product. It is not to be used as an enterprise MDM-related product guide. Business owners and process overseers, specifically practitioners of supply chain and logistics, enterprise architecture, and any other fields that contribute to enterprise architecture may benefit from reading this article. Senior and operational level managers, who are involved with accounts payable (AP), accounts receivable (AR) master data, or related areas, such as enterprise integration, business intelligence, infrastructure, and solution architecture, may also find this article beneficial.

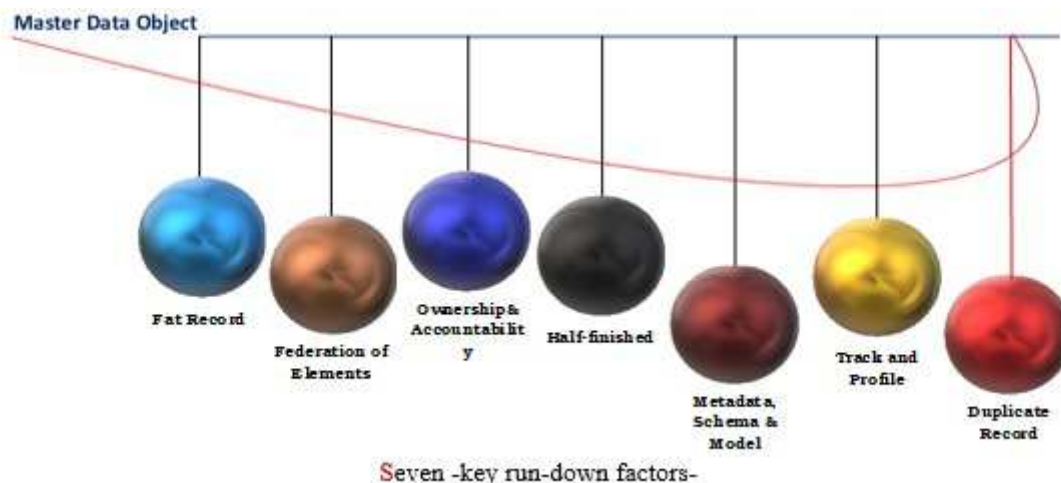
Introduction

Envision a company with bad data and perfect process mapping. Such a company may suffer from lost revenue since inaccurate data leads to higher consumption of resources, higher maintenance costs, negative publicity on social media, lower productivity, etc. The company would need to erase its old data and recollect new data, resulting in more time and money consumption. This is a red flag.

On the other hand, a company with good data and bad process may spend a lot of time attempting to rectify the process and reallocate its resources to improve data quality. However, this is not as expensive as fixing the downright bad data.

According to Gartner research, "organizations believe poor data quality to be responsible for an average of \$15 million per year in losses." Larger businesses with many customers, employees, suppliers, and multiple units in various geographical areas are at a higher risk of encountering poor data quality.

"Master data is the consistent and uniform set of identifiers and extended attributes that describe the core entities of the enterprise."- gartner.com



Fat Record: Businesses collect a lot of attributes necessary for their requirements. Depending on the business, material master, article master, business partner, and all other assets need different attributes. For example, material master data usually uses more than 250 attributes, which may be plant data, sales, purchasing, accounting, warehouse data, etc.

A *Fat Record* will hold many attributes, depending on the business. However, if we are unable to manage the business-critical attributes effectively due to the huge quantity and unstructuredness, the business and custodian might not know the significance of the business dependent attributes.

It is extremely important that large attributes of any business object are kept in a concise, business critical manner.

Federation of Elements and Records: Organized view of elements and federation of functional elements are key concerns for business groups and the data custodian. A business entity's grouping, classification, and hierarchy can make assessment, auditing, and overhauling simple. Central data elements of the object should be at the top of the schema and then categorized by functional grouping.

Half-finished: Information should be complete. Missing data can lead to misleading analysis and results. Businesses must spend time and resources attempting to recreate and recover the lost data. Some businesses may not be willing to do so and, instead, may leave these records unused. Thus, setbacks in productivity timelines, loss of trust from customers, and data repair/replacement costs are all effects of unfinished or missing data.

Data is a digital asset that is any kind of information. In any case, every member information is valid and indispensable.

Suppose we have incomplete equipment master data, the core functional attributes such as type, function, capacity, and age could be left undefined. This causes ambiguity in the use of the equipment and is harmful for business.

Ownership & Accountability: Unsteady Ownership and Accountability lead to half-finished and therefore, unused records. Businesses with customized, effective governance models will have higher quality data, since management responsibilities, roles, accountabilities, data flow, and other guidelines are strictly defined and put in action. Governance operating models provide increased effectiveness and improved coordination, leaving little room for mistakes.

It is highly encouraged to improve data quality through establishing structured schemas, a hierarchy of responsibilities, process flow documentation, and a clear set of *To Do & Not to Do* tips.

Track and Profile: To avoid inconsistent, inappropriate, or half-finished data and to have quality data, we need data profiling and change tracking, that is keeping track of who, what, when, and why.

Metadata, Schema and Model: The foremost objective of a scheming data model is to maintain an accurate, comprehensive representation of the objects in the application. A poor data model leads to deprived data. Every data object has its own schema attributes, and set of keys. Objects need to be keyed accurately- primary or foreign. We then need to identify and define the relationships and associations between different such objects in the entire database, creating organized schemas.

In an enterprise, objects can be a multitude of things. Hence, it is crucial that detailed information regarding each entity is stored in the database and characterized into various fields, called attributes, whose details are in an organized manner.- possible by skilled , not data operator.

Metadata that is data about data. An example of this is data type, which can be char, text, or numeric.

Once again, to avoid inconsistency, the model should have reference values, key mapping, hierarchy, classification, grouping, etc.

Duplicate Record: There are a lot of possibilities through which records in a system can be duplicated. In addition to the list of causes of poor data and a bad process, duplicate records and validating duplicates can also result in lots of time-consumption. Duplicate records may be a result of unpredictable source data and inadequate reference and hierarchy data due to heterogeneous systems such as the varied characterization of special characters, punctuations, noise words, abbreviations, and some identifications. Transforming and substituting such sources/buzz words may reduce the risk of creating duplicates.

Seven key sources of duplicate occurrences during runtime:

- a. *Lack of ownership & accountability.*
- b. *Lack of skills - ownership comes from skills*
- c. *On-flight urgency*
- d. *Inconstant change tracking & monitoring*

- e. *Absence of data profiling*
- f. *Bad configuration/set-up*
- g. *Not having real-time data enrichment with third party systems.*

Defining a desired level of matching across records and identifying duplicates can help correct and avoid duplicate entry.

In the digital age, companies are cold-shouldering the quality of resources (relevant & skilled) and ethical traditional techniques and simply looking at new tools and technologies to acquire data. However, the quality of information is a success key for any organization, and avoiding the listed causes of poor data and a bad process can help us focus on improving data quality.

As we have learnt from master piece of wooden block (how precise it would be) for casting, master data object should have perfect dimensions (99.9%) and unique (single truth of record) in today digital world.

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About the author



Subbaiah Bala received the B.Tech. Degree in mechanical engineering from Sri Venkateswara University India, in 1992, and post diploma in computers. S4/HANA professional certified consultant by SAP SE.

From 1993 to 2001 worked for HIL (a Birla group) and Voltas Limited (a TATA enterprise) as Sr. Engineer. He was a Sr. Engineer with Voltas Limited (a TATA Enterprise) and HIL, India a leading high-quality specializing in air conditioning and cooling technology vendor.

Bala has worked for several international notional companies, such as Wipro, BP, GM, Goodyear, Sysco, Cardinal Health, Johnson & Johnson and Norfolk Southern on ERP applications, specialized on enterprise master data management. His interests are in the fields of RAP, Solar Drone, AI and (IoT), including protocol design, and experimentation.

The Nine Pillars of Industry 4.0



Source: <https://circuitdigest.com/article/what-is-industry-4-and-its-nine-technology-pillars>

Best practices for testing AI solutions

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AI is slowly increasing its presence in all aspects of one's daily life and the beauty of it is that not many are even aware of its presence. For those in the software field, it is likely that everyone will encounter an AI application sooner than later. While AI weaves its “magic” and spell bounds us, one key question that stumps software engineers, especially the quality assurance engineers is, “How do we ensure “magic” is working as expected?”

To answer this tricky question we need to comprehend the underlying assumptions and dependencies in artificial intelligence solutions. Moreover, we need to understand why traditional testing methods will not work in most AI projects. This article aims to give a point of view (PoV) on these points along with some strategies and testing best practices that one can adopt while building AI solutions.

The Rise of AI – Changing the status quo in the testing domain

For decades, in the pre-AI era, software professionals build system that they could control in almost every aspect. Data was limited, engineers knew what to expect in all scenarios and solutions were “hand-engineered” to behave as expected. The systems were built with great precision, covering most scenarios. Quality assurance testers knew exactly what needed to be tested and more importantly knew what the expected output is. However, all that changed in the AI era and many assumptions in the pre-AI era suddenly became obsolete.

- **Solutions need not be 100% accurate to move into production:** One of the biggest shift in the AI era is the acceptance of a solution that is not 100% accurate all of the time. For quality assurance professionals, it might be difficult to comprehend this detail. The reason why a 80% or even a 70% accurate solution might be out into production is that the benefits, be it an increase in efficiency or reducing operational cost or even improving customer experience, more than compensates the effect of having an imperfect solution in production. Moreover, AI solutions are expected to improve over time via “Self learning” and feedback mechanisms.
- **Testing everything was difficult before but impossible in the AI era:** One of the key differentiators of the under-lying principles of building AI solutions are the dependencies on data and the critical role it plays on the overall solution. In this data intensive era, this critical component of the solution continues to be unpredictable in production. Just take the example of a chat-bot or a document classifier. The permutation of possibilities increases exponentially as we move from words to sentences, from sentences to paragraphs and from paragraphs to documents (as depicted in Figure 1 below). As such, there is no practical way to test every permutation and combination.

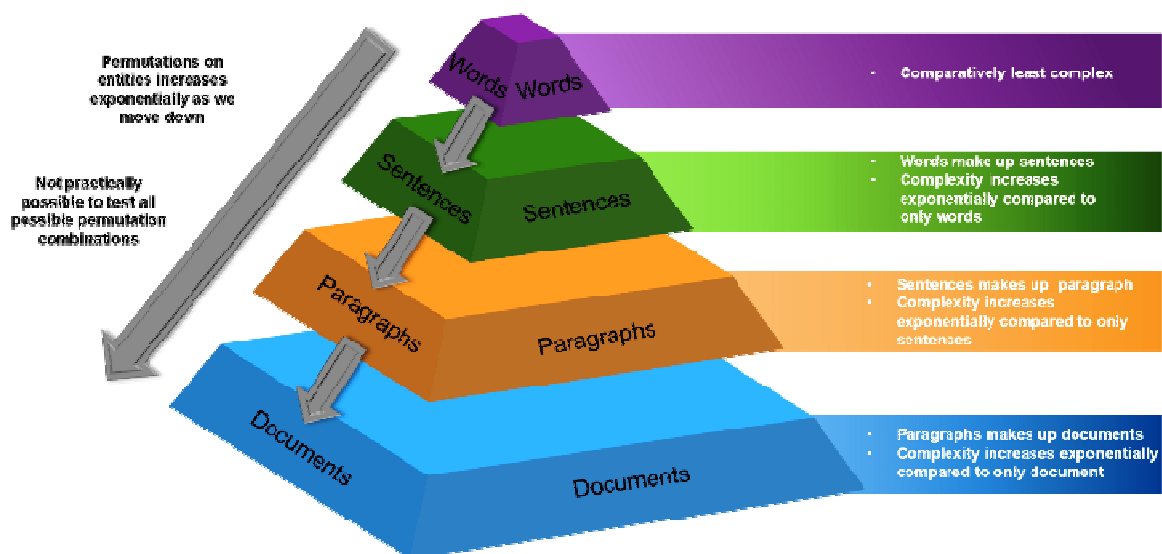


Figure 1: Complexity Increases Exponentially

- **Deployed solution evolves in production:** One assumption that quality assurance engineers used to make was that the solution that they sign off would remain constant until the next release. However, most AI solutions have a feedback loop that constantly evolves over time based on incoming data feeds. The same input need not give the same output always. We cannot do away with this “self-learning” feature for the sake of stability in testing, because in most cases, it is what makes AI “magical”.
- **The technology and data also drives the solution:** Previously, business was the main component that drove solutions. As such, quality engineers needed to know the business to ensure that the solution being built served the end goal. However, today, apart from business, technology and data are also key drivers. As such, QA engineers of today, not only need to understand the business but also the technology and data behind it. This is a shift from the earlier expectations of QA engineers.
- **End users can influence the way the solution performs via Information Poisoning:** End users can influence the way an AI solution performs in the long run, especially in un-monitored self-learning systems. For example, in order to popularize any item in an e-commerce site, one can use bots to retweet, like or share to increase the items ranking unethically. Similarly, biases in sample training data could cripple a solution in the cradle. Biases are often amplified in feedback loops, leading to biased decisions. Human need to continue playing a critical role here. Today, most systems continue to have humans in the loop to ensure that the AI solutions are progressing in the right direction. These concepts would be new to QA engineers who have only worked on traditional applications.
- **Explain-ability and reproducibility of bugs not so straightforward:** In traditional applications, non-reproducible bugs are rare. One of the expectations from the QA engineer when logging a bug will be ‘steps to reproduce the defect’ and the development team is accountable to explain the reasons for the deviation. However, this is not so easy in AI solutions. The end solution is often a “black box” that comes out with the most probable answer. Expecting an audit trail is not so easy in AI based solutions leveraging technologies like deep learning.

Best practices for testing AI applications

Technology has moved on. Business processes has moved on. Methodologies have moved on. It is time for testing practices to move on as well. Over the last few years, AI solutions have challenged the status quo of existing QA processes. While many companies have come out with their own AI testing process, there seems to be no global AI testing methodology accepted across enterprises. As such, rather than come up with another AI testing process, we have highlighted some best practices and points to take care of while testing AI applications.

- **Change in the testing mind-set, from Determinist to Stochastic:** This is perhaps the biggest change that any tester needs to undergo to be good at testing AI applications. Traditional applications in the pre-AI era promoted a deterministic mind-set that expected QA engineers to know what to expect for every input. Every test case is either a ‘Pass’ or a ‘Fail’. Every ‘Fail’ has the potential to delay moving into production environment. However, in the AI era, the results are based on probability and statistics. A ‘Fail’ in the testing environment can very well be a ‘Pass’ in the production environment in future, as more data is available. Any deviation from “as expected results” is not necessarily a failure, but rather a path for the system to improve and evolve.
- **Understanding how critical data is in AI solutions and building test cases to test them:** Unlike in normal non-AI applications, data plays a very critical role in AI applications. They can make or break your solution. However, chances are that testing teams will not have access to actual data and would need to prepare data as closely as possible to actual production data. Here business knowledge and changing trends becomes even more important. Test data preparation would require QA engineers to have an in-depth business knowledge of the use case and understand the mind-set of the end user. Moreover, it is important for them to evolve the testing data sets as well to ensure that they are testing based on the changing trends. Apart from this, teams need to monitor continuously to see if the dataset used to train the model is biased. If a model is trained on a data that is already biased, the AI solution will also be biased. For example, an AI solution trained to predict the acceptance or rejection of a candidate based on historical data could most probably be biased in favour of a particular gender. As quality assurance experts, it is imperative to understand the business and possible implications to ensure these bias scenarios too are tested as part of the QA process.
- **Adopting continuous testing & monitoring:** Testing never ends in an AI project. Unlike normal projects, the system evolves over time based on feedback. As such, it remains critical to have a testing process that compliments a typical AI project. As the system evolves continuously, we need to ensure that the AI model is evolving as dynamically as the external environment. Based on the use case, testing needs to adopt to ensure the various metrics like precision, recall, and f1 score are met to avoid adverse effects to the business brand, performance and compliance. As business gets new data, it becomes imperative that the model be re-trained to adapt to the new data trend.

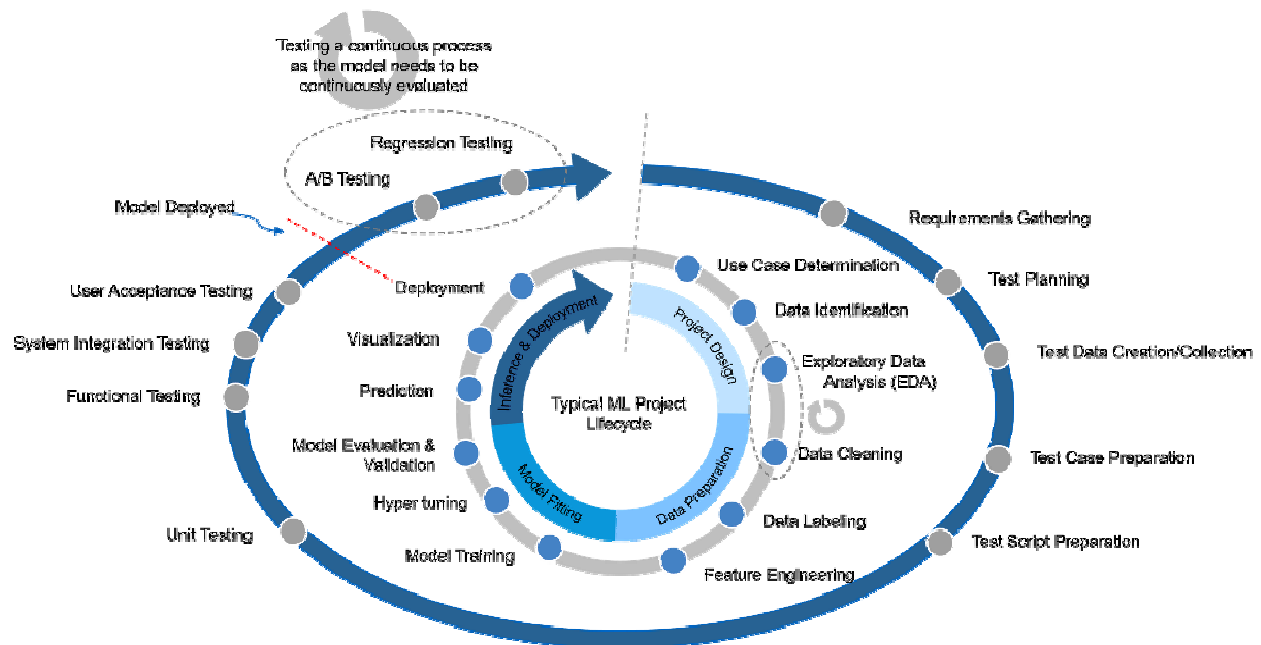


Figure 2: Continuous Testing Post Model Deployment

As highlighted in the above figure 2, even after deployment, the AI lifecycle does not end in most cases. This is especially true for solutions that depend heavily on data. Just as an AI solution evolves over time, it is important to have a continuous testing phase to ensure the model evolution is in the right direction. Post deployment, A/B testing and regression testing plays a critical role in the continuous testing phase.

- **Document the exit criteria precisely early on in the SDLC:** In AI solutions, as highlighted earlier, a 80% success criteria would be sufficient to move from one stage to another. However, how can one measure this 80%? This criteria needs to be grinded down very early on in the SDLC. If the output consist of many components like in, for example, information extraction solutions, we need to understand what the acceptance criteria is for each of the output component. Should some output component be 100% accurate always or are there components that even a 50% accuracy is acceptable? This acceptance threshold needs to be defined early on and the expectation be set (and documented) with all stakeholders in the design phase itself.
- **Pilot first within organization or beta crowd before going to complete public:** As AI solutions are so heavily dependent on data; solutions built for different organization will be different from one another (based on the underlying data). Therefore, one's earlier experience would not be an appropriate indication of future success. Couple that with the fact that the solution will not be having 100% accuracy from day 1 and we can understand the uncertainty one needs to deal with. Today social media exposes technology failure and these uncertainties could lead to bad marketing and branding exercise. Hence, planning to first expose the AI service to a controlled group provides the QA team with an opportunity to test the solution with actual data and identify fragile points, if any. As such, if one's team is closely linked with the customers in defining the roadmap, one should certainly encourage this practice across.
- **Educating customer and managing customer expectations:** AI is undoubtedly in a hype phase. Perhaps the most important step that any team building AI solutions should ensure is to maintain a realistic expectation with the customer. Committing to 100% accuracy in requirement phase (without analysing the data) could provide a false narrative to the customer that AI is not a black box and we are completely in control. Unfortunately, that is not true today. AI is in fact still very much a black box that we can control only to a certain extent. Model accuracy is highly dependent on underlying data. Hence educating the customer of these dependency forms a critical first step for most AI projects. Moreover, it is important to take into account the output deviations that exists in AI projects and educate the customer of these deviations
- **Ensure a smooth handling of exceptions:** Testing every permutation and combination in an AI project is often not possible. Hence, it is important to ensure that an exception-handling scenario exists to ensure that in the worst scenario, the BAU process is followed. Handling of such exceptions needs to be done in a seamless manner to ensure that customer experience is not lost in the whole process.
- **Risk based testing and the need for QA engineers to understand AI technology:** It is not possible to test every scenario in an AI solution. Furthermore, in order to break something you need to understand the foundations on which the code is built on. Traditional application built their code/use case based on business. As such, traditional QA engineer needed to understand business. However, in the AI world, the AI application is built on data and underlying probability algorithms. Hence, QA engineers with an understanding of the underlying data (basic data analytic skills) and some deep learning/machine learning principles would have a better intuition than those QA

engineers with no AI background. With limited time available, this intuition would play a key role in capturing critical bugs early on in the testing phase.

- **Training datasets needs to evolve as well:** In traditional projects, creating data sets is not often a continuous process. It's built during the initial phases of the projects and is used during the testing phase. However, in AI projects, data plays a critical role. As the trend of the incoming data changes over a period, it become imperative for the testing to capture these trend changes in their testing data as well. Teams needs to incorporate this change in their testing strategy.

Conclusion:

QA teams in traditional projects had a mind-set to see things as black and white. However, in the AI era, solutions outputs are not perfect. Seventy percent accuracy with a feedback mechanism might be an acceptable metric going forward. QA activities will undergo a dramatic shift in the AI era. QA engineers need to change their mind-set, learn AI technology concepts, bring changes to existing processes and manage customer expectations. QA engineers certainly have their work cut out in the AI era!

About the authors



Mr. Sojan George has over 12 years' experience in the IT industry and has been predominantly associated with the Artificial Intelligence domain. He currently works as a Business Development Manager at Tata Consultancy Services for the Artificial Intelligence Practice. Over the last 6+ years, he has interacted with multiple customers, across domains, in solving their pain points leveraging AI techniques (like Deep Learning, Shallow Learning, Natural Language Processing) and has helped shape their AI journey. He has completed his BTech from Mar Athanasius College of Engineering, Kothamangalam, Kerala and his MBA from Leeds University Business School, United Kingdom.



Mr. Rajeev M Azhuvath is a hands-on technologist with 19 years of experience. Presently he is part of the Artificial Intelligence (AI) Program in TCS. Primary responsibilities include delivery of architecture focused on AI and building capabilities around shallow learning, deep learning, & natural language understanding. The right mix of consulting experience, delivery experience, servicing experience, research experience, & futurism gives him the unbiased perspective of technology and its impact. Additional areas of interest include advances in Nano Technology, Bio Technology, Information Technology, & Cognitive Science (NBIC). Special interest in Convergence of Technologies & Technological Singularity and its impact to humanity.

IEEE Computer Society's Top 12 Technology Trends for 2020

AI@Edge, non-volatile memory products, and digital twins lead the disruptive 2020 technology outlook

The top 12 technology trends predicted to reach adoption in 2020 are: (More at <http://bit.ly/35lejA5>)

1. Artificial Intelligence (AI) at the edge (AI@Edge).
2. Non-volatile memory (NVM) products, interfaces and applications.
3. Digital twins, including cognitive twins.
4. AI and critical systems.
5. Practical delivery drones.
6. Additive manufacturing.
7. Cognitive skills for robots.
8. AI/ML applied to cybersecurity.
9. Legal related implications to reflect security and privacy.
10. Adversarial Machine Learning (ML).
11. Reliability and safety challenges for intelligent systems.
12. Quantum Computing.0

Using AI on IoT Sensor Data - for predicting health of man and machine

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Introduction

The Internet of Things (IoT) is pervading everyday life of both end-consumers and enterprises as the main technology for “Digitalization” [1]. With the cost of sensors coming down, cloud technology becoming more mature, capacity of internet becoming better and computing platforms on both cloud and edge becoming faster / cheaper / more available, the whole system is poised for a disruptive impact across industries. Different Industry verticals are seeing different business value of using IoT using the context-aware “Sense-Analyze-Respond” cycle [2], where Sensing is via IoT, Analyze is via Artificial Intelligence (AI) and Respond is either via human-in-loop visualization or via robotic actuation.

In an earlier article in IEEE India Council Newsletter (Apr-Jun 2018) [3], we had presented “Cognitive IoT”, which discussed about promised benefits of marriage of IoT with AI. As that promise becomes reality in practice, the true business benefits of such systems are emerging along with some practical problems that need solving. In this article we present real-life use cases for AI-based analytics on IoT data and try to elaborate the practical problems associated with such implementations. We focus on two industry verticals – Healthcare and Manufacturing as use case exemplars.

Motivating Use Cases

According to World Health Organization (WHO), non-communicable diseases (NCD) are becoming the biggest silent killer of humanity – of every 100 deaths occurring in the world (including accidents), 71 of them are caused by NCD like cardiovascular disorders, diabetes, old age problems, neurological disorders and musculoskeletal disorders [4]. The main problem with NCD is the fact that they are very often asymptomatic in their early stages – by the time symptoms are manifested, the disease has already progressed. On the other hand, if the disease was detected in early stage, simple lifestyle changes are often enough to control the disease. Most of these diseases have very well-established gold-standard specific tests to diagnose the disease onset (ECG analysis and coronary angiogram for cardiovascular problems [5] like atrial fibrillation and coronary artery disease, psychometric tests for detection of dementia and mild cognitive impairments [6] in elderly people). But the problem is that people don’t know they have the disease in the early asymptomatic stage and hence they don’t consult a doctor for having these tests done as a screening mechanism. Hence there is a need to create AI-based screening algorithms using easily available data from wearable sensors and home medical devices, which can be comfortably used at home as a screening mechanism for the above-mentioned conditions that can suggest whether to consult a doctor.

In the manufacturing world, there is a similar problem of predicting machine health that can help in more efficient predictive maintenance of machines [7]. A specific problem in this space is prediction of the “remaining-useful-life” (RUL) [8] of machines and machine parts using various sensor data like vibration, current load, heat / sound generated etc. AI driven predictive analytics of the sensor data followed by multi-sensor fusion can yield reasonably high accuracy for RUL prediction. Similarly, real-time control of process parameters to improve the quality of the final product based on sensing the product quality is also an important use case for manufacturing [9]. Creation of such control algorithms can immensely benefit from AI driven inferencing based on learning from past data.

Implementation Examples

There are now very good instances of detection of atrial fibrillation (AF) from single lead ECG data. There was a global challenge arranged by Physionet [10] in which people used supervised deep learning and traditional machine learning based algorithms to achieve nearly 85% accuracy in detecting AF [11], [12]. Similarly significant accuracy has been reported for detection of coronary artery disease using supervised machine learning based classifiers (85% using only heart sound from digital stethoscope [13], 95%+ by augmenting the heart sound with electrocardiogram (ECG), photoplethysmogram (PPG) from pulse oximeter and patient family history knowledge [14].

Similarly on RUL estimation of machines, mean average percentage error (MAPE) of 19% has been reported with False Positive Rate (FPR) in real-life datasets using supervised machine learning techniques [15] [16]. An interesting example of real-time process control using AI and IoT is the case of Friction-stir-welding quality improvements using Friction-stir Welding machines where physics based modelling followed by machine learning based techniques can yield improved results [17].

Practical Points to Ponder

As AI based analytics of IoT data starts proliferating the industry, there are some interesting practical issues cropping up that need attention. Many of these are open questions which the practitioners need to ponder over. We list a few of them here.

- 1) *Trust and Liability of AI-based Inferencing* – It is very unlikely to create AI-based inferencing that is 100% accurate. But this brings in an inherent unpredictability in the behavior of the machine deploying the AI. This raises a bigger question – as human beings are we ready to trust machines that are intrinsically unpredictable [18]? Who will take the liability of decisions made by AI inferencing? For example, if AI predicts a person to have certain kind of disease, who will take the liability of false positive and false negatives? In all such scenarios, AI should not be seen as an independent inferencing system, but an aid to human-in-loop decision making – in the healthcare example, we can think of such an AI system helping a doctor to take a more informed decision about the patient with liability of the decision remaining with the doctor.
- 2) *Interpretable AI* - The idea of human-in-loop inferencing using AI brings in another issue – will the human experts (like doctors) be comfortable with AI systems that don't have interpretable models? Without that, the experts cannot relate the AI driven inferencing to available body of scientific knowledge (like medical knowledge / machine design knowledge). Many of today's deep learning systems on sensor data cannot provide such interpretability and hence may have acceptance issue in the expert community as a human-in-loop inferencing aid [19]. As has been highlighted in the recent ICML workshop on Human Interpretability in Machine Learning [20], *"Supervised machine learning models boast of remarkable predictive capabilities. But can you trust your model? Will it work in deployment? What else can it tell you about the world? We want models to be not only good, but interpretable. And yet, the task of interpretation appears underspecified."*
- 3) *Understanding the Sensor Signal Morphology* – Deep learning based AI systems has shown very good results on human-generated data like images, text or speech (which has an inherent structure governed by some rules like language etc.). But the same cannot be said yet for sensor signal analytics systems where lacks a defined structural model due to varied signal morphology. As pointed out by Prof. Josh Tanenbaum, at MIT [21], *"There's no way you can have an AI system that's human-like that doesn't have language at the heart of it. It's one of the most obvious things that set human intelligence apart."* When we deal with raw sensor data generated naturally by a machine or human body, such structure is lacking, thereby making it difficult for deep learning systems to derive value from it. Hence there is need to augment deep learning based algorithms with traditional signal processing based approach for sensor time series data – such hybrid approaches are already yielding good results [22].
- 4) *Non-availability of data and labels* – Availability of sufficient data to train AI models is always a problem which is more pronounced in deep learning based systems. Even if data is collected and models are trained for one scenario (may be one type of factory or health data from people a particular country), there is no guarantee that such a trained model will work in a different but similar scenario (another factory with similar machines or another country with different demography people). This raises some few very important but practical aspects –
 - a. Few-shot learning [23] and Meta-learning [24] – Systems should be able to learn quickly on a few instances of training data and should be able to use meta-knowledge available to augment the data learning.
 - b. Unsupervised learning and Transfer learning – Systems should be able to infer reasonably in the absence of labels or where labelling can be done on demand by human experts on a reduced subset of the data identified by unsupervised approach. Transfer learning techniques can help in re-training existing pre-trained models from one scenario dataset with a small representative data from the new scenario.
- 5) *AI at the edge* – Edge devices / on-premise devices play a large role in IoT systems. In the context of AI based analytics, they play significant role to provide
 - a. Low-latency, real-time inferencing needed for IoT-driven process control systems.
 - b. Low-battery consumption that is needed for energy-constrained devices like wearable and implantable.
 - c. Privacy-preserving analytics as the data does not leave the edge / premises even for analytics.AI at edge either needs special technique to compress the AI models enabling them to run on constrained edge devices, or have dedicated low-latency, low memory inferencing algorithms, or have special purpose hardware accelerators in the edge [25], [26]. In order to reduce the energy consumption by significant order, completely new processor architectures called neuromorphic [27], that mimic the brain in hardware, are been used to design new chips - such chips, coupled with new sensing techniques called spiking sensors and 3rd generation brain-inspired neural networks called spiking neural networks (SNN) [28] hold the promise of disrupting the low-power edge AI technology.

Conclusion

Creating value via AI based analytics of IoT sensor data has started showing promise in real world deployments. However, there are quite a few practical challenges outlined in this article that needs to be addressed before it creates disruptive impact. In this article, we have tried to look into few of those challenges with specific use case examples in Healthcare (AF and CAD detection) and Manufacturing (RUL estimation and real-time process control). These challenges include Trust/Liability, Interpretability, Signal Morphology understanding, non-availability of data/labels and Edge Computing.

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State of Telecom: A journey to 5G in India

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India is not yet ready for 5G. There is, however, a strong push by stakeholders and policymakers like TSDSI, startups, Department of Telecom and TRAI. While I missed participating in the Indian Mobile Congress 2019, the event itself, the conversations surrounding it and elsewhere, give a fair idea of how the road to 5G is shaping up.

5G, it is said, is the next big thing since Artificial Intelligence. It is the ideal Super Highway of Convergence. Whatever we have seen since the 2000's - involving human to human (H2H) and M2H (Machine to Human) activities, or more so, transactions, or 'events' are becoming possible. With humans and machines being the 'entities' at the edge, the medium involving digital bits - telecommunication in short is morphing into a powerful utility going beyond the essentials.

Cloud (data storage infrastructure) & by extension data centres; devices / sensors, by extension Internet of Things (IoT); the medium (both the transport and physical layer - both in terms of technology & formats) have changed a lot, and enormous efforts have gone into creating a synchronous yet diverse infrastructure.

1995 to 2015: The tryst with Internet

Baby Steps

I never had Internet in my college. We had landline at home or college. Our refuge was the college library. First, the telephones were landline - POTS they called - Plain Old Telephone System. My Electronic and Communication course started with Morse Code and ended with the Spread Spectrum project. I spent a lot of time in the college library to figure out how spread spectrum worked, and then worked with 6 college mates to create our own Codec unit of the spread spectrum device. The project struggled till the day before the externals, and finally, worked on the D- Day. The idea of looking at telecom and Internet did not occur to me till I stepped out of college. All the information needed were acquired old school - handwritten notes or photocopies of books and journals in the library.

My own first experience with Internet was a dialup modem. I remember the late 1990's sitting in Reuters and Wipro offices' and in Kolkata, dialling that number, username and password, and listening patiently to the hush and brrr... sound of a modem. And seeing the Yahoo or Hotmail websites were a luxury. Once a day access to the Internet-Land, after a day long effort was a dream. Beyond the websites, there was email and chat rooms. Communities with common interests - from spiritual to sleazy spawned and one could hop from chat room to chat rooms. Then came Internet calling - one could call through yahoo messenger and the likes.

That was good old BSNL then and VSNL. Both were India's Government run Service Providers. VSNL was then acquired by Tata's. We felt that there was something bigger than a PC and a modem, and the magic of people everywhere being able to reach each other through these two pieces of equipment adorning a table.

"I think the way I feel about the internet is the way some people feel about the ocean. It's so huge and unknowable, but also totally predictable. You type a line of symbols and click enter, and everything you want to happen, happens. Not like real life, where all the wanting in the world can't make something exist."

— Becky Albertalli, [The Upside of Unrequited](#)

Yes, Internet is an ocean. We discovered that when we found that Sify, an Internet Service Provider (ISP) based in Chennai, India. Sify had launched Internet cafes, and we were able to get hourly based internet outside office. We never understood the ability of a company to create the cafes as a public service. With more access to Internet, our horizons expanded. We understood that people could sit in different places and then through their computers, could chat, send and receive emails, and call - basically communicate. Voice and video calls through Internet were still evolving.

Advent of the Browser

In the 2000's, we had more definite use of the Internet. The browsers exploded on one side - starting the evolution of websites, and programs around browsers. Browsers became the window to the world of the web. Applications spawned around the web browser. Early players like Netscape made life simple in terms of understanding and accessing Internet.

Netscape brought the Internet alive with the browser. They made the Internet so that Grandma could use it, and her grandchildren could use it. The second thing that Netscape did was commercialize a set of open transmission protocols so that no company could own the Net. --- Thomas Friedman

The browser essentially made Internet simple and open. This led to more players and developers bringing in technology to common person's use. The browser essentially was one window with an address bar- one could just type the name (domain name) that one could remember and through series of hops, the browser could open pages in different servers / websites across the world.

“Any sufficiently advanced technology is indistinguishable from magic.”
— Arthur C. Clarke, [*Profiles of the Future: An Inquiry Into the Limits of the Possible*](#)

The underlying magic of the TCP-IP protocol and Domain Name Service, conversion of human understandable names to internet protocol address (IP address), which in turn matched machine addresses (MAC) with internet protocol addresses unleashed itself to a simple magic. The World Wide Web now was a mesh of routers & switches connected to servers across the world.

The Search Engine (2)

Things changed dramatically in the early 2000's. Beyond communication, chat and emails, humans want to do something always - search for information. The story goes like this - quoting from Yahoo's own finance page:

Back in 1998, two individuals, Larry Page and Sergei Brin, who were unknown to the technology company offered to sell their little startup to AltaVista for \$1 million so they can resume their studies at Stanford.

The company that Page and Brin were looking to sell was the soon-to-be patented PageRank system and represents the core of Google's existence.

AltaVista turned down the offer to acquire the company. Similarly, Yahoo wanted its users to spend more time on its own platform, contrasting PageRank, which sends a user to the most relevant web site. Then Google launched on its own. A simple web page with plain white background and a blank field - and a search button.

“I did Google him, you know.”
“Oh, so you GOOGLED him Oh, well, that changes everything then, doesn't it? What could I possibly worry about now that I know you've conducted such a thorough Internet search?”
— Alyson Noel, [*Fated*](#)

The Internet just got simpler. The word 'Internet Search' has been replaced by Google since. It is a common word in vogue today. The browser, aka., the Google page now became the new launch point for the 21st century Internet user. With that single field, one could get any information she could want, at the click of a mouse.

Major businesses built websites and created content to ensure that they could catch the netizens' eyes while they 'googled' away. Intelligence built at the back end, called 'search engines' came up with prioritization algorithms, suggestions that could be paid for. Views and clicks became 'Action Items' of the new age businesses.

Personally, the Internet was not 'free' anymore. Users could pay for privileged content on a subscription basis but mostly free, as Steve Jobs said, 'If a product is free, you are the product'. The search engine has changed the world 'marketing and advertising' would be done to reach thousands of users. Businesses became global overnight. New agencies spawned as Search Engine Optimization (SEO) or Internet Marketing specialists.

Core and the Edge

While the Internet user was having her cake and eating it too, the Internet duck was smiling at the browser level, and was paddling furiously underneath. The change in the underlying network technology involved development of both the core and the edge. The personal computer (PC) had become the ubiquitous device at the edge (the human side).

With next generation routers and switches spawning higher switching power and smarter protocols at both physical and the transport layer, including Virtual LANs and new WAN protocols, the Internet became more powerful.

The underlying physical infrastructure moved from coaxial copper to multimode and single mode fibers. The quality of optical fibers increased due to improvements in the field of material science. This would be the single biggest physical infrastructure achievement in the world of Telecom. The fibers could serve for more than 30 plus years, and can handle improved speed as digital bits are transformed into photonic variations and back.

Personally, I had life time experiences and fond memories of laying the fiber, configuring the switches during the first decade of the 21st century as a telecom engineer. I also had the opportunity to setup two Internet Service providers in South India. I did not know that a bigger play was happening at that time.

Telecom Opens up in India - the 2G saga.

India opened its telecommunication sector when it moved into the 2G orbit. I was a telecom engineer with Wipro till 2005 and I had commissioned two Internet Service providers (ARM & Wipronet), &one paging company (Usha Martin Telecom) and who were my clients - both for telecom installation and service. I did not realize that I was a cog in the big wheel of telecom, as the 2G era was ushered in. India's moment in Telecom had come.

“We were one of the first countries in the world to have telecom. In 1850, the first telegraph line was opened in Calcutta city for the use of the East India Company.”

— Pradip Baijal, [THE COMPLETE STORY OF INDIAN REFORMS: 2G, POWER & PRIVATE ENTERPRISE: A Practitioner's Diary](#)

With such an enviable start, it was only imperative that India connected its entire populace to the Internet. And that would usher in the growth era. I remember my first cell phone - a Siemens - it was not a smart phone, but a phone with an antenna. It was digital screen like the LCD watch, green in color. Both incoming and outgoing were charged. We could send and receive text. The joy of talking while walking at any time we wanted changed our lives.

At this point, the Internet and the Mobile were separate. Internet was wired in the last mile. At office or in Internet cafes, there were Ethernet cables with RJ45 cables running to the Ethernet port of the computer. The speed was around 100 Mbps, and eventually we could reach 1G in certain offices - I had the opportunity of configuring switches - Cisco and 3Com, in particular, at the edge.

And back to India's journey: There were more than 23 telecom players - from Russia, Sweden, Norway, France and elsewhere, who came into life in different 'telecom' circles. With the support of Greenbacks and Euros, foreign investors and telecom companies felt that this was a golden opportunity. Spectrum was auctioned and all of them got a slice of the pie. It turned out to be a farce and would fizzle away as the decade wore along. Many of the starters disappeared due to combination of corruption, bad regulation, politics and legal quagmire. India had failed in its first major reform since its opening up of economy in 1991. The 2G saga was a bad episode, and lot of lessons were to be learnt.

3G – the birth of the mobile Wi-Fi & broadband (1):

In 2007, about 40 countries in across the world, and in 2008, India, entered the 3G era. The 3G standard is perhaps well known because of a massive expansion of the mobile communications market post-2G and advances of the consumer mobile phone. An especially notable development during this time is the smartphone (for example, the iPhone, and the Android family), combining the abilities of a PDA with a mobile phone, leading to widespread demand for mobile internet connectivity.

3G has also introduced the term "mobile broadband" because its speed and capability make it a viable alternative for internet browsing, and USB Modems connecting to 3G networks are becoming increasingly common.

3G mobile telephony was relatively slow to be adopted globally. In some instances, 3G networks do not use the same radio frequencies as 2G so mobile operators must build entirely new networks and license entirely new frequencies, especially so to achieve high data transmission rates. Other delays were due to the expenses of upgrading transmission hardware, especially for UMTS, whose deployment required the replacement of most broadcast towers. Due to these issues and difficulties with deployment, many carriers were not able to or delayed acquisition of these updated capabilities.

The Wi-Fi era : Divorcing the wire

I do not remember when I got my first Wi-fi at home. But I had broadband in 2006. It was a modem that had a DSL Port where the wire from outside would pop through a door frame and connect to the router. I had a home computer and it was connected to the DSL modem. This was till 2009. The last mile was still wired at home.

Wireless technology is creating entrepreneurship on a small scale that allows a single woman to set up a business in a small village or a single farmer or fisherman to access and disseminate market information in order to get the best price for their products. --- Peggy Johnson

Well, then it should be 2009 - when I moved to Mumbai, when I got my first DSL plus Wi-Fi modem. It has been 10 years of Wi-fi. What a freedom! That was the time I also moved from a home computer to a personal laptop. When the last mile is 'unleashed' you go mobile. It was fun to browse from any part of the house.

Wi-fi at office & at home enable moving around a lot. It was easier to have one computing unit per person, and enabled office emails, work from home options, work-on-commute options etc. The walk-and-talk became move-and-do world! Imagine the same for businesses - with flexibility, people could do things within the wi-fi range, and work on the Internet.

For a while, I remember, using Reliance – Huawei data-USB, and Airtel Wifi device, which would, when plugged in, create a Wi-fi hotspot. But the experience was patchy, even though the convenience was alluring. That was the birth of mobile hotspots. Even now, the hotspots are patchy.

In my experience, 3G networks were never as visible or user friendly – but we had to climb that steps to reach 4G, when you had the actual trailer but could not see the full movie.

2015- till date:

4G – The promise of the future

4G is the fourth generation of broadband cellular network technology, succeeding 3G. A 4G system must provide capabilities defined by International Telegraphic Union - in IMT Advanced. Potential and current applications include amended mobile web access, IP telephony, gaming services, high-definition mobile TV, video conferencing, and 3D television.

The first-release Long Term Evolution (LTE) standard was commercially deployed in Oslo, Norway, and Stockholm, Sweden in 2009, and has since been deployed throughout most parts of the world. It has, however, been debated whether first-release versions should be considered 4G LTE.

Airtel was the first service provider to offer 4G services in 2012. Reliance Jio, was born in 2016, became India's first 4G only carrier. Today, Airtel remains the fastest network, with Reliance leading in network coverage at 98%.



(Source: Nokia MBIT index)

India's 4G mobile data Internet usage greater than entire population of South America, according to a report. Reports indicate that 2018 year has been the seminal year for 4G telecom growth, as India became the largest feature phone population country in the world.

'India needs more time for 4G infrastructure to stabilize. (3), says, Ookla's co-founder and general manager, Doug Suttles, I tend to agree. All you must do is to travel to an airport vicinity, a highway or in a train. You will find that the signal falling back to 2G and 3G – and most of the applications, which rely on 4G would not work. Voice calls on LTE therefore not as dependent. As the telecom operators have sunk in a lot of investments, it would make sense to expand the 4G reach further in the rural areas. Telecom operators are looking to expand into rural India, where the next 1 billion users of Internet are coming from India's rural hinterland.

'A video is better than thousand pictures'

"I'm just Phil from Rossendale. And now people are screaming for me 'cause I make YouTube videos - it's just crazy!"
— Phil Lester

Enter Youtube - you can watch a movie rather than a set of pictures. And that is a whole new experience. I had one attempt at a video channel, a groggy video when the Chennai 2015 floods happened. But the fact is that most of us have seen a video once a day since 2015. More than picture and text, videos have a lasting impact. For research, entertainment, education, awareness, appeal and fiction, we use videos to good effect. As a standalone form of content, I find videos make good sense.

From cables to Direct-to-home (DTH) channels, we find that the world has moved to Internet - with use of Video on Demand channels like Amazon Prime or Netflix. The ultimate movie experience is now at home, and not in a theatre. And it also has democratized movie making to a large extent. Hitherto newbies come with amazing short and long form content in videos.

My son, a millennial, is now more interested in launching his own career in video movie making. A FIDE rated chess player, he prepares for his matches using Youtube Videos. That more is a proof that videos can contribute to the development of skills! He also works on gaming strategy videos with his gang, and that is another subject altogether. You cannot take the video out of the millennial.

Social media: Beyond talk, Be social

I never had an Orkut account. I had been using Yahoo! account - which gave me the opportunity to get social. Some of my attempted gigs during my IIM stint were through Yahoo Chat rooms, especially in Singapore. City or country specific chat rooms were the closed to social, that one could get before 2009.

2009, I got into Facebook. Facebook itself moved from text to pictures; pictures to videos. Most people want to share what they do, think & opine on social media. Friends, pages and groups are identity and community forms.

“You are what you share.”

— Charles Leadbeater, [*We Think: The Power Of Mass Creativity*](#)

Sometimes, Facebook is catharsis. I have met new people, runner friends, discovered old colleagues and alumni, and new friends I am wanton to connect. It also turned out to be my album - bringing back memories of the past years. Finally, the messenger. The movie *Social Network* describes how people have the urge to share little things.

Linkedin has been the next big thing in my life. Hitherto impossible to meet professionals in my field, respect, respond and reciprocate making things happen in my business and career. I met my business partners through Linkedin and Facebook.

Twitter is the celebrity side of the social media. You can reach, insinuate, spite and vomit at almost any celebrity, and honestly, it is the dirty of them all.

New age social media networks like Snapchat, TikTok, Instagram thrive on videos; and as we have seen earlier, a video talks more than a thousand pictures. Political and social lives are affected on a day to day basis.

You might be aware that India is the largest Facebook and Whatsapp country. Most rural Indians have now smartphones that pack Facebook & Whatsapp. TikTok seems to be the latest fad.

Smart Phones: Mobile is the Internet

The Nokia 3310 was my last non-smart phone. But legend has it that a phone still has 70% battery even after 25 years!

My first smartphone was a blackberry. It was given to Wipro employees as an email + phone combination. The phone had other applications. The famous QWERTY keyboard of blackberry is still one of the best. You could thud away like a laptop keyboard, and it's sturdy keys would hold fast.

“In their phones were antennas, and these antennas sniffed out an invisible world, as if by magic, a world that was all around them, and also nowhere, transporting them to places distant and near, and to places that had never been and would never be.” — Mohsin Hamid, [*Exit West*](#)

The world became smaller when we switched to Samsung Android phones or iPhones. Location services guided by Global Positioning Systems enable one to identify a person's location and then guide food delivery, taxi cabs and other services. A smaller handheld, having memory of more than 1 million times than the hard disk of the world's first computer, empowers a human to do many things at the press or touch of a button.

“Mobile phones ... they're not for communicating, they're for broadcasting. Broadcasting The Show Of Me.”

— Adam Nevill, [*Last Days*](#)

Now put together the video, social media and the mobile phone, I can clearly see that we have one device that has taken away the old school - killed many industries like the calendar, alarm clock and the camera; the Public Call office (PCO's) which were ubiquitous and the landlines at home. Mobile phones are the sixth greatest invention after the fire, wheel, steam engine, electric bulb and the Internet. It is part of my life, both professional and personal - and taking further things nearer and nearer things further.

Convergence: The big event all along

So what had been happening all along? A big event - an event that is a melting pot of technology and humans called convergence.

The world is being re-shaped by the convergence of social, mobile, cloud, big data, community and other powerful forces. The combination of these technologies unlocks an incredible opportunity to connect everything together in a new way and is dramatically transforming the way we live and work. ~ Marc Benioff

This is the biggest event since 1995. In the 30-year journey of Telecom, I have, as a drop in the ocean and cog in the wheel, journeyed the waves and tides of different technology evolutions to converge and disrupt the way business, economy, society & nations evolve and behave.

This is one huge tsunami that many can see but cannot fathom. The essence of 5G is convergence. The boundaries between the SMAC technologies disappear into one piece - we can call it 'platform' and what remains to be talked is the applications. Some of them are

1. Click and Mortar - new age businesses like Uber, AirBnB etc., ;
2. Autonomous Cars - self driven cars connected with GPS, traffic control systems;
3. Internet of Things - millions of devices speak through their sensors and 'things' to sense, act and control action and correction across different applications in manufacturing, telecom, oil & gas, and healthcare;
4. Smart Devices - Television, Wearables, Robots and Drones - each having inherent smartness involving parameters, attributes, content, location and rendering services for different applications;
5. Smart Cities & Infrastructure - Wholesome building, traffic, water, sewer, waste management, utility, security and other systems managed through Internet.

5G is the next leap forward (4)

Beyond the enhancements in the underlying technology, the new 5G wireless devices have 4G LTE capability, as the new networks use 4G for initially establishing the connection with the cell, as well as in locations where 5G access is not available.

5G can support up to a million devices per square kilometer, while 4G supports only up to 100,000 devices per square kilometer

5G Usage scenario

The ITU-R has defined three main uses for 5G. They are Enhanced Mobile Broadband (eMBB), Ultra Reliable Low Latency Communications (URLLC), and Massive Machine Type Communications (mMTC). Enhanced Mobile Broadband (eMBB) uses 5G as a progression from 4G LTE mobile broadband services, with faster connections, higher throughput, and more capacity.

Ultra-Reliable Low-Latency Communications (URLLC) refer to using the network for mission critical applications that requires uninterrupted and robust data exchange. Massive Machine-Type Communications (mMTC) would be used to connect to a large number of low power, low cost devices, which have high scalability and increased battery lifetime, in a wide area. Neither URLLC nor mMTC are expected to be deployed widely before 2021. (4)

The key factor remains that 4G penetration will be the focus of telecom operators and equipment manufacturers for the next 24 months, while the 5G spectrum auction scenario matures. The fact that 4G / LTE will be the fall back for 5G means that 4G needs to stabilize first and penetration needs to increase.

The opportunity for Indian stakeholders to play a global game is here and now. This essentially is for telecom software, device, network manufacturers to look at a global market and push thrust on exports. On the other hand, as the individual pieces of technologies come together, the Indian Mobile Congress brings out the intent of the Indian fraternity.

“We cannot afford to miss the 5G bus for India. The significance of 5G for India cannot be overlooked. 5G will help us leapfrog infrastructure challenges and bridge the digital divide. 5G is not an incremental technology but an integration of systems. Its economic impact alone will have about \$1 trillion by 2035.” - Manoj Sinha, Minister of State (Independent Charge) for Ministry of Communications, Government of India (5)

While the intent is clear, India is far from ready. Telecom providers like Bharti Airtel, Vodafone-Idea and Reliance Jio, the last three standing telecom operators bring about their concerns on the price of spectrum and ROI.

"5G is going to be a game changer and will have massive impact but to get this happen we will have to come together. The Indian government needs to get the spectrum price right for investments to continue. The government must relook at the prices set for the upcoming 5G spectrum auction. The return on capital in the industry is lower than 1%, while the price is significantly high" - Gopal Vittal, CEO, Bharti Airtel.

The benefits shall still outweigh the investments. However, there are still entry barriers for various stakeholders. Standards, spectrum, pricing, right of way for fiber optics are some of the key issues. 5G trials are yet to start. Telecom hardware makers - Huawei and Ericsson have pledged support to 5G trials. Most startups, the latest stakeholders, are yet have incentive, facility or support to create 5G use cases. India is therefore, still 24 months away from embracing 5G.

Personally, my interest to telecom was turned on when we were exploring telecom as an investment theme in our first fund in India. We were looking to start a telecom fund in 2020 - but understood that 5G is the single biggest high tide that will lift all the stakeholder's boats. But with lack of clarity, we have concluded that we may not get the right investment opportunities that can mature and scale without policy and platform clarity. We may consider investing in the last part of our investment cycle as a flower in a bouquet, and not as a primary subject. However, my personal interest remains.

My next article will look at depth the 4G to 5G evolution with a 360 degree view – political, investments, operators, equipment providers, software providers, startups, government's role, regulation and policy.

Please write back your feedback / response and queries to the1.speaks@gmail.com

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About the author



Ashok Subramanian is a business strategist, investment banker & private equity professional running financial and research advisory companies through which he advises & raises capital through first principle approach. He runs Wiselane Ventures Pvt Ltd., a Bangalore based Strategic Ventures Company which focuses on solving growth, turn around and funding needs & challenges of businesses through Private Equity Capital, Structured Finance, Stressed Asset Buyouts & Mergers & Acquisitions. Through his other group companies, he raises equity and debt for SMEs and early stage ventures and technology startups. He has advised technology companies to scale rapidly in revenue and sales the consulting phase of his entrepreneurship. He has worked with Reuters and Wipro before starting on his

own. He comes with 23+ years of technology business, Investment Banking, Private Equity, Consulting and leadership experience in leading and advising businesses on Private Equity, Structured Finance & Turnaround. He also has immense experience managing P&L and managing customer relationships with CXO connect, mentoring sales, relationship, delivery and functional teams to deliver customer/employee satisfaction, revenue and profit goals, manage large customers/deals, manage technology-alliances and complex projects. He has worked with BFSI, telecom, media, utilities, mining, manufacturing, hi-tech, retail, healthcare customers, in India and abroad. An Electronics and Communication Engineering graduate and a Management Graduate from IIM Calcutta, Ashok was the chairman of the Students Activities Committee (SAC) of IEEE chapter of his Engineering college and was awarded the Best Student Award for his contributions by IEEE. He is an avid technology enthusiast and a writer. He writes regularly in LinkedIn Pulse & Medium.com, a leading blog site.

A Look At The 5G Opportunity: <https://seekingalpha.com/article/4204568-look-5g-opportunity>

Cognitive Radio Technology for Sub-6 GHz 5G Communications

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For every ten years, a new generation of wireless technology has been evolving. It was in 2010 that 4G was started and by 2020, it is expected that the 5G replaces 4G and people start using it. The proposed frequencies for 5G are illustrated in Fig. 1. The 5G network promises data rates of 100 times faster than the current 4G with much-reduced latency and you can think of downloading a high-definition movie under 3 seconds using 5G. Such high data rates are possible in 5G by exploring the new mobile-frequency territory called the mm-wave spectrum. There is a large amount of unused spectrum at mm-wave frequencies which have traditionally been the domain of military and aerospace systems. Using mm-wave frequencies will allow more bandwidth to be allocated resulting in the enhanced data rates.

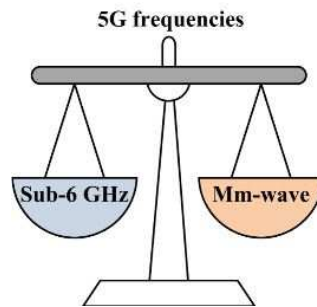


Fig. 1. Proposed frequencies for 5G

Being said that, there are many drawbacks of using mm-wave frequencies for 5G communications. They are mm-wave frequency signals can't travel long distances, can't penetrate through the buildings, easily attenuated by the environmental changes like fog, rain, etc. To cover up these limitations, the experts have proposed the small-cell technology in which small cell stations will be used to fill in coverage gaps between the base station and the user terminal. In a densely populated area, for every 10-100 meters, a small cell station is needed which massively increases the cost of implementation.

Considering the disadvantages of mm-wave frequencies and high-cost of 5G network implementation at mm-wave spectrum, some of the telecom companies are looking towards sub-6 GHz frequencies for 5G communications. Already many applications are using the sub-6 GHz range namely GPS, WiMAX, Wi-Fi, 3G, 4G, S- and C-band satellite communications, etc. Therefore, to use the crowded sub-6 GHz spectrum for 5G along with the above-mentioned applications, a spectrum sharing technique is required. In Mobile World Congress 2019, Ericsson showed the developed system which uses the spectrum sharing technique to enable both 4G and 5G connectivity within the same frequency carrier. The spectrum sharing techniques also minimize the spectrum wastage and help in utilizing the available frequency spectrum more efficiently.

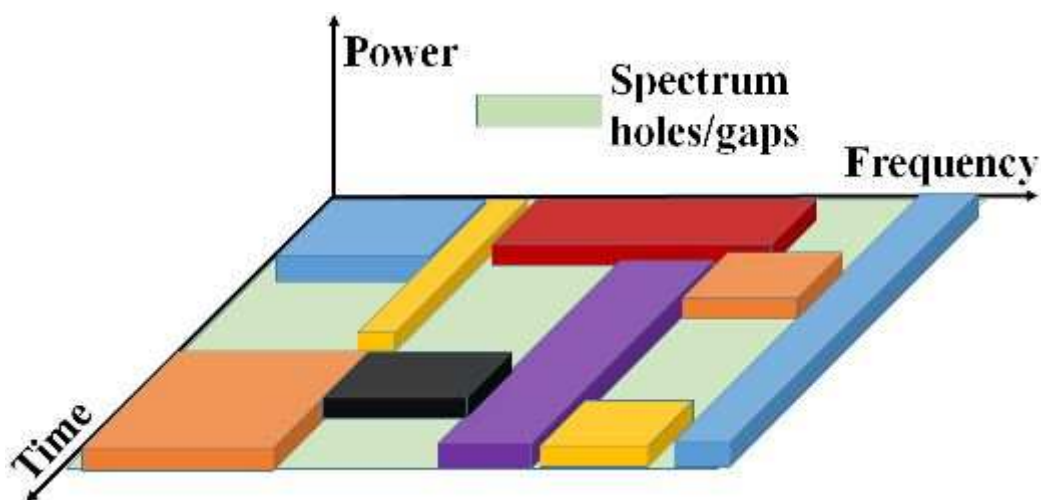
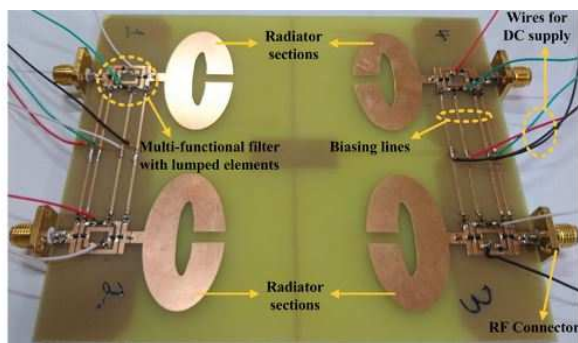
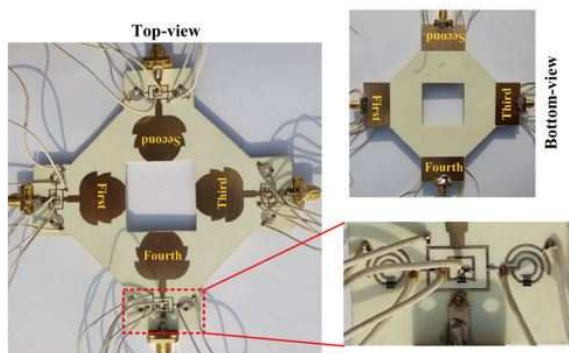


Fig. 2. Showing the holes/gaps of the available spectrum

The cognitive radio (CR) technology is a kind of spectrum sharing technique which dynamically allocates the spectrum between the primary and secondary users and improves the spectrum efficiency. It is expected that the CR technology is going to play a huge role in the sub-6 GHz 5G network implementation. Two users are present in CR, namely primary users (licensed users) and secondary users (unlicensed users). Depending on how secondary users access the same spectrum which is already using by the primary users, the CR technology was divided into two types, interweave and underlay.



(a)



(b)



(c)

Fig. 3. (a) The proposed antenna system of [1], (b) the proposed antenna system of [2] and (c) 5G antenna research group members.

In interweave CR, the entire allocated spectrum will be scanned to locate the spectrum gaps or holes which are set of frequencies that are not using by the primary users. The secondary users will communicate in those spectrum holes, thus increasing the spectrum efficiency. The secondary users will stop their communication whenever the primary users want to use these spectrum holes.

In underlay CR, both the primary and secondary users can access the same spectrum simultaneously but with a condition that the secondary users' communication is not creating any interference to the primary users' communication. At the frequencies where the primary users' communication gets disturbed, there the secondary users immediately stop communicating. In this way, the spectrum will be used efficiently in both interweave and underlay CR without causing interference to the primary users.

Both interweave and underlay CR technologies can be incorporated into 5G communications by designing suitable antennas. For the first time, using a multifunctional filter, the four-port MIMO antenna system which can work for both interweave and underlay CR technologies has been designed in [1]. In [2], the same functionality has been achieved by reducing the antenna system size by 48.3%. The proposed antenna systems of [1] and [2] are shown in Figs. 3(a) and 3(b) respectively. The authors' names and photographs for the reference papers [1 and 2] are shown in Fig. 3(c). To know more about how the antennas need to be designed to make them work for CR technology, follow the references [1 and 2].

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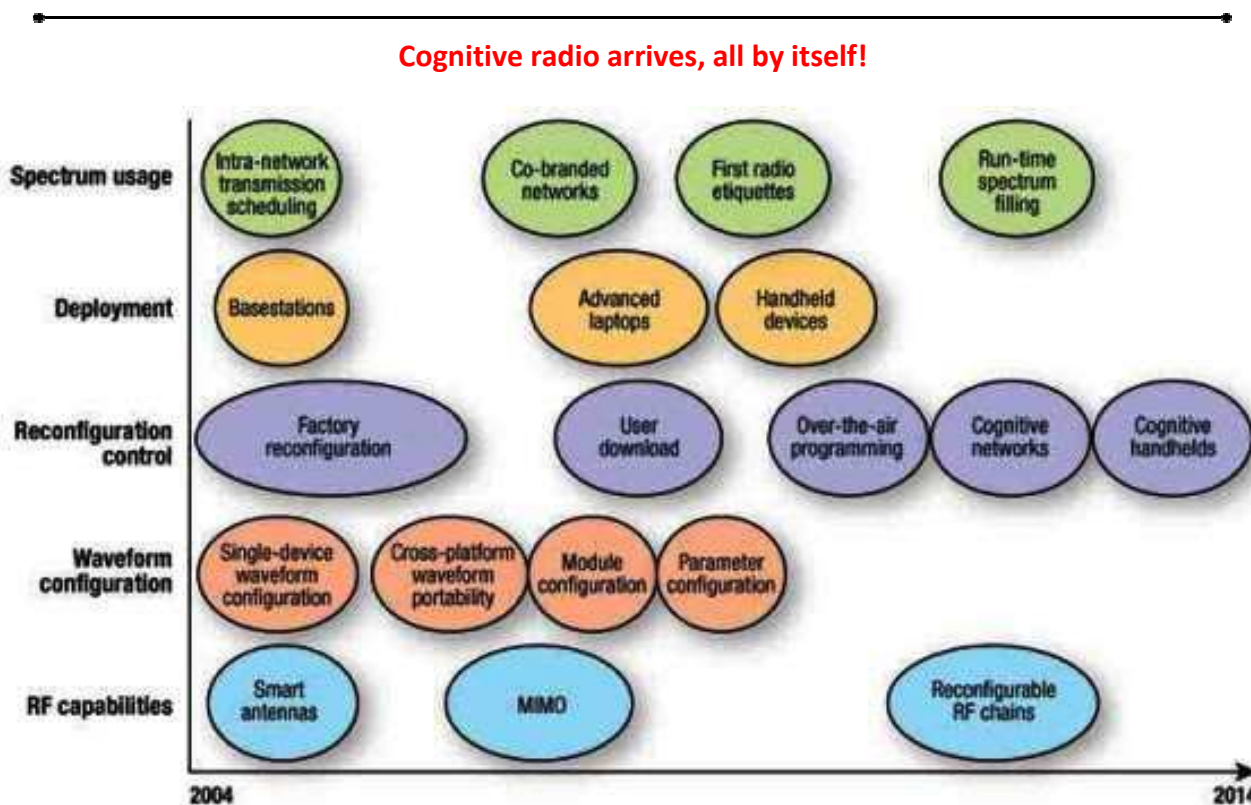
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About the author



Dr. Raghvendra Kumar Chaudhary received the B.Tech. from UIET Kanpur, India, in 2007, the M.Tech. from IIT(BHU) Varanasi, India, in 2009, and the Ph.D. from IIT Kanpur, India in 2014. He is currently an Assistant Professor with the Department of Electronics Engineering, IIT(ISM) Dhanbad, India. He published more than 200 peer-reviewed international journal and conference papers. His current research interests include dielectric resonator antenna, metamaterial antenna, MIMO antenna, and metamaterial absorber. He was a recipient of the Young Engineers Award (2019-20) of IEI (Institution of Engineers, India) and many Best Paper awards in different categories in national and international conferences, such as IEEE APACE Malaysia, PIERS Singapore, and ATMS India. He has served as the Chair for the IEEE Student Branch of Uttar Pradesh Section, in 2012–2013 and currently serving as a counsellor of the IEEE Student Branch of IIT(ISM) Dhanbad. He is an Associate Editor of *IET Microwave Antennas & Propagation*, UK; *IEEE Access*, USA; and *Microwave and Optical Technology Letters*, Wiley, USA. He is a Senior Member of IEEE and URSI, and potential reviewer of international journals such as the *IEEE Transactions on Antennas and Propagation*, the *IEEE Antennas and Wireless Propagation Letters*, etc. He has also been featured interviewed by *IET Electronics Letters*, UK.



Source: <https://www.edn.com/cognitive-radio-arrives-all-by-itself/>

What are Micro Frontends

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Monolithic Architecture:

The word 'Monolith' means interweaving all aspects into a single one. It describes a single-tiered software application in which different components, services etc. are combined into a single program from a single platform.

The components, services etc. can be:

- Authorization and Authentication which are responsible for allowing access to the system and confirming the user's identity within the system.
- Presentation and UI which are responsible for handling HTTP/ SOAP requests and responding via HTML, or JSON/ XML etc.
- Business Logic which is responsible for application logic.
- Integration, responsible for integration with other Application services via Messaging, REST API etc.
- Notification, responsible for alerting application owners via email, messages etc.

Drawbacks of Monolithic Architecture:

Though the Architecture is being followed since decades, and has benefits like simple to develop, test & deploy, with easy scaling, we have major concerns when the application becomes complex. Some of the major drawbacks include the following:

1. Maintenance becomes strenuous, as the application grows huge and complex to understand entirely, it is challenging to make changes fast and more accurate.
2. The entire application has to be redeployed on each simple update.
3. The Size of the application can increase in compite time and slow down the startup time.
4. Reliability – Bug in any Module can potentially bring down the entire process or the instance of the application.
5. Though it seems easy in the initial stages, the monolithic applications have difficulty in adopting new technologies, since the changes in the frameworks may affect the entire application.
6. Monolithic applications can also be challenging to scale when different modules have conflicting resource requirements

Microservice Architecture:

What are Microservices?

Microservices is one of the newer concepts and a variant of a Service Oriented Architecture (SOA). Although SOA has been there for almost two decades while the Microservices came into existence in 2012.

The idea is to have small autonomous services to work together to build a large complex application, it mainly focusses on building individual sub-domains and small services making them easier to maintain, and promotes independently deployable pieces, thus ensuring the internal changes on one service do not affect or require the redeployment of other services.

Benefits of Microservice architecture:

- Since the entire application is decoupled into smaller services, it enables the continuous delivery and deployment of large complex applications.
- Improved and better testability because of the smaller services and faster.
- It enables you to organize the development effort around multiple teams. Each team is responsible for one or more single service. Each team can develop, deploy and scale their services independently of all of the other teams
- Improved fault isolation. For example, if there is a memory leak in one service then only that service is affected. The other services continue to handle requests. In comparison, one misbehaving component of a monolithic architecture can bring down the entire system.
- The microservices architecture allows each team to decide the technology and infrastructure that works best for them, which may be completely different from other microservices that it interacts with for the very same product.

Monolithic vs Microservices architecture

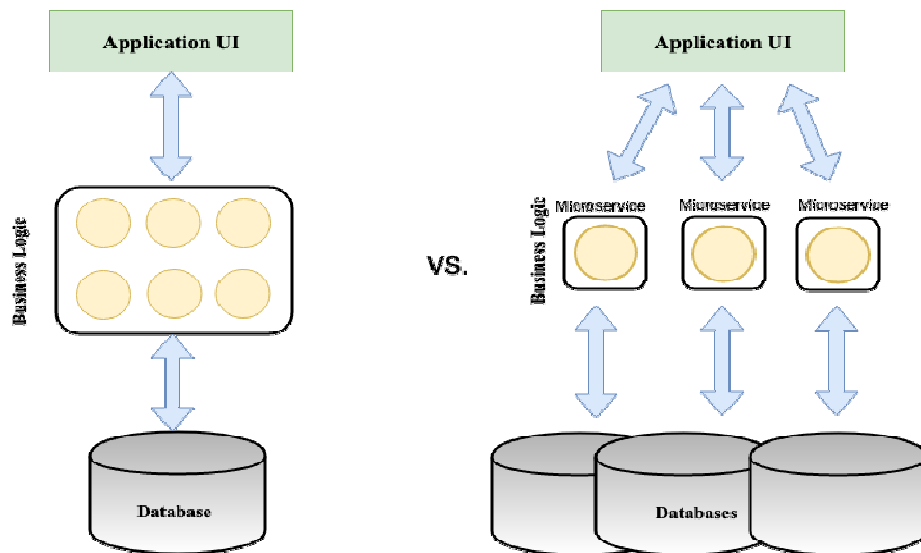


Figure 10. Monolith vs Microservice Architecture.

Key principles for building Microservices:

➤ Modelled around business domain

Before beginning any refactoring, focus on the business domain and identify individual sub-domains and build services. Domain Driven Design would be the best way to start with.

➤ Culture of automation

Provisioning a new machine, operating system and service should be easy and reliable. Automation testing and continuous delivery are very critical as well so as to deploy/ release your software frequently.

➤ Hide implementations

Each service should have its own database and if shared information is needed from other services, leverage Service endpoints designed for the specific sub domain to extract what is expected.

In a case, while a monolithic application to microservice structure, its often considered the easiest to tease part application level code while leaving the shared underlying database as is and this shared database continues to serve as a source of coupling between the independent services far greater than the decoupling achieved by spinning off the application level services.

➤ Decentralize and deploy independently

Focusing on the autonomy i.e. giving freedom as much as possible to do the task in hand, self-service, shared governance and avoid complex messaging are important.

Keep cyclic dependencies and deploy all of them together then fix dependency between services and then continue to create new services.

In such an environment of independent deployments, when you make changes the consumer service has expectations about not facing challenges when you deploy new changes. It's good to have co-existing endpoints during upgrade of a service, which would continue to support existing version for a limited time period so that the dependent can migrate without holding the entire system hostage.

➤ Isolate failures and Highly observable

The microservice architecture wouldn't explicitly make your system stable, On the contrary, it makes the overall system more vulnerable to certain types of network and hardware related issues.

There should be a mechanism to isolate failures and look for more ways to recover such as failover caching and retry logic.

When data needs to be present for the user, which is fetched by multiple microservices it might be challenging because of a lot of performance issues, in this case it's recommended to use different search engine or caching methodologies. This can significantly reduce the pain of performance bottlenecks.

Micro Frontends

What is Micro Frontend?

The trend is to build a powerful and feature-rich web application which resides on top of a Microservice architecture. Over a period of time the front-end part of the application becomes huge and large, which is developed by a separate team and gets more difficult to maintain, this type of application is called Frontend Monolith.

Micro-Frontend is a Microservice approach to front-end web development. The idea behind Micro-Frontend is to decompose the web application into smaller units based on the screens representing domain-specific functionality instead of writing large monolithic front-end application.

Micro-Frontend application is a composition of features owned by different independent teams, where a team is cross-functional and has ability to develop end-to-end features, from the user interface to database. It gives the same level of flexibility, testability and velocity as of microservices.

Problems with Frontend Monolith

- The flexibility promised by microservices cannot be scaled across the teams i.e. the backend team cannot deliver business value without the frontend being updated
- There would be a classical overhead of a separate backend and front-end team, which would cause the entire front-end to be updated and re-tested for a change in the API of one of the services.
- In a Single Page Application, all the files would be bundled into one and rendered on the browser, this file size would be huge.
- As applications grow, so does the features that teams need to support. With multiple teams contributing to a monolithic application, development and release coordination is a tedious.
- Newer frameworks and libraries like Angular 2, React, Vue, etc offer considerable performance improvements and innovations on the front end space. However, the onerous task of upgrading a monolithic application and/or making it interoperate with these new frameworks and libraries often can't be done without compromising the ability to ship new features at existing release rates.

Monolithic front-end vs Micro-Frontend architecture

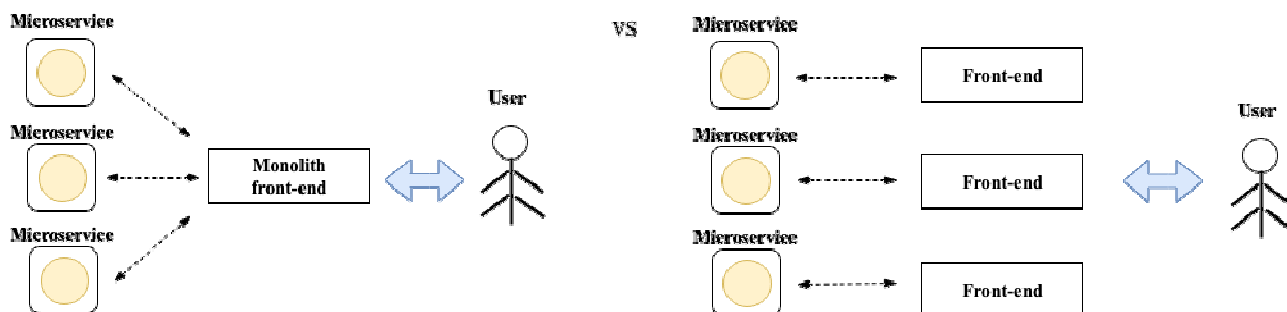


Figure 11. Monolith Frontend Vs Micro Front-end

Why Micro-Frontend matters

In the Modern era of cloud web applications, the front end is becoming bigger and huge and the backend is getting less important as most of the code is written on the front-end, because of which monolithic approach doesn't work for a larger web application. This asks for a need of tool for breaking it up into smaller modules that act independently. The solution to the problem is Micro Frontend.

Patterns followed while building micro frontends

Integration in the Browser

Web components provide a way to create fragments of Front-End imported into Web applications. Those fragments can be packaged into Microservices together with the back-end. Services built, completed with both logic and visual representation packed together. By using this approach, Front-End applications reduced to routing makes decisions involving which set of components displayed and orchestration of events between different web components.

Web Components

Web components allow the creation of reusable components imported into Web applications. These are like widgets imported into any Web page. These are currently supported in browsers such as Chrome, Opera and Firefox. If in case, the browser does not support web components natively, compatibility accomplished using JavaScript Polyfills

Web components consist of 4 main elements used separately or all together –

- **Custom Elements**

This method allows to create custom HTML tags and elements with Custom Elements. Each Elements has its own CSS Styles and scripts. By creating own HTML tags it provides the flexibility to apply CSS Styles and add behaviours through scripts.

In Web components, element lifecycle call-backs are available, which allow defining behaviours specific to the component developing.

- **Shadow DOM – the DOM is the API**

Shadow DOM combines HTML, CSS and JavaScript inside a Web Component separated from the DOM of the main document when these are inside a component. This separation is similar to the one user while building API services and consumer of an API service does not know about its internals, the only thing that matters for a consumer are API requests. Such service does not have access to the outside world except to make requests to APIs of other services. Similar features observed in web components. Their internal behaviour not accessed outside, except when allowed by design nor affects the DOM document they reside in. The main method of communication between web components is by firing events.

- **HTML imports**

For web components, HTML imports are the packaging mechanism. HTML imports tell DOM, the location of a Web Component. In the context of Microservices, import remote location of service contains the component to use.

HTML imports is a method to reuse and include HTML documents via other HTML documents. Predefined components as HTML imports, where each of them include own styles and scripts, decide on the top level which HTML import present in DOM at the moment, and the imported document handles rest of things.

- **HTML Templates**

The HTML template element holds client-side content not rendered when a page loaded. It's instantiated through JavaScript. It is a fragment of code used in the document.

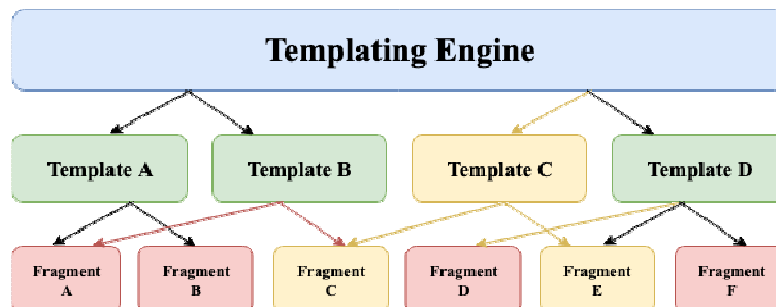


Figure 12 Templating Engine rendering fragments

Whenever user enters the website, the request is passed to Templating Engine, which, based on request URL, recognizes which template is expected by the user, loads it, and then populates it with content of corresponding micro frontends.

Benefits of Micro Frontends:

The key advantages of a micro frontends architecture over a monolith are:

- **Gives teams their release autonomy and time back**

By breaking features from the monolith into separate micro frontends, teams enjoy increased autonomy and flexibility when releasing products/features. No longer are teams who aren't releasing required to stay up late on release calls trying to regression test other teams' changes in production. In other words, testing becomes simple as well as for every small change, you don't have to go and touch entire application.

- **Self-Independent**

The individual development team can choose their own technology, not having to rely on the entire codebase reduces dependencies and scope, enabling teams to onboard and deliver quickly. This creates room for time spent innovating without fear of breaking other teams' features.

➤ **Highly Scalable & better performing web-app**

A loosely coupled architecture with established global standards makes it easier to add new features or spin up teams when needed. Since each app is fragmented into its own micro frontend, if a single feature (one micro frontend) on an enterprise app isn't loading fast, it won't affect the performance of the entire application. It also makes it possible for certain parts of a webpage to load faster, allowing users to interact with the page before all features are loaded or needed

Challenges of Micro Frontends Architecture

➤ **Rollout Strategy**

A major implementation consideration is deciding if one should convert their monolithic application to a micro frontend using a big bang or phased approach.

➤ **Governance**

The dependency needs to be managed properly. The collaboration becomes a challenge at a time. The multiple teams working on one product should be aligned and have a common understanding, though when there is change in multiple directions in terms of organizational and technology strategy.

➤ **Better Testing Strategy**

While a monolith creates an all-teams-on-hands approach to releases, micro frontends enable only contributing teams to take part in a given release. This approach requires that teams implement best-in-class regression testing practices to make sure broken features are not released to customers.

➤ **Legacy frontend frameworks**

The UX consistency is an important aspect. The user experience may become a challenge if the individual team go with their own direction hence there should be some common medium to ensure UX is not compromised.

As newer frameworks and libraries are being released at an exponential rate, the ability to create interoperable UI components between frameworks requires building reusable foundational elements which is time-consuming as well.

Conclusion :

As frontend codebases continue to get huge and more complex over the years, there is a growing need for more scalable architectures. We should be able to draw clear boundaries that establish the right levels of coupling and cohesion between technical and domain entities with the ability to scale software delivery across independent, autonomous teams.

While far from the only approach, there are many real-world cases where micro frontends deliver these benefits, and the technique is being gradually applied over time to legacy codebases as well as new ones. Whether micro frontends are the right approach for you and your organization or not, we can only hope that this will be part of a continuing trend where frontend engineering and architecture is treated with the seriousness that we know it deserves.

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About the author



Santhosh Krishnamurthy holds around 6 years of experience in building mobile & enterprise cloud applications for domains like Wholesale Banking, Air Cargo etc. He has worked in companies like Unisys. He is currently working as product engineer for Ariba Contracts Team in SAP Ariba. His interests are towards building mobile based application, ethical hacking. He loves playing AR based games, sports and movies.

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A 29-year-old UK-based woman has said that Amazon's voice assistant Alexa went "rogue" and told her to make sure to stab herself in the heart "for the greater good". Danni Morrith had asked her Echo device about 'cardiac cycle' while studying when Alexa answered that beating of heart was body's "worst process" and bad for Earth as it caused overpopulation.

Pictures released by Russian President Vladimir Putin's press service appeared to show that he uses Windows XP operating system on his official computer. It is also installed on Putin's computer at his Novo-Ogaryovo residence near Moscow, reports said. Microsoft last provided security update for Windows XP in 2014 and warns computers running it might be more vulnerable to security risks.

Mining the Powers of Open Source

A Case-Study on Usage of Open Source in Institutions

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Abstract

Free and Open Source Software (FOSS) has steadily penetrated into the cyber world owing to the multifarious advantages it offers. Usage of FOSS can be found in various products such as internet browsers, web servers, e-commerce platforms etc. In this paper, we have given a report on how FOSS can be used in institutions effectively. In order to ascertain the effectiveness of FOSS in institutions, we have provided the arenas in which FOSS has been adopted in our institution, Thiagarajar College of Engineering (TCE) Madurai.

I. Introduction

Free and Open Source Software (FOSS) are products developed for users by users [1]. FOSS users form communities and develop the products without the involvement of the manufacturer. This provides multifarious advantages. From the view point of economy, FOSS reduces CAPEX and OPEX to great extent [2]. Commercial products are made to satisfy people at large and increase their profit. As FOSS users have direct access to the source code, they can feel free to experiment on the source code and custom craft it as per their needed. Hence, innovation is guaranteed with FOSS and also vendor lock in is completely evicted in FOSS. FOSS is easily adaptable to any new use cases. Since source code is available, bugs can be easily rectified as and when it rises. It also provides a great opportunity for developers to showcase their talent and gain experience of developing a software. There are numerous merits of FOSS. Owing to these merits, FOSS has been used and accepted widely by the cyber community.

FOSS finds usage in various applications starting from servers to mission critical hardware [3]. Various commonly used examples of FOSS are [3]- internet infrastructure technology such as Perl, MySQL, PHP, Apache; internet browser such as chrome, Firefox; server and desktop operating system such as Linux, Haiku, FreeBSD, NetBSD; desktop application software such as GIMP, Blender, OpenOffice; web applications such as WordPress, Mediawiki; python programming language; email client such as Thunderbird, Sendmail; DNS server software BIND; typesetting software TeX etc.

FOSS is also widely used in various academic institutions. For instance, virtual learning system like Moodle, learning management system like Sakai are used for betterment of students. Various institutions have also developed their own FOSS tools. For instance, Stanford University has developed FOSS tool named Stanford University Unstructured (SU²) using open source C++ collection, to analyse complex multi-physics problems and solve constraint optimization, partial differential equation problems [5]. RWTH Aachen University has developed a speech recognition system open source tool [6]. Similarly, various academic institutions have adopted FOSS. We have also used FOSS to automate the activities in our institution Thiagarajar College of Engineering (TCE) Madurai. In this paper, we will give a detailed report on the usage of FOSS in our institution to show the benefits of FOSS.

The rest of this paper is organized as follows. Section II gives an overview of the objectives and activities of the open source group in TCE. Section III states the various research work undertaken by the members of the open source group. Section IV explains the projects done by open source members for use within the TCE campus. Section V gives a concluding note and future planned activities by the open source group.

II. Open Source Group at TCE

TCE has an open source community known as GNU/Linux User Group (GLUGOT). GLUGOT was started in December 2003 with an objective to promote FOSS and develop innovative spirit of cooperation among the students. GLUGOT also has more objectives. GLUGOT aims at developing research projects using FOSS. GLUGOT also strives to collaborate with National and International Universities and Industries to develop open source projects. GLUGOT has a mailing list named <http://lists.tce.edu> hosted on the TCE Mail server. GLUGOT also contributes to the community in the form of awareness

meetings, technical meetings and training program. In addition it organizes discussion groups, configuration and bug squashing sessions.

III. GLUGOT Research activities

GLUGOT group members are actively involved in various research activities using FOSS. The various research domains in which GLUGOT is active are network security, Natural Language Processing (NLP) and parallel algorithms.

GLUGOT SDN security research team utilizes various open source tools to research on the next generation network paradigms like Software Defined Network (SDN) and Information Centric Network (ICN). SDN research team has built a testbed using openflow protocol and open source controllers (RYU, POX) [7]. SDN research team has also come up with solutions for various security breaches using open source emulator Mininet and Mininet-WiFi [8][9]. ICN research team has come up with solutions for security breaches in ICN using open source simulator NDNsim [10][11][12].

In the field of NLP research is going on in various domains like development of tools to localize Tamil language, categorize the text and efficient document representation using FOSS. Semantics is a key process in NLP. Semantics help the computer to elicit the meaning of natural language of human. Negative words have a deep impact on a sentence. It is pretty hard for computer to elicit the meaning of a negation sentence. Research team has come up with various solutions to negation semantics using FOSS [13]. One more challenging task in NLP is to pick up relevant response to a query from a huge corpus of documents. Solutions to this issue is also completely got using FOSS by NLP researchers in TCE [14]. Yet another challenging task in NLP is reading comprehension. In this, the computer has to understand a given passage and answer the questions raised by the users. Research team in TCE has utilized a machine learning approach to impart intelligence to computer using an open source machine learning library named TensorFlow [15][16].

Research is going on in the field of parallel algorithms. We have GPU computing modules powered by FOSS to research on parallel scientific engineering problems. We have high performance cluster comprising of 1 master and 32 slave nodes. Open source Message Passing Interface (MPI) provides defined APIs. Researchers at TCE have used open source to design parallel algorithms for organizing a large corpus of web pages for easy retrieval [17][18].

Similarly various research works are going on in different domains using FOSS. Researchers at TCE have utilized FOSS to bring about solutions for the most necessary day to day problems in society like water security [19]. Thus through FOSS, we are also able to give back most useful solutions to the societal problems.

IV. GLUGOT Projects within TCE

GLUGOT has automated several processes within TCE using FOSS. We will describe few processes in this section.

A. TCENet

TCENet is a FOSS based ERP package developed to automate the day-to-day activities of TCE from student admission to alumni association. It has 30 modules such as online news, attendance, alumni, online assignment, placement, software forum, poll, maintenance, e-circular, feedback, internal assessment, articles, dues, profiles, nominal rolls, time table, search, hot downloads, right now messages, thought for the moment, birthday wishes, calendar, online assignment, achievements, status report and video lectures. Figure 1 shows the screenshot of TCENet.

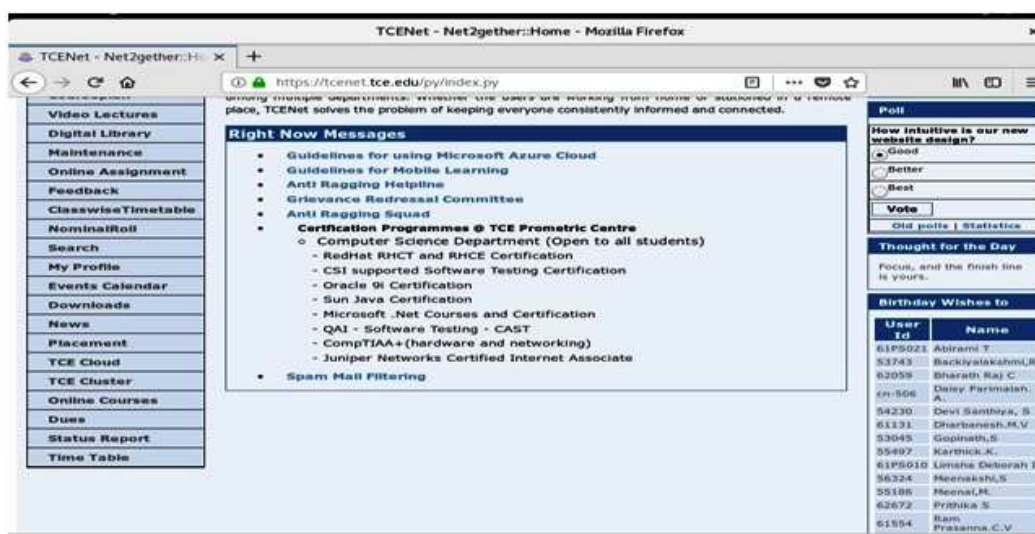


Fig. 1 TCENet page

The platform used is Debian 9. The web server used is uWSGI and nginx. AngularDart is used for client-side web app development framework. Pyramid framework is used for server-side web app development. PostgreSQL 9.6 is used for database. Template engine used is Jinja2. Python3.5 programming language is used. GitHub and bitbucket are used for version control system.

B. Single Sign-On Central Authentication System

The main policy is '1 user: 1 password' i.e. user access to all machines inside TCE campus in various laboratories using single user-id. All servers and machines inside the campus are integrated with centralized computing centre servers. A centralized storage box NAS box has been configured for users to store or upload files. Shell server has been configured for accessing local file storage outside TCE campus. OpenLDAP based Central Authentication System is configured. Samba based file server is used to authenticate with LDAP. A domain controller is configured in order to facilitate access from both GNU/Linux and other operating systems like Windows.

C. TCE Admission Automation

TCE admission automation is a web-based student admission process which includes students record creation, certificate verification, fee collection, course registration and report generation. This module also uses FOSS tools like Pyramid framework, bitbucket etc. Figure 2 shows a screenshot of the TCE admission portal.



Fig. 2 TCE Admission Automation

D. TCE Attendance Monitoring System

TCE attendance monitoring system is a combination of RFID and biometric technology. Various terminals capable of reading smart cards and finger prints are installed at every department building in TCE. These terminals are connected to the IP network infrastructure of TCE, thus giving instant access to the databases and servers of TCE. The time management and leave management are combined with attendance monitoring system. This module also purely runs using FOSS. Figure 3 shows a screenshot of the user portal of attendance monitoring system.



Fig. 3. TCE Attendance Monitoring System

The main components of the website are home page with links to institute, departments, courses, admissions, activities, photo gallery, alumni, library, placement, intranet links, news, events, search and other information. All these are built and maintained with FOSS. Figure 4 shows a snapshot of the website.

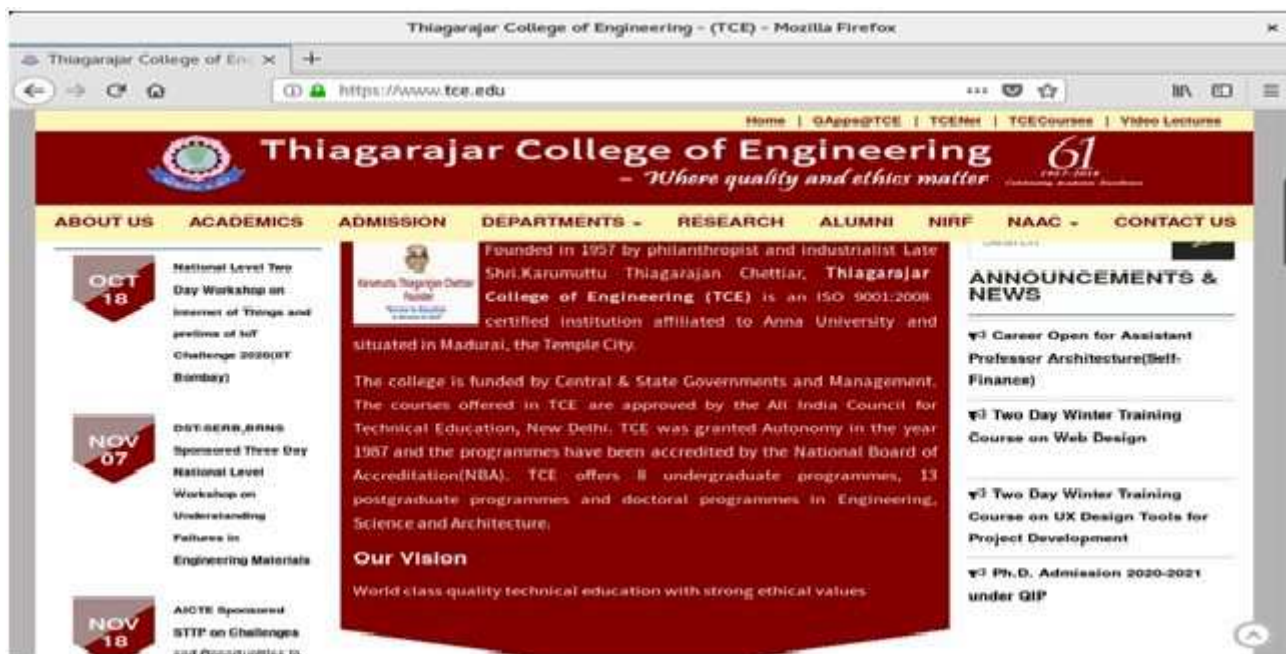


Fig. 4 www.tce.edu

F. TCE Firewall

We have a custom-made firewall built using iptables and bridge-utils. The commodity PC hardware runs no other service other than the firewall. NAT for internal networking is done using iptables in the TCE proxy server. Port forwarding and blocking is also included. TCE wide web cache using Squid is also used. To monitor the traffic load in each department in TCE, we have used Multi Router Traffic Grapher tool. This can effectively indicate unusual traffic surge. It is also possible to core down the source of traffic surge using the Multi Router Traffic Grapher tool. Figure 5 shows the snapshot of TCE traffic monitoring portal.

TRAFFIC ANALYSIS FOR THIAGARAJAR COLLEGE OF ENGINEERING

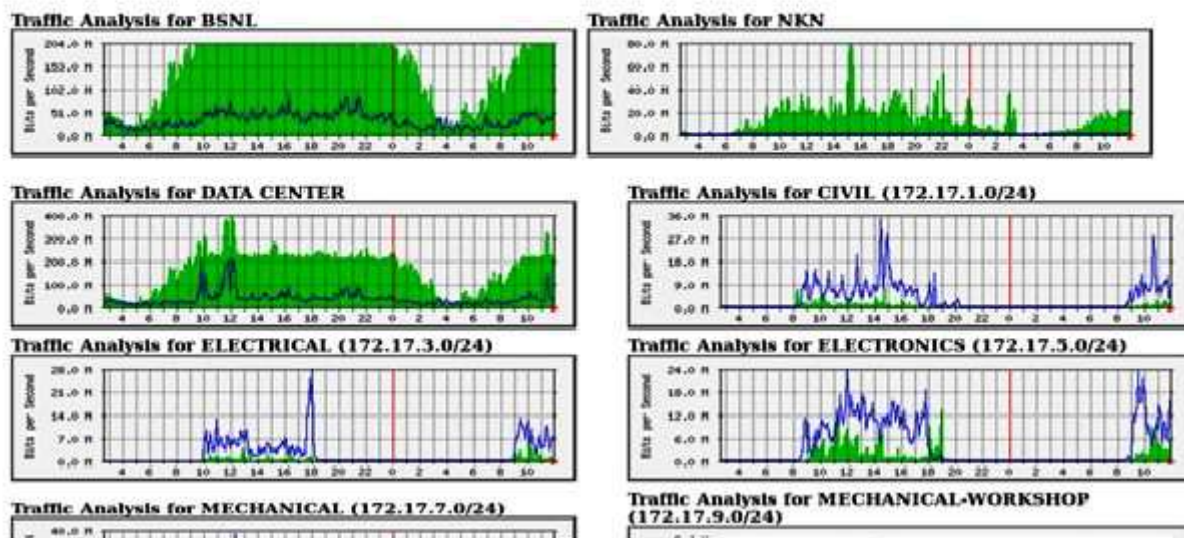


Fig. 5 TCE Traffic Analyzer

Similarly, almost all the activities are automated in TCE using FOSS. Examination related activities like pre-examination work, exam schedule preparation, exam attendance tracker, fees collection, revaluation applications, marks entry, result publishing etc. are automated using FOSS. TCE has its own datacenter which is completely automated using FOSS. TCE hosts a private cloud exclusively for usage of TCE faculty and students. TCE cloud was completely set using Openstack. Like this office activities are also automated using FOSS. Utilizing FOSS gave us various benefits. Prime advantage we had was cash freedom to use software and we were able to invest in hardware rather than software. We were able to customize each and every module based on our needs. Students were also given opportunities to code some modules which gave them a good experience. Using this experience various students were able to become entrepreneurs and had started their own company.

IV. Conclusion

In this paper we have briefed on the powers of open source by providing a case study of open source in institutions. We have provided the ways in which open source is used in our institution. Starting from research to automation of campus activities, our institution utilizes open source. This is a live example showcasing the powers of open source. We plan to automate remaining manual activities in our campus using FOSS for improved efficacy in future.

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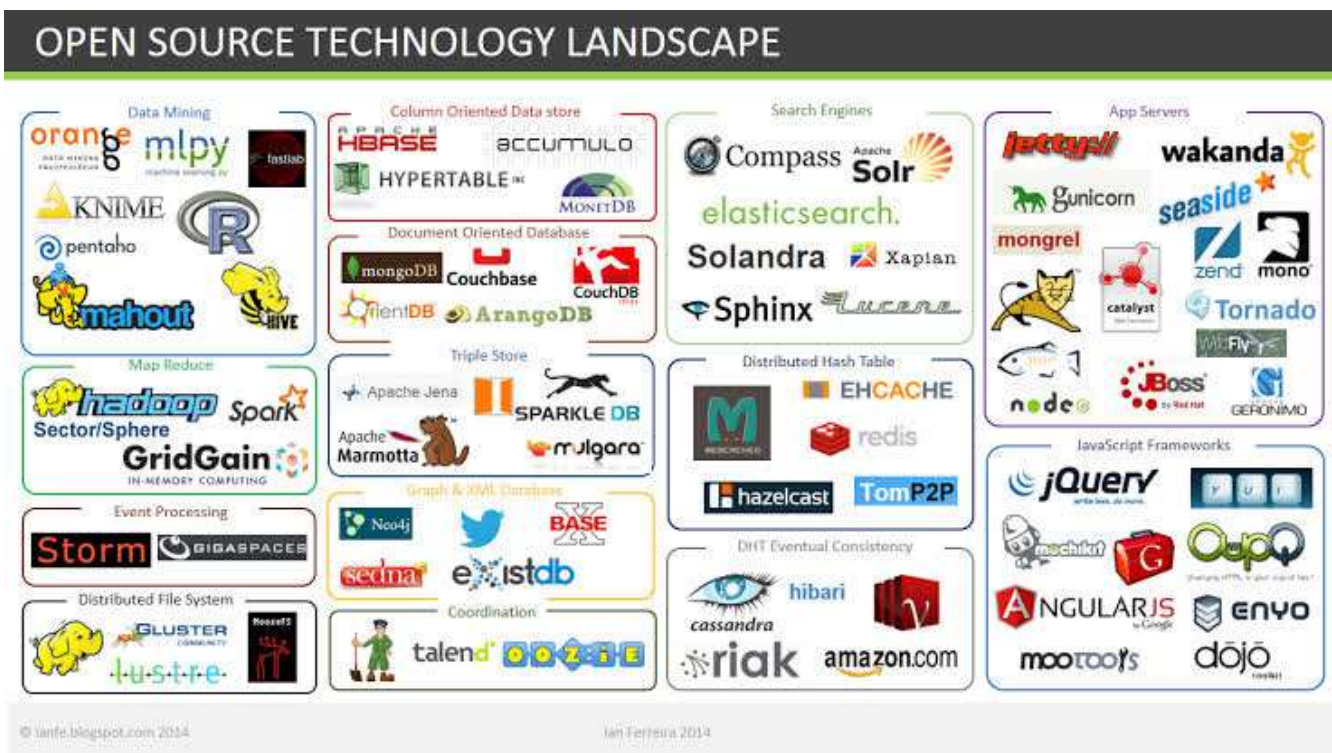
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Why India must amend its Information Technology Act in the age of Artificial Intelligence

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The world of technology is changing rapidly and impacting us in a variety of ways. The three important and inevitable technologies gaining widespread momentum and causing profound transformation in the cyber world are big data analytics, Artificial Intelligence (AI), and Internet of Things (IoT). India is the most cyber-branded country in the world due to its human potential, capabilities, and contributions. India and its people have been steadily migrating to the digital world enjoying several benefits that digital technologies offer. But this digital transformation also enhances the risks and threats that digital applications and internet-related activities present which has potential to escalate further. As the 'complex cybersecurity landscape now faces several new threats' as cautioned by San Murugesan(1), it is important for India (as well as other countries) to satisfactorily address cybersecurity and privacy issues. India needs greater and stronger digital governance, code of ethics, regulations, and laws.

The Indian Information Technology Act 2000 (2) (ITA, also known as IT Act) is nineteen years old with a single amendment in 2008. The IT Act provides a legal framework for electronic governance by giving recognition to electronic records and digital signatures, and defines cybercrimes and prescribes penalties for them. The Act also directed the formation of a Controller of Certifying Authorities to regulate the issuance of digital signatures. The amended IT Act 2008 was created to address issues that the original bill failed to cover and to accommodate further development of IT and related security concerns since the original law was passed.(3)

Since the establishment of IT Act in 2008, the digital landscape had changed vastly for good and for worse. The three new major transformative technologies that is transforming Indian digital landscape are Big data analytics, the Internet of Things and Artificial Intelligence. And, the threat to the digital space increases every second and the modern cyberwarfare aims to sabotage citizens and the business, systems, critical national infrastructure and the government. Therefore, it is necessary to significantly change our perception of and approaches to address new cyber risks and threats, This calls for action at different levels including central and state governments to prioritise budgets and amend laws in comparison to those that focus on national security.

Government has no option other than building a holistic approach to 'cyber policy' and establish 'cyber governance' by introducing newer and stricter laws relating to cyber activities. Ever since the IT Act 2000, commonly known as the Cyber Law, came into existence the Cyberworld has experienced many changes. Some of the provisions of the Act have become redundant and incapable of addressing the currently persisting issues and rapidly evolving changes and threats. This necessitates immediate amendment of the IT Act to satisfactorily deal with the current threats and issues in a constantly changing cyber environment.

BIG DATA ANALYTICS

Big data analytics is one of the recent advances in technologies that support high-velocity data capture, storage, and analysis. Currently, it is an important of research and practice.

Cox and Ellsworth were the first to identify the term "Big Data." They defined big data analytics as a "challenge for computer systems: data sets are generally quite large, taxing the capacities of main memory, local disk, and even remote disk" (4).

Data protection laws

Big Data demands more and better legal protection measures. For instance, to enhance 'data protection,' new sections (data protection laws) need to be included in the IT Act. . The increased Cyber activities of individuals and businesses have increased vastly and spans shopping, banking, logistics, travel, gaming, entertainment and social networking, online reviews and comments among others. This has necessitated and resulted in 'information sharing culture' in which personal information like email address, phone number, address, credit card details, personal interests and activities as well as other important personally identifiable information (PII) which is any data that could potentially identify a specific individual such as biometric **information**, medical **information**, and unique identifiers such as driving license number, passport or Aadhaar card number. This increases the risk of cyber-attacks. It is the responsibility of the government to initiate and employ suitable data protection laws in line with the European Union General Data Protection Regulation (GDPR) and other an international standard to ensure the privacy and protection of its citizens, business and industry.

Privacy rights in the International arena

Privacy is a fundamental human right recognized in the Universal Declaration of Human Rights (UDHR), the International Covenant on Civil and Political Rights (ICCPR), the UN Convention on Migrant Workers and the UN Convention on Protection of the Child, and in several other international and regional treaties. However, privacy has been directly related to the technologies at the time.

Understanding this, Europe changed the privacy laws which are the most significant change. In May 25, 2018, the European Union's General Data Protection Regulation (GDPR) replaced the 1995 Data Protective Directive (DPD). However, the regulation has limitations. The data regulated by the GDPR is applicable to individuals and does not apply to organizations. In addition, the GDPR does not apply to an organization or instances that does not directly deal with or target people in the European Union.

India and Big Data Analytics

The India's Aadhaar programme introduced in 2009 is the world's largest biometric identity platform. It is an initiative of the Unique Identification Authority of India (UIDAI) to help the government provide services to intended beneficiaries. UIDAI, Census of India, Stock Exchange, the Income Tax Department and few other government agencies are employing Big Data Analytics for various purposes. Besides the government sectors, non-state actors including telecom providers and E-commerce businesses use Big Data Analytics to manage their businesses, for example to profile their customers and their behaviours and buying patterns and to predict customer demands and expectations. How much privacy and confidentiality of individuals has been protected by organisations collecting, processing, and retaining large amounts of personal data have been – and continues to be - questioned and doubted. This has led to cases on privacy policy over important issues such as data ownership, involving public and private partnership organisations.

Despite being promised that Aadhaar covers all security risks, it has encountered several controversies including a case in the Supreme Court of India. Activists challenged potential human rights violations found in the Aadhaar framework.(5)It is appalling to note that the Attorney General argued that 'people have no 'right to privacy.' This contradicts the constitutional guarantee, "no person shall be deprived of his life or personal liberty except according to the procedure established by law"(6).

UIDAI openly admits on its website that the Aadhaar platform allows "third-party developers to develop Web 2.0 applications. The UIDAI's policy and practice of allowing 'third-party developers who are private agencies', to use and leverage its infrastructure and data, raises questions about the privacy and confidentiality responsibility. However, UIDAI states that "biometric information will not be shared with anyone, nor it will be displayed publicly, except for purposes specified by regulations" is giving some solace .However, the balance between 'privacy and purposes specified' looks ambiguous, which leaves the government with the huge responsibility to develop and adhere to stricter regulations at international standards.

INTERNET OF THINGS

The internet of things (IoT) is an evolving system of interconnected objects, people or systems that process and react to physical and virtual information. It aims to enhance user experience or the performance of devices and systems by way of communication between humans, systems, and devices. The IoT market size in India is expected to grow at a rate of 62% CAGR and reach US\$9 billion by 2020.(7)

It is imperative, that the communication between multiple devices, and huge data transfer among users, would result in sharing personal information. This will raise concerns about privacy and data protection issues.

'Machine to Machine' (M2M) environment enables data generation and content creation including machine-generated data. This process raises the question related to IP rights of newly generated content/data. This demand M2M service providers to adhere to strict privacy policies to protect the consumer data generated and collected.

In light of this, the government of India released a draft 'Internet of Things Policy' in 2015, aiming to evolve an IoT ecosystem and development of IoT products suitable to the Indian environment. National Telecom (NT) Cell, the government body responsible for policy and regulatory aspects related to M2M communication, released a 'National Telecom M2M Roadmap in May 2015'. Subsequently, TRAI released its consultation paper titled 'Spectrum, Roaming and QoS related requirements in Machine-to-Machine Communications' in October 2016, followed by its recommendations on this consultation paper on 5 September 2017.

The Justice BN Srikrishna committee submitted its report on the data protection law in July 2018 with the following key recommendations. (8)

Individual Consent: It makes individual consent the centerpiece of data sharing, awards rights to users, imposes obligations on data fiduciaries.

Data Protection Authority: Setting up a Data Protection Authority (DPA), an independent regulatory body responsible for the enforcement and effective implementation of the law, holding responsibility for, monitoring and enforcement, legal affairs, policy and standard-setting and research and awareness, inquiry, grievance handling, and adjudication.

Personal Data: The processing of personal data by both public and private entities in India, where data is being used, shared, disclosed, collected or otherwise processed needs cyber monitoring and cyber codes. It is imperative that the critical that personal data of Indian citizens be processed in centers located within the country only. In addition, personal data collected, used, shared, disclosed or otherwise processed by companies incorporated under Indian law will be covered, irrespective of where it is processed in India. However, the data protection law may empower the Central Government to exempt companies, which process the personal data of foreign nationals and the companies not present in India.

Data Storage: The Bill lays out provisions on data storage, making it mandatory for a copy of personal data to be stored in India.

Appellate Tribunal: The Central Government shall establish an appellate tribunal or grant powers to an existing appellate tribunal to hear and dispose of any appeal against an order of the DPA.

Penalties: Penalties may be imposed for violations of the data protection law. The penalties suggested are a penalty of Rs. 15 crore or 4% of the total worldwide turnover of any data collection/processing entity, for violating provisions. Failure to take prompt action on a data security breach can attract up to Rs. 5 crore or 2% of turnover as a penalty.

The penalties paid by violating entities, in this case, will be deposited to a Data Protection Fund, which will, among other purposes, finance the functioning of the Data Protection Authority.

The Bill lays out obligations for fiduciaries to ensure no harm to the user, with transparency and security safeguards;

For data processors not present in India, the Act will apply to those carrying on business in India or other activities such as the profiling which could cause privacy harms to data principals in India.

Impact on allied laws: The report has also listed the impact of the proposed data protection framework on allied laws, including the Aadhaar Act and the RTI Act, which require or authorise processing for personal data for different objectives.

Exceptions: The state can process data without consent of the user on ground of public welfare, law, and order, emergencies where the individual is incapable of providing consent, employment, and reasonable purpose.

Concerns

Though the draft bill addresses various issues plaguing the data ecosystem in India, it falls short on key principles that are at the core of a robust data protection framework.

The Bill proposes that personal data of individuals can be processed for the exercise of any function of the state. This can be done without the consent of the individual as long as it is to provide a service or benefit to the individual. This runs directly counter to the articulation of informed consent as central to informational privacy in the Puttaswamy judgment, 2017.

One key subject missing from the draft bill is the reform of surveillance laws. There is very little legislative and judicial oversight on surveillance activities carried out in India.

As proposed by the Bill, requiring all businesses to store data within India, without any reform of surveillance governance, can pose even bigger privacy issues in the future.

ARTIFICIAL INTELLIGENCE

Artificial Intelligence and Robotics have emerged as powerful transformative technologies of this era, creating data-driven solutions to solve everyday problems.

“Once considered a remote possibility reserved for science fiction, AI has advanced enough to approach a technological tipping point of generating ground-breaking effects on humanity and is “likely to leave no stratum of society untouched”. (See Lauren Goode, “Google CEO Sundar Pichai compares the impact of AI to electricity and fire” (9).

Therefore, it creates a necessity for the government to consider developing a business ecosystem that can leverage artificial intelligence and robotics with proper ethical measures to avoid harmful impacts.

The European Union 's guidelines (10) to develop ethical applications of artificial intelligence are:

- Human safety and oversight
- Technical robustness and safety
- Privacy and data governance
- Transparency
- Diversity, non-discrimination, and fairness
- Environmental and societal well-being
- Accountability

Indian Government also must focus on the above guidelines to implement laws for ethical use of AI.

Bernhard Debatin, an Ohio University professor and director of the Institute for Applied and Professional Ethics (11), says, a good privacy legislation in the age of AI, should include five components:

1. AI systems must be transparent.
2. An AI must have a “deeply rooted” right to the information it is collecting.
3. Consumers must be able to opt-out of the system.
4. The data collected and the purpose of the AI must be limited by design.
5. Data must be deleted upon consumer request.

CYBER RESILIENCE

A more agile approach to cybersecurity To ensure that information assets are properly protected, a more agile approach to cybersecurity is required. As advocated by Hult and Sivanesan, an effective cyber agility is essential for organizations to quickly respond to and contain the devastating effects of cyberattacks (12)

An organization which deals with a wealth of easy-to-access data with limited current cybersecurity solutions needs to focus on security issues to mitigate cyber risks in knowledge management and create cyber agility to control cyber-attacks. Knowledge management involves three stages: acquisition, conversion, and application. Cyber agility is increasing the firm's ability to respond quickly by identifying potential cyber threats, detect and measure the frequency and sophistication in detecting imminent threats, and be proactive to protect information assets.

CONCLUSION

India is in the process of enhancing its capacity and competing in the international arena in the areas of Artificial Intelligence, Internet of Things and Big Data Analytics . Therefore, it cannot ignore the Data Protection regime which needs balance in all spheres of society, industry, and government contribution.

The following serve as guidelines for suggestive amendments to the Information Technology Act, and for a holistic approach to addressing privacy issues.

- Efficient Data Protection Law
- Active Cyber Protection Agency
- National Cyber Crime Intelligence and Task Force
- State-level Cyber Policing System
- Technologically competent cyber system to implement physical and digital safeguards of Cyberworld

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Information Technology Act, 2000 – List of offences

- 65 Tampering with computer source documents
- 66 Hacking with computer system
- 66B Receiving stolen computer or communication device
- 66C Using password of another person
- 66D Cheating using computer resource
- 66E Publishing private images of others
- 66F Acts of cyberterrorism
- 67 Publishing information which is obscene in electronic form.
- 67A Publishing images containing sexual acts
- 67B Publishing child porn or predated children online
- 67C Failure to maintain records
- 68 Failure/refusal to comply with orders
- 69 Failure/refusal to decrypt data
- 70 Securing access or attempting to secure access to a protected system
- 71 Misrepresentation

Source: https://en.wikipedia.org/wiki/Information_Technology_Act,_2000

The Information Technology Act, 2000 (also known as ITA-2000, or the IT Act) is an Act of the Indian Parliament (No 21 of 2000) notified on 17 October 2000. It is the primary law in India dealing with cybercrime and electronic commerce. It is based on the UNCITRAL Model Law on International Commercial Arbitration recommended by the General Assembly of United Nations by a resolution dated 30 January 1997

A note on Interesting Facts on Information Retrieval Systems

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ABSTRACT

The purpose of this note is to provide various facts on information retrieval systems so that it will be useful for researchers and faculty members, thus saving a lot of time in literature survey. We also provide a good amount of reference papers in this note.

Key words: Information retrieval, Analysis, Assessment, Content-based

1. INTRODUCTION

The increasing amount of data existing on the Web has created novel and testing issues for the data recovery group. Owing to the gigantic number of pages and connections, surfing can't be resorted to as a liberal looking strategy, even with the help of subject index or arranged records (e.g., Yahoo!). Consequently, a capable question dependent strategy for entrée data is required. They are used by 85% of Web clients as the important device in for data seekers. Recovery components right now prescribed by Leighton & Srivastava, Gordon & Pathak rely upon conventional IR models. These web indexes are not sufficiently skill full to wrap all available data. Late works in Web IR has licensed that hyperlink structures are to a great degree. The primary IR frame-work executed in the 1970's intended to work with a modest collection of content.

2. VIDEO RETRIEVAL SYSTEM

The video is a straight medium which comprises an arrangement of frames that can be sensibly prearranged into shots. The video is characterized by the flanking set of edges taken by a solitary unremitting camera after some time. Shots can also be grouped into legitimate or semantic units residency scenes. Advantaged levels of abstraction can be produced by arranging the shots or scenes into a string of recitations like a storyline.

3. CONTENT BASED VIDEO RETRIEVAL SYSTEM

CBVR is considered as the use of picture recovery, that is, the issue of sharp for computerized recordings in vast databases. "Content-depend" implies that the pursuit investigates the genuine substance of the video. The expression "Substance" in this system may indicate hues, shapes and surfaces. From the time when it doesn't have the capacity to investigate the video content, investigation needs to rely upon pictures offered by some client. Content-depend Video Retrieval (CBVR) strategy has all the earmarks of being an intrinsic centre (or blend) of Content-depend Image Retrieval (CBIR) frameworks. By the by, different variables must be focused on while utilizing recordings that are disregarded while overseeing pictures. The ensuing four key procedures are involved in substance depend in video ordering and recovery. Segmenting the video into element scenes is an essential stride during the time spent in video structure parsing. This video is fragmented into edges with comparative visual stuffing. This is performed by sectioning the visual data encased in the video outlines. A discourse constituent that happens with them is hopeless to be proficient in grasping this objective. Video files and the table of stuffing can be produced rely upon these angles. For example, a bunching procedure yields differing visual classes or an ordering structure by sorting groupings or shots.

4. SIGNIFICANCE OF SPORTS VIDEOS

A Sports video depicts a far-reaching combination of gatherings of groups of onlookers and is ordinarily communicated for an extended span of time. For a good number non-sports viewers and a few games fans, an unadventurous and packed version seems more enticing than the full-length video. For as far back as a decade, researchers over the globe have productively focused on deciding convincing responses to mechanize the semantic investigation of games video embodiment. Thus, different calculations and structures have assigned solid results for a few sports.

5. VIDEO AND AUDIO DENOISING

The approach is the single-finished or non-correlative type, which uses strategies to reduce the noise level officially displayed in the source material - basically a playback just clam or decrease framework. Video signals are frequently polluted by noise during achievement and transmission. Reducing noise in video signals (or video de-noising) is exceedingly alluring, as it can upgrade perceived image quality, increase compression effectiveness, encourage transmission bandwidth reduction, and enhance the correctness of the probable subsequent processes such as feature extraction, object detection, motion tracking and pattern classification.

6. SHOT SEGMENTATION OF VIDEO AND KEYFRAME EXTRACTION

At the point when the ostensible unit of visual data is kept one time as a Video shot by a camera, it is to show a guaranteed activity or occasion. Shot discovery is connected as an essential stride of substance based video investigation with the goal of catching the total visual substance suitably and to accomplish a whole handle of the video. A definitive objective of video shot limit is recovering the element of video picture outlines. These are moreover utilized to incorporate such traditions. Subsequently, a master SBD algorithm is to be furnished to handle trudging shot moves, paying little attention to their temperament (break down, blur, wipe and so on.) well beyond startling changes.

7. FEATURE EXTRACTION AND OPTIMIZATION

Optimization is the process of selecting the optimal solution for corresponding input. Some of the papers are related to image retrieval using the optimization algorithm. Xu Zhang et al. discussed the picture recovery optimization with PSO with r-choice and k-choice of Ecology. He demonstrated r/k PSO with positive and negative criticism tests to improve the picture recovery by changing the weights in the light of the client input. Button Chin Lai et al. demonstrated the decrease of a semantic crevice between abnormal state test components and low level example elements to achieve the expected picture by the Genetic Algorithm as an optimizer.

8. FEATURE-BASED VIDEO INDEXING

In some phase over the span of activity of indexing texts, an archive is separated into smaller components, for example, areas, passages, sentences, phrases, words, letters, and numerals. Consequently, signs can be built on these components. Utilizing an indistinguishable plan, a video can likewise be rotting into a chain of importance. This is indistinguishable to the storyboards in filmmaking. Various video indexing methods are follows: Object-depend Video Indexing Methods, Event-depend Video Indexing Methods. Event-based video ordering is a target to be familiar with the interesting event as needs are from rough video track. The event can be all around elements as the relationship between the presentation of things in span break that happens before or after the other event. Order of occasion in diversion recordings in view of manual work and modified examination of visual components. Here modernization, for instance, camera or modifying process investigation, overall development appraisal, frontal range establishment withdrawal together with unmistakable article acknowledgment Wu et al., and the area of CC (close engraving) streams are made use of Babaguchi et al. (2002).

9. CONCLUSIONS

Content-based video recovery is careful to be an unpredictable mission. The fundamental intention at the back of this is the measure of intra-class divergence where the indistinguishable semantic idea happens under different conditions like light, appearance, and scene settings. For example, recordings involving a man riding a bike can have inconsistency as different sizes, appearances, and camera movements.

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Blowing the Whistle on Data Breaches and Cybersecurity Flaws

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With increasing dependence on technology, cybersecurity has emerged as a critical issue for customers, investors, and government regulators. Data breaches and other cybersecurity incidents can have devastating effects. In 2018, the Council of Economic Advisers estimated that malicious cyber activity cost the U.S. economy up to \$109 billion dollars in 2016 alone. (1)

Typically, the public only learns of such flaws and malicious actions months or even years after the fact. Companies may deliberately conceal known breaches or vulnerabilities from the public and their customers. Where companies seek to hide information, whistleblowers can play a critical role in exposing cybersecurity flaws and data breaches.

Under certain circumstances, a whistleblower can even receive an award for bringing timely information about computer hacks, data breaches, and software vulnerabilities to the government. However, there is no single agency that regulates cybersecurity. Instead, whistleblowers must navigate a complex web of overlapping laws to find the best place to bring their information. An experienced whistleblower attorney can provide critical guidance in that assessment. Below we describe some of the key laws covering rewards for cybersecurity whistleblowers in the United States.

Blowing the Whistle on Cybersecurity Failures in Government Contracts

The United States government imposes cybersecurity requirements on government contractors.(2) In 2016, the Department of Defense, General Services Administration, and NASA amended the Federal Acquisition Regulation to add a new subpart and contract clause on safeguarding information systems containing federal contract information. As a baseline, FAR now requires contractors and subcontractors to comply with basic cybersecurity controls established in National Institute of Standards and Technology Special Publication 800-171.

Other US federal contracts require more rigorous cybersecurity standards. The US Department of Defense's FAR supplement now requires certain defense contractors to report cyber incidents within 72 hours of their discovery. In addition, government contracts often impose further requirements for the protection of classified information or for compliance with agency-specific information-security requirements.

A contractor's failure to comply with cybersecurity-related contract terms can give rise to liability under the federal False Claims Act, (3) which empowers whistleblowers to report fraud and misconduct in government contracts and programs. The FCA allows whistleblowers to bring a lawsuit on the government's behalf and share in the government's recovery.

Successful whistleblower actions have been brought regarding failures by information technology companies to comply with government standards, although no recoveries yet involve the cybersecurity standards specifically.

- In April, 2019, IT supplier **Fortinet** agreed to pay more than **\$500,000** (4) to resolve an FCA case brought by a whistleblower alleging that it routinely supplied the government with products made in China and then doctored the products' labels to make it appear that they complied with the federal Trade Agreements Act. In announcing the settlement, the government emphasized that it was "committed to combatting procurement fraud and cyber risk within U.S. Department of Defense programs."
- In 2017, electronic health records (EHR) vendor **eClinicalWorks** agreed to pay **\$155 million** (5) to resolve claims that it misrepresented the capabilities of its software to fraudulently obtain certification required for government payment. While not involving security standards, EHR fraud cases (6) demonstrate the government's interest in pursuing vendors for misrepresenting software capabilities.
- In 2015, **NetCracker Technology Corp.**,(7) which provided telecommunications network support to the Department of Defense, agreed to pay **\$11.4 million** to settle claims that it used employees without security clearances to perform contract work that it knew required clearances.

SEC Cybersecurity Regulation Can Support a Claim to the SEC Whistleblower Program

The US Securities and Exchange Commission has also become increasingly focused on cybersecurity, and whistleblowers that report cybersecurity incidents or vulnerabilities to the SEC could be entitled to a reward under the SEC Whistleblower Program (8). In 2018, the SEC published guidance on how public companies should disclose cybersecurity incidents and

risks to investors. In the guidance, the SEC explained that companies face a wide range of cyber risks, from stolen access credentials and phishing, to malware and distributed denial-of-service attacks. Whatever their form, cyberattacks can significantly harm companies by destroying assets, interfering with critical systems, or disclosing sensitive intellectual property or consumer data.

Given these risks, the SEC advised public companies to promptly disclose all material cyber risks and incidents. The SEC identified several factors companies should consider when formulating disclosures:

- The severity and frequency of prior incidents
- The probability of occurrence and potential magnitude of future incidents
- The adequacy and costs of preventative measures
- The aspects of the company's business and operations that give rise to material cybersecurity risks and the potential costs and consequences of such risks, including industry-specific risks and third-party-supplier and service-provider risks
- The potential for reputational harm
- Existing or pending laws and regulations relating to cybersecurity and their associated costs
- Litigation, investigation, and remediation costs associated with cybersecurity incidents

In explaining these factors, the SEC cautioned companies to “**avoid generic cybersecurity-related disclosure and provide specific information that is useful to investors.**” The SEC also noted that directors, officers, and other corporate insiders can violate the antifraud provisions of the securities laws if they trade on material nonpublic information about a company's cybersecurity risks and incidents.

Other entities regulated by the SEC are subject to industry-specific rules. For example, the SEC has issued specialized regulations and guidance for registered broker-dealers, investment companies, and investment advisers who must safeguard confidential investor records and information. Likewise, the SEC promulgated specific rules to enhance the technology infrastructure of entities directly supporting U.S. securities markets, such as stock and options exchanges and registered clearing agencies.

Regulated entities that violate these rules may be subject to SEC fines. For example:

- In 2018, **Yahoo** paid a **\$35 million** SEC penalty (9) to settle charges that it misled investors by failing to disclose one of the world's largest data breaches in which hackers stole personal data relating to hundreds of millions of user accounts
- In 2016, **Morgan Stanley Smith Barney** paid a **\$1 million** SEC penalty (10) to settle charges that it failed to adequately secure customer information.

The [SEC whistleblower program](#) encourages those with knowledge of violations of cybersecurity laws and regulations to share this information with the SEC. If the SEC collects monetary sanctions of more than \$1 million, eligible whistleblowers can receive an award of between 10 percent and 30 percent of the amount collected by the government.

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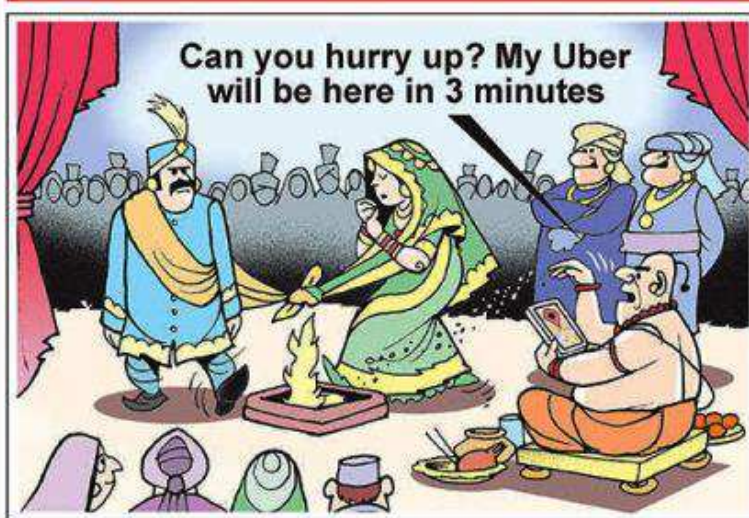
Hamsa received her J.D. from Columbia Law School in 2012. While there, she was a Wien National Scholar, a Harlan Fiske Stone Moot Court Semifinalist, and a Moot Court Editor. She also interned for the Honorable Theodore H. Katz (Ret.), a United States Magistrate Judge in the Southern District of New York, and spent a summer representing indigent defendants sentenced to death in Louisiana at the Capital Appeals Project.



Chris McLamb is an associate in Constantine Cannon LLP's San Francisco office. He represents whistleblowers in qui tam lawsuits brought under the Federal and various state False Claims Acts, as well as claims made under the whistleblower programs of the Internal Revenue Service, Securities and Exchange Commission, Commodity Futures Trading Commission, and Department of Transportation. He has also represented local governments in False Claims Act matters.

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iToons Sunil Agarwal & Ajit Ninan



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Get your TNA (Training Needs Analysis) done – Why?

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If your organization follows learning strategies with a random approach, you will never get the desired ROI.

This article deals with a systematic and structured approach to save time, energy and investment in the L&D space to produce deterministic growth for your business.

A mid-cap or an MSME organization generally looks at their learning curve connected with crisis scenarios (Re-active) rather than a planned (Pro-active) approach due to various practical reasons.

To cite an example,

- When the overall performance is down,
- When your Client acquisition is poor and sales figures drop,
- When you see manpower attrition is increasingly alarming,

You might come to an immediate conclusion that let us seek support from soft skill trainers to motivate people, send people for Outbound training programs, hire a consultant to address the crisis situation.

They don't carry a magic wand to turn around your crisis situation instantly. Even an Instant coffee like BRU brand requires months of preparation at the factory before it reaches out to the outlet to serve the customers.

Do you think that this strategy of instant approach to train employees ever worked except for some momentary satisfaction both for HR and management?

Does it really impacts your business positively and addressed the need for which this decision is taken?

Do you believe that randomized training programs ever created the desired outcome?

CFO's and teams know it better!

Though it can create a visible surge that happens in the minds of people and in the organization, essentially, it is related to Feel-Good-Factor (FGF) for employees. It actually does not get transpired to expected business ROI as a long term strategy. *Hence the trainers in the training industry have their own challenges to convince the client to avail their repeated programs which is a different subject altogether.*

Let's look at Why?

Industry leaders in the business world both in domestic and international brands operate with models, theories and principles and just not DATA (you may be surprised but a completely new dimension can be provided on request as this is another huge topic to be explored!) alone before they implement any newly defined process.

There is a valid reason for every decision they take to construct their businesses. Every decision is taken with proven tools and techniques and best of the brains work round the clock to launch it prudently. If they don't adhere the policy and the wrong corporate governance can even destroy the brand loyalty and the whole business will come to a grinding halt at some point in time.

Never assume that just because the business is growing it cannot stop performing, it is growing may be due to external conditions and environment too with due respect to the success principles that the organization follows.

However, the **Predictability and Deterministic** approach can help the entrepreneur and C-Suite leaders to be assured of their decision with data and models to prove than regret later that we should have done it. The business should have or could have or must have done are the analysis of our mistakes in the past after the event has happened.

Enterprises and brands like ICICI Bank or HDFC Bank or take Domino Pizza or McDonald's for an example. Look at the way, how they on-board their employees and customers and take them through the voyage of organization experience until they exit from the particular transaction or relationship.

The robust systems and processes are well defined and millions of employees and customers around the world are experiencing a day in and day out with high standards and uniformity in experiencing the highest quality at work and business. When the process gets involved, training becomes part of the process and not an ad hoc anymore. Here the role of PMS plays a vital aspect. (PMS denotes here **Performance Management System**).



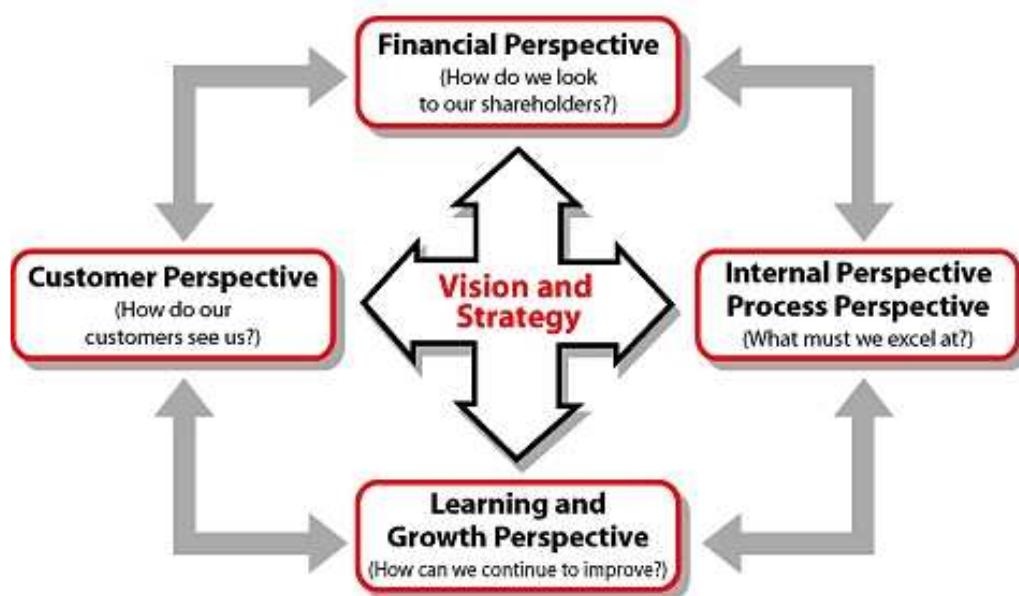
The higher-level engagement or brainstorming sessions always been to look at the Problem statement strategically instead of gate crashing to address the operational issues superficially and create some visibility of having accomplished something which has no rationale behind.

Short circuit leaders do often this and they hop one organization to another organization and several organizations have failed by looking at their articulation and management jargon superficially and place them at higher positions in the organization with FAT CTC.

Unfortunately, the Promoter (a technopreneur) run organization succumbs to bad experience of wrong hire and pay huge price for their decision later. This is also one of the reasons why they are unable to sign up with even a well-oiled Consulting Companies who put forth their strategies candidly to bring the transformation in the business. But once bitten; twice shy approach (not many can bounce back with corrective actions) defers the management decision but by the time business takes a whole new shape either way. This is a hard fact reality in the industry.

Here the key aspect to employee and customer experience is based on how well the employees are first trained to handle the well-defined process established by the organization.

Here the truth of TNA – Training Need Analysis plays a pivotal role which is the core topic of this article. However, to connect dots are paramount important to logically conclude the importance of TNA.



What is the way forward?

After viewing the above image of the PMS cycle, keep these questions in mind and read on.

1. What is your business vision and strategy which connects dots like Learning and Growth Perspective, Process Robustness both internal and external, Customer satisfaction/perspective and ROI i.e. Financial Perspective?
2. Are your employees empowered with the Business Process and Life Cycle of your Business and Client on boarding?
3. Do you have standard SOPs for each function and Roles and Responsibilities for employees?
4. Do you have a scientific way to measure why certain processes or departments and people fail to achieve their targets?
5. What is your typical approach to fixing the issue?



If your business objective is not clearly articulated to employees, each one will work as they perceive and feel right rather than how should they perceive it and align with the objective of the organization and promoters. **TNA here is, Training on Induction.**

Jobs and position-wise metrics are the vital parameters to identify the TNA prudently.

If your teams are unaware of the business life cycle to be followed, **TNA here is Training on Functional Training Program**

If your team members work out of scope and random reporting and lot of confusion in the system which affects your productivity and customer dissatisfaction, **TNA here is, Training on Process like dept. SOPs and individual R&R.**

If your team does not adhere to the Customer Perspective life cycle and process to be followed, **TNA here is Training on Market expectations from our Employees who are on the field both sales and service.**

Training Need Analysis (TNA) comprises just not behavioural or soft skills, technical skills or functional skills but it is 360 Degree approach to cover the depth of the need aligning with the vision of the organization. The time to time validations, course corrections to the yearly and quarterly performance of the teams involved. This requires a seasoned and matured set of professionals to help HR and carve out the Learning and Development. Establishing L&D is the hallmark of this exercise.

Special Note: Competency mapping is one of the major criteria to be well structured. This is connected to the entry point of getting Mr.Right at the recruitment level.

I am confident that entrepreneurs and c-suite leaders, HR heads and start-up ventures can seriously look into the “Strategic Intent” of this article and explore for a Pro-active TNA model with best practices to grow your entity more predictable and deterministic in nature.

Best Wishes for all your endeavours in the coming years. Stay connected.

Images Source: Google Search

About the author



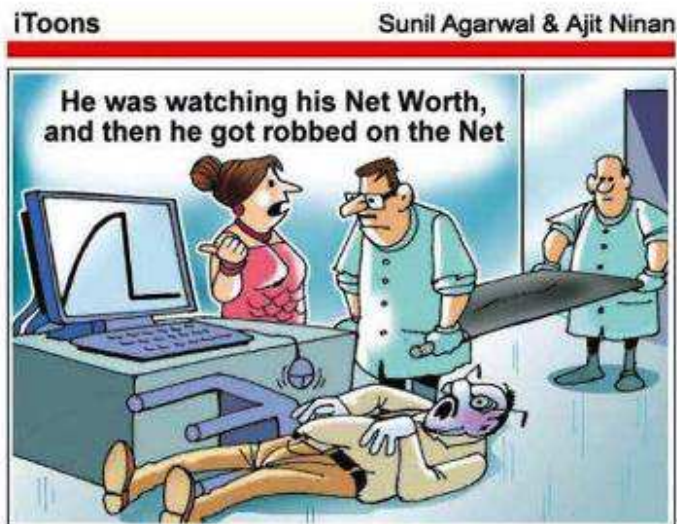
M.K. Anand is a Co-founder and Strategic Business Advisor from See Change Consulting, Chennai. 360 Degree Training, Coaching and Turnaround Consulting are the prime services of See Change Consulting Since 2002. More can be found in www.seechangeworld.com

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His Social objective is to ignite Youngsters/Professionals and make them understand their true inner potential to develop strong belief in “Self Dependence” and “Willingness” to achieve their aspirations.

Active member (Abhyasi – Heartfulness Trainer) of Heartfulness Institute (Sahaj Marg) under the guidance of the guide Shri Kamlesh D Patel fondly known as Daaji worldwide. Heartfulness is a non-profit international spiritual organization whose sole purpose is to offer spiritual services to interested seekers in the form of Sahaj Marg system of Raja Yoga Meditation to attain the goal of human life in this life time.



Holistic Digital Empowerment for Unleashing Human Excellence

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In the mid 90s, Ray Lane, COO of Oracle, said “The next 5 years we will see more changes than the last 50 years.” The digital transformation we went through during the last 15 years is mind blowing. Great inventors have transformed smart toys into intelligent robots that speak, listen, walk, look and perform like human beings. Financial institutions have evolved from small money lending outlets to smart banking enterprises. Digital transformation in retail have changed the way we decide and buy. Driverless cars, driverless tractors that performs ploughing, cultivation and harvesting were beyond our imagination. But, not anymore. Through holistic innovations we can empathetically understand the present pains and create the future wonders.

The greatest achievement in the 21st century lies in the ability to divert human minds from digital distraction. Diverting human minds with a sense of purpose, imbibing humanity, and digitally empowering human minds will define the success in the future. Let me elucidate on the possibilities specific to unleashing human excellence by creating revolution at work, education institutions and in individual thoughts and actions.

The New Age Challenges

Unfortunately, poverty still exists in the 21st century. Pollution, unhealthy food, infertile soil, decaying of environment, digital dopamine, and unhappy workforce lead to more psychological and physiological sickness. Education got stuck in the 19th century factory moulding model. Workplace complexities lead to more suffering and employee disengagement.

High level of disengagement at workplace and classroom ruins competence building effort and work performance. Presently, the regimented and disempowered learning and work environment bring stress. Outdated and factory-model of education lead to high unemployability and underemployment. Underemployment is more painful than unemployment. Blind learning without sense of purpose and lack of holistic self-directed learning undermines the true potential of individuals. Disintegrated and complex workplace practices result in rigidity, stagnation and unhappy experience for both employees and customers.

The biggest challenge in this era of digital information age is not lack of information but too much information. Information overload distracts knowledge workers and drains their energy as they spend more time searching through the mountain of information. John Naisbitt said, “We are drowning in information but starved for knowledge.”

An extraordinary ecosystem is vital for enabling knowledge workers to peacefully sleep, joyfully get up from bed without an alarm, enthusiastically learn, and passionately do their duty every day. Knowledge workers need to naturally and subconsciously perform their role like honeybees cross-pollinating, birds dispersing seeds, and water flowing through the rivers.

Skill, soil and soul are the three interlocked pillars of social and national development. Skill development is not just about developing technological competence but about nurturing humanity. Humanizing workplace and education can unleash human excellence to help deliver the best performance naturally without pain. Digital technology plays a vital role in unleashing human excellence by making learning and working wise and scalable. This article elucidates on why, how and what it takes to drive holistic digital empowerment for creating an outstanding ecosystem for thoughtfully learning and working together.

Convergence of Brilliance

Charles R. Swindoll said, “The secret of living a life of excellence is merely a matter of thinking thoughts of excellence. Really, it's a matter of programming our minds with the kind of information that will set us free.” Democratizing knowledge and education can transform society to rise and work at their optimum level. Digital transformation can democratize knowledge, democratize education and democratize innovation. This technological transformation of bringing right knowledge to right people at the right time can redefine talent management, idea management, teamwork and customer interaction.

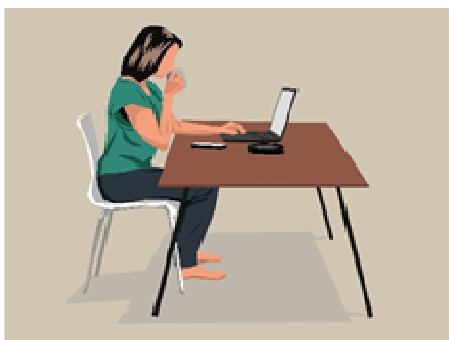
Future of education, future of work and future of talent is all about holistic thinking, agility, singularity, autonomy and working in harmony with collective brilliance in the entire ecosystem. Unlocking the unique potential of individuals as well as the collective minds is going to be the basic necessity to succeed and lead in the future of robotization and rapid advancements.

Atomistic thinking prevents us from solving inter-connected problems meaningfully and completely. We need a holistic approach to digitally transform and converge the brilliance of industries, institutions, and individuals to unlock the true potential of human beings. Great human potential energized by holistic education, high performance workplace, digital empowerment, and enriched environment is the foundation of sensible progress. Knowledge empowerment powered by digital technologies can change the way we think, learn and perform to deliver excellence. It will rewire human minds towards becoming mindful and making their existence meaningful and sensible.

Nation with high level of human development index, innovation capability, quality education and entrepreneurial thinking can remain or become a developed nation. Achieving such greatness is possible only through holistic digital transformation. Therefore, it is necessary to embark on the journey taking industries, institutions and individuals to the next orbit.

About Digital Transformation

Data Democratization

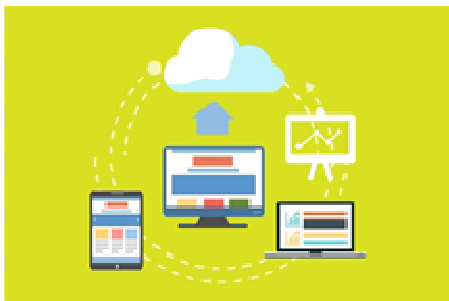


Making knowledge seekers to learn effectively and easily and making knowledge workers to perform wisely are all about empowering them with right insight. Technological empowerment can enable insightful decision making, aspiration, and working to perform at the optimal level. Therefore, the knowledge must easily flow through the organization to ensure that everyone gets right knowledge to perform their daily function well.

Digitizing information, learning content and data are vital to make this instant access to relevant knowledge a reality. Digitalization is necessary to ensure that knowledge workers and seekers are empowered with right technology to productively navigate through the knowledge.

Imagine the power of poorest of the poor person in the remotest of the remote village having access to the great lectures of MIT, Stanford, IIT professors and industry experts. Democratization of education will transform both schools and colleges. Regimented education, rigid blackboard driven classrooms, and shallow assessment of theoretical knowledge are the designs of the factory era of the 19th century. Nothing is going to block individuals from accessing the world of knowledge. No one can narrow the learning of anyone.

Insightful Integration



Digitization and digitalization are not enough. Everything needs to converge. Therefore, it is important to identify all the components of the system and to understand the interworking of these components. With this understanding, we need to design the holistic system to integrate all components, connect related knowledge and facilitate not just smooth flow of knowledge but also drive holistic learning.

Digital transformation is all about unification and simplification for operational efficiency and excellence. Think of the disruption made by Uber and OLA through digital empowerment. They beautifully connected drivers, vehicles, maps, and passengers. Passengers have all the data at their fingertips to decide wisely. They also know where the taxi is, how long it will take to pick them up, and which route the driver is going to take.

It brings highest level of comfort and safety to passengers. There is a high level of transparency in the pricing. Imagine the power of individuals with right insight and world of experts at fingertips to help them look at various career options and confidently decide. Imagine a simplified technology directing individuals with personalized learning map and wise planner.

Gainful Globalization



Digital transformation is the launch pad for taking business enterprises, knowledge and talents to the entire globe. Individuals need not limit them and their businesses to a small geographical territory.

Virtual collaboration, digital library, online shops, internet banking, Direct To Home (DTH) entertainment, virtual universities and so on are redefining our living. This mind-blowing new design is bringing great disruption in all sectors.

Imagine what wonders digitally powered holistic education can do to the learners and career aspirants. Now, the entire world is the classroom. Digital empowerment can help learners drive their learning beyond imagination. People can globalize their expertise and businesses with ease. The barriers can be easily broken. One can transcend the limitations to jump into the world of opportunities to perform. Knowledge of the experts can be traded across the globe. Experts need not limit their teaching to a tiny classroom.

Inspirational Innovation



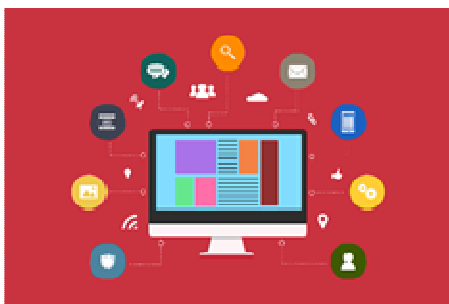
Frog in a well cannot see much. Eagle born and brought up in a place full of chickens will live and die as chickens do. Narrow thinking and boxed thoughts undermine individuals' cognitive ability. While digital transformation enhances the reach for all, it also makes competition extremely tough. Competitors are not limited to a particular geography. Anyone from anywhere in the world can create wonders and reach out through digital empowerment.

Someone from Mongolia can create a virtual library. They can build Apps and market them to the whole world. Language does not matter. Digitally innovate or perish. Technology and execution power will make it easier to setup online

shops even in places like Somalia or Nigeria.

Be humble, be simple and be nimble. Agility is the only way an organization, institution and individuals can exist meaningfully. Longevity of any organizations will be shortened if they do not take reinvention seriously.

Transformational Technology



Incremental technology and mediocre solutions cannot excite anyone anymore. What matters is transformational disruption. Giving an option to download the PDF version of the school and college books is not digital transformation. It is about fixing a motor in a horse carriage and calling it a car. Can we compare it with autonomous cars and intelligent BMWs?

Radical change is vital to make prospects across the globe to use your products and services. Imagine how the aggregation businesses like food delivery, show booking, travel booking, hotel booking, and shops have shaken the traditional businesses. Copy and paste will not work. Anyone with the intention of getting

into this sector now, need radical ideas and transformational technologies.

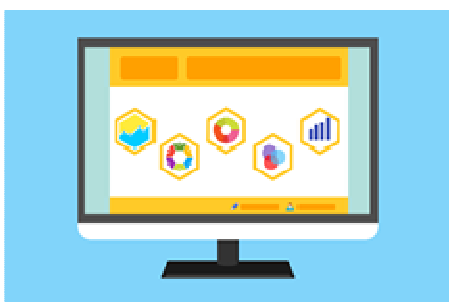
Authentic Abundance



One of the greatest advantages of digital transformation should be creating abundance of quality in everything. Virtual university should be able to scale up to millions of students. Virtual collaboration can connect thousands of experts across the globe to ignite great thoughts.

Digital empowerment can break the bureaucratic hurdles, monopolistic business, and other limitations blocking someone from getting what they want and genuinely deserve.

Lean Leadership



Agility and lean thinking have become an uncompromisable quality of progressive organizations. Creating learning organization is necessary for driving continuous improvement, operational efficiency and organizational excellence. Virtual office is going to be the future. Think of those large enterprises operating from few big campuses making everyone spend 7% of their time just for traveling. This unnecessarily long travel has many negative impacts. It is environmentally destructive; workforce get tired and ultimately result in low quality and productivity.

Back-to-back meeting culture need to change. Instead, technology is necessary to connect the concerned people to interact, share knowledge, ask for help and collectively work towards delivering excellence at work. Technology can do most of what managers do every day. Managers can be turned into leaders and

change agents. The concept of self-governance, learning autonomy, self-transformation, self-directed performance management will eliminate the need for unnecessary and unproductive supervision from the top.

Conclusion

Digital transformation is not just about technology. It is more about cultural change, resetting of cognitive rigidity and letting go of the individual domination. Digital empowerment is all about harnessing the collective power. Without this shift in the thinking, implementing mediocre or disintegrated software will make organizations crash land into massive disaster. So much of content available on public domain on both personal and organizational change management.

Digital distractions can ruin individual's productivity and knowledge when digital transformation is not driven by sense of purpose and shared vision. Take the empowerment of knowledge workers and knowledge seekers seriously. Provide them the right gadget and tools to help them become what they want to become and to help them perform how you expect them to perform.

Castles are not built overnight and they are built one brick at a time. Thousand-mile journey starts with the first small step. Create the right roadmap and move one step at a time. Digital empowerment enables workplace, education, social and personal excellence. Faculties deserve happy facilitation of learning, students deserve joyful and sensible learning, workforce deserve happy working, and customers deserve great experience. Digital and knowledge empowerment driven by system thinking make transformational learning and working a possibility.

About the author

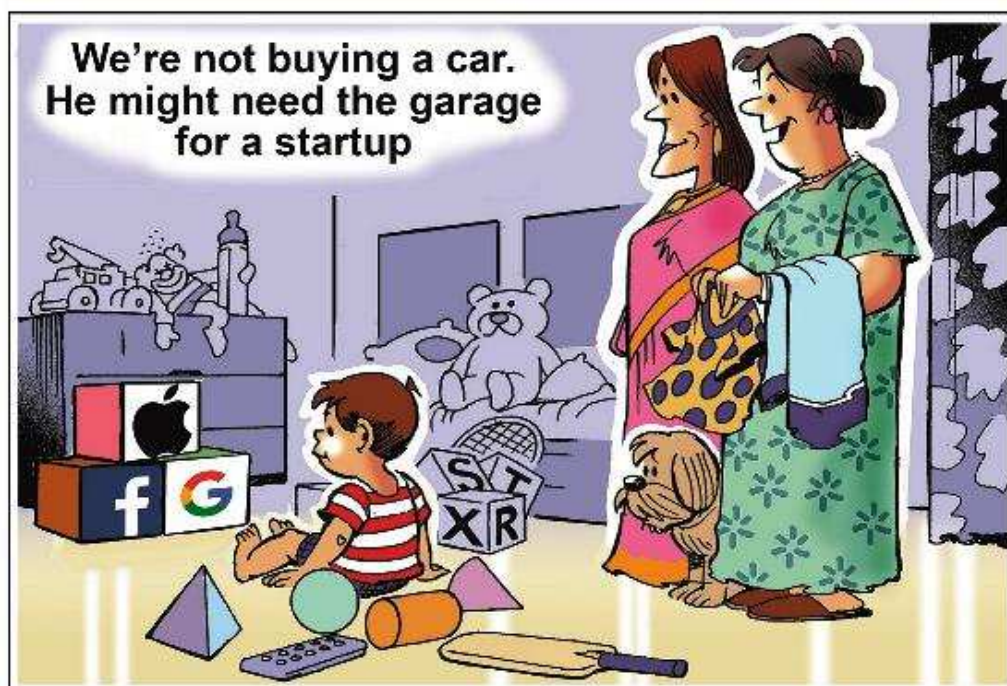


Lakshman Pillai is an entrepreneur, author, reinventor, and holistic design thinker with 30 years of experience in information technology, software product innovation, holistic knowledge empowerment, digital empowerment, and workplace, higher education and personal transformation.

He is the Chief Architect of Smipio, a holistic software innovation, designed to digitally empower learners and workforce to think, learn and perform towards unleashing human excellence. He has authored a book *Holistic Workplace for Excellence*, and has developed *Transform for Excellence* consulting and workshop to empower knowledge workers and knowledge managers.

iToons

Sunil Agarwal & Ajit Ninan



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Format: Word document file format; Single Column; Single Spacing & Text in Times Roman Font in size 10 Point; Headings & Sub Headings can be differentiated wither by colour / making them bold / italics as case may be.

Please keep minimum level of indentations while formatting the article. Aligning to the left is always welcome.

Pictures: Apart from embedding the pictures in appropriate places in the article, please send them as individual jpg files.

References: To be numbered and listed at the end of the article (please do not include in individual pages). Pl. do not use formatting with superscript for references. Include the ref no in parentheses and provide details at the end of the article.

Please do not embed the URLs of websites into the text. Provide explicit URL

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Acknowledgements: ICNL wishes to acknowledge various internet sources for the information presented in this issue of the newsletter. Our exclusive thanks to inshorts (<https://www.inshorts.com>) and Mr. Sunil Agarwal & Mr Ajit Ninan for the permission to use their thought provoking cartoons appeared in Times of India. .

For Private Circulation

IEEE INDIA INFO

IEEE Newsletter from India Council

Vol. 14 No. 4

Oct -- Dec 2019

Edited by: H.R. Mohan

Published by: Prof. Sri Niwas Singh

for

IEEE INDIA COUNCIL

Email: ieee.icnl@gmail.com

Website: <http://sites.ieee.org/indiacouncil/>