LEAPFROGGING INTO THE NEW FUTURE WITH EXPONENTIAL TECHNOLOGIES

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Research and Digital

Foreword

We are delighted to present this important report on "Leapfrogging into the new future with exponential technologies" prepared along with our knowledge partner "Itihaasa research and Digital" as part of the FICCI Digital Disruption and Transformation Summit (DT4) and exhibition 2020. FICCI has been in the forefront of not only spotting this digital transformation trend early but has been enabling discussions and policy by studying the pros and cons of this trend and the opportunities it presents etc. since 2015. DT1 conference was launched in 2015 along with "CISCO systems India" as the knowledge partner. DT4 conference planned for 2020 is the 4th in a series of Digital transformation conferences from FICCI technology panel. This is just not relevant only to the ICT industry or technology industry but very much important and embedded with manufacturing, financial services, insurance, retail, e-governance, utilities, telecom, automotive, real-estate and construction industry because technology has become the core of every industry.

India's massive transformation in its socio-politico-economic space has been achieved by circumventing geographical and physical challenges of access and connectivity that isolated large parts of the country from the mainstream discourse by leveraging ICT technologies, opening the gates of opportunity for many of the disadvantaged. India today is the only country in the world that sports a billion mobile phones, billion biometrics and billion bank accounts. During 2020, we will be joining the select few of countries in the world, who have rolled out 5G at scale. This is going to present new opportunities and a new future.

Exponential technologies are those innovations that continue to advance exponentially, with disruptive economic and lifestyle effects. Moreover, exponential technologies provide a price-performance that makes it feasible to incorporate them into today's business and social problems in new and previously impossible ways. Examples of exponential technologies include Artificial intelligence (AI), additive manufacturing, augmented and virtual reality (AR, VR), digital biology and biotech, data science, medical tech, nanotech, robotics, autonomous vehicles, etc. At FICCI DT4, we have a full day of deliberations planned around these exponential

technologies and how they are helping in leapfrogging in terms of performance and impact.

We wish you a good conference and an insightful day ahead (Mar 7th,2020) with lot of takeaways for you and your organization in taking the leap into the new future.

Ms.Kavitha Dutt,
Chair Person
FICCI Tamil Nadu State Council

Mr.Rajaram Venkataraman
Convenor
FICCI TNSC Technology Panel

Foreword

We are delighted to author this important report on "Leapfrogging to the new future with exponential technologies". We set-up itihaasa Research and Digital (www.itihaasa.com) as a not-for-profit research organization that studies the history and evolution of technology domains in India. We study domains like Information Technology (see our chronicle on the history of Indian IT), Artificial Intelligence and Brain Sciences (see our landscape studies of research in India in these domains).

This theme of leapfrogging with exponential technologies is very important to society and business. We are already witness to the ubiquity of technology in our daily lives – it affects the way we acquire new knowledge, shop, socially interact or seek entertainment. Many of these technologies are now entering what is called the second half of the technological chessboard. We are already seeing that with Artificial Intelligence – computing power is growing fast pushing Moore's Law to its limits and we have seen an explosion of AI-enabled applications in our lives. Now, another law, the Flatley's Law governing DNA sequencing is being pushed and we are going to see an avalanche of applications involving genetic sequencing like personalised medicine and targeted cures. It is at the intersection of these exponential technologies that we will discover solutions to humanity's problems. For instance, the next generation will be about the innovative combination of biology and computer science.

Society, industry and individuals – all have to figure out ways to understand and harness these exponential technologies in their own ways. We hope the ideas we present in this paper provide a direction and trigger an active discussion.

Krishnan Narayanan
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Evolution of exponential technologies in human history

Evidence points to the fact that stone tools were first used by Australopithecus Africanus about 3.4 million years ago, and fire was first controlled by Homo Erectus about six hundred thousand years ago. We have come a long way since Homo Sapiens - our species - first made an appearance about two hundred thousand years ago. The most interesting phase of the history of our species is arguably the last five hundred years that coincides with the start of the modern scientific revolution in the mid-16th century, with the publication of Nicolaus Copernicus' "On the Revolutions of the Heavenly Spheres" - the seminal work on the heliocentric theory - in 1543[1].

In the book "Critical Path", futurist and inventor Buckminster Fuller estimated that if we took all the knowledge that mankind had accumulated and transmitted by the year one CE as equal to one unit of knowledge, it probably took about 1500 years until the 16th century for that amount of knowledge to double. The next doubling of knowledge from two to four units was completed in 250 years by the mid-18th century. By the turn of the 20th century, 150 years later, human knowledge had doubled again to eight units. The speed at which knowledge doubled was getting faster and faster. The doubling speed is now estimated between one and two years.

We are indeed living in rapidly transforming times. This is the era of the fourth industrial revolution which is powered by the current technological advances. It is characterized by a fusion of technologies that is blurring the lines between the physical, digital, and biological domains. There is tremendous disruption at the edge and at the intersection of the emerging technology domains and economic activity. Some of the exponential technologies defining this era are shown overleaf[2]. How have these exponential technologies affected humanity?

[1] Kris Gopalakrishnan, Speech on "Science, Technology and Knowledge" at TIFR, 2019
[2] Kris Gopalakrishnan, Speech on "Navigating Disruptions" at Manipal Global Education Services, 2019

- *Digital computing which is increasing in power and decreasing in costs*
- *Very high-speed Internet and ubiquitous connectivity of up to 300 Mbps powered by 5G bring ultra-fast access to information from across the world*
- *Mobile phones that bring amazing computing power at very low costs in the hands of every human being*
- *Social networks that provide collaboration and communication platforms to connect people, communicate and enable action*
- *Robotics and drones that can completely automate personal transport and logistics*
- *Nanotechnology which among others can be used in water purification and environmental clean-up applications*
- *IoT and sensors which provide offer real-time data and hence a provision of control to machines as diverse as airplanes, electric utility meters, personal blood sugar monitors, etc.*
- *3D printing especially 3D bioprinters that can print human organs*
- *Augmented reality and virtual reality that can revolutionize diverse fields like education and field service*
- *Blockchain that has the potential to speed up back office settlement systems in banks and improve efficiencies, integrity and trust many fold*
- *Renewable energy is environmentally friendly and smart grids help to judicially use and conserve power by matching supply and demand on a real time basis*
- *Biology and gene editing that can potentially provide treatment and cure to diseases like AIDS and cancer*
- *Recently, there have been press reports about us achieving a "quantum supremacy" breakthrough – where a quantum computer solves a problem in seconds which a powerful supercomputer will take 10,000 years to solve*
- *AI (artificial intelligence) is becoming one of the most important technologies of all time.*
- *We have the confluence of at least three technologies (mechanical automation, computing & communications and molecular biology) that have reached steep exponential scale.*

Impact of exponential technologies – on society, research and business

Let us analyse the tremendous impact these technologies have had on three aspects of humanity – the society at large, the research and scientific community and the world of business and companies.

Impact of exponential technologies on Society

What has been the use of scientific discoveries, technological inventions and the knowledge gained thereof to humanity across the continuum of industrial revolutions? While progress in better understanding the universe and how things in the universe work has been an important goal in itself, it has also been important to translate the impact of science and technology to tangible societal and economic benefits for a larger population.

One of the fundamental measures of societal progress has been global average life expectancy at birth. According to various estimates, the global average life expectancy in the world was about thirty-two years in 1800. And by 2012, the global average life expectancy went up to about seventy years. What has been impressive is that the population of the world has increased from about one billion in 1800 to about seven billion in 2012. Humans are not only living longer but are also economically better off in general.

According to data from studies by the World Bank, the percentage of the world's population living in poverty based on purchasing power parity units has decreased from 94% in 1820 to about 9.8% in 2015. In absolute numbers there are lesser number of people living in poverty in the world in 2015 than in 1820, despite a 7x growth in world's population.

What about the economic benefits of science and technology? Let us visualize the world's GDP in trillions of international dollars on the Y axis of a graph. (An international dollar would buy in the world a comparable amount of goods and services a U.S. dollar would buy in the United States.) Let us assume the Y axis goes from zero at the origin to 127 trillion international dollars - current world's GDP. Let us denote time in the X axis. Let the origin on the X axis denote 8000BCE – about the time humans started farming. And extend the X axis to 2018CE. The graph of world's GDP vs. year is for most part is a line hugging the X axis. Only in at the turn of the 20th century does the graph start to spike vertically upward. This reveals the increase step change of the world's economic activity that has been spurred by advances in science and technology from the turn of the 20th century including advances in information technology. In fact, the vertical part of the spike becomes pronounced only after 1950 when computers started being adopted in industry and government.

Let us look at the evolution of world economy from another lens. Historical data indicates that the world's economic growth undergoes increasing step change with every major paradigm shift in technology. Robin Hanson, a researcher at the Future of Humanity Institute in Oxford University, modelled the step change in economic activity. If humans continued as a hunter - gatherer society, then the world's economy will double every 224,000 years. If we continued as a purely farming society, then the world economy doubles every 909 years. And if we continue as an industrial society - the first three industrial revolutions - then the world economy will double every 6.3 years. Now imagine the growth that we will witness in a knowledge society powered by the science and technological advances of the fourth industrial revolution

DOUBLING WORLD ECONOMY
22400 yrs – 999 yrs – 6.3 yrs

Let us visualize the impact exponential technologies have on our society by looking at illustrative examples of applying AI and ML in our lives.

- For example, the most significant aspect of automotive technology today is autonomous vehicles that use AI and ML to either assist humans or completely take over driving from humans.
- Another example where AI and ML are redefining another technological domain is biomedical engineering. Image processing is an area where ML has made rapid strides.
- We have seen Facebook suggesting correct labels for photos of our friends and family. The use-case in biomedical engineering is similar.
- Stanford researchers developed an algorithm in 2017 that offers diagnoses based off chest X-ray images. It can diagnose up to fourteen types of medical conditions and is able to diagnose pneumonia better than expert radiologists working alone.
- Recently researchers in Germany have developed a ML neural network model that can spot the signs of myocardial infarction – heart attacks - which matches the performance of human cardiologists for the first time.

While AI and ML technologies are likely to impact our lives in fundamental ways in the near future, they are not without a bias. Till recently the general reason for the bias in the IT industry was thought to be the fact that the IT-professionals community is predominantly male and socio-culturally homogeneous. However, a recent study from Stanford reveals something more fundamental. ML algorithms may be learning from society's deep-rooted biases.

For example, AI and ML are assisting humans in judicial decision making. Last year, a man in Wisconsin, USA was sentenced to a six-year prison term based on a report generated by private proprietary software whose ML algorithm was unavailable for inspection. ML algorithms are increasingly becoming integral to human life, and impacting our daily lives. They are making decisions by analysing and interpreting the analysis of the prolific amounts of data that we and our gadgets are generating. From the mundane like, what route we need to take to reach our destination in the quickest time, to the more serious lifesaving contexts of helping doctors choose an appropriate cancer therapy. It is imperative that the ML algorithms we design are robust.

Impact of exponential technologies on Research

The scientific revolution has powered the rapid societal and economic progress, and the growth of institutions like universities that continue to be centres of scientific research and education. **Not only is research becoming global, it is also becoming multidisciplinary.**

MULTI-DISCIPLINARY RESEARCH

20% in 1980 to 35% in 2010

A report in Nature mentions that the percentage of research papers in science and engineering with references to other disciplines increased from about 20% in 1980 to about 35% in 2010. Interestingly, a 2015 study by Elsevier notes that authors from India are among the most prolific in publishing interdisciplinary papers. According to another study, the number of multiple author scientific research papers with collaborators from more than one country doubled from 1990 to 2015, from 10% to 20%[3].

Let us consider the example of a relatively young domain in the sciences – brain science. Brain science combines physiology, anatomy, molecular biology, developmental biology, cytology (study of the structure and function of cells), mathematical modelling, computer science, electrical and other engineering disciplines, and psychology to understand the fundamental and emergent properties of neurons and neural circuits. Modern multidisciplinary brain science traces its origins to the neuroscience research program weaving biology, chemistry, physics, and mathematics started within the Biology Department at the Massachusetts Institute of Technology in the 1950s. The leading information technologies of today AI (artificial intelligence) and ML (machine learning) were inspired by the research of neuroscientists done about three decades ago.

Let us consider AI/ML and see how it is now an important part of the toolkit in many areas of science.

[3] Kris Gopalakrishnan, Speech on "Building a world class capability for tomorrow's science" at IISER Pune, 2019

- It is interesting to note that AI/ML has come a full circle and is helping neuroscientists analyse brain imaging data more efficiently. It is helping speed up the analysis research data in other scientific disciplines as well.
- ML today helps to analyse gravitational waves data from LIGO experiments, and enables detection of new classes of gravitational wave sources that may go unnoticed with existing image processing algorithms. While existing techniques may take several days to narrow down the features of gravitational events from detector data, deep convolutional neural networks do that within a second.
- In late 2017, NASA announced the discovery of two new exoplanets in collaboration between its space telescope Kepler program and Google AI - exoplanets Kepler-90i and the Earth-sized exoplanet Kepler-80g. Google AI has analysed about 10% of the 150,000 stars NASA's Kepler Mission has been monitoring across the Milky Way galaxy. Google AI is sifting through Kepler's entire catalogue to find other exoplanetary worlds that have either been skimmed by scientists or haven't been checked yet.

Impact of exponential technologies on Business

The march of information technologies in the past few decades have meant IT platform companies like Microsoft, Amazon, Apple, Alphabet (parent company of Google), and Facebook are companies with the largest market capitalization in the world today. They were all startups in the not too distant past; the oldest being Microsoft which was founded in 1981. It is interesting to note that none of the companies existed fifty years back. Of these companies, only Microsoft existed twenty-five years back. Facebook, the youngest was founded in 2004. All these companies have one common thread. They leveraged technology innovations that were emerging when they were founded and disrupted existing business models. The classic example is Amazon that leveraged ecommerce related technologies including the growth of Internet access, web technologies, and secure online payments to disrupt the prevailing retail business model. These companies have become so powerful that different countries are considering regulations to control their powers.

TRANSFORMING HEALTHCARE INDUSTRY

Real-time, image-guided and robot-assisted surgery

The exponential technologies are being put to good use in transforming industry after industry. Let us look at a 21st century example. Real-time image-guided and robot-assisted surgery where imaging coupled with robotic assistance helps in assessing the area of procedure, monitoring the tools in 3D and updating pathophysiology knowledge of the targeted tissue in real-time. **This innovation is at the intersection of AI, robotics, biotechnology, telecommunications and clinical domains.** A few months back, expert doctors successfully directed surgeons 200 km away in a remote area in China to perform a gall bladder surgery using 5G network. This innovation opens up new healthcare delivery models at very different price points.

There are many more such innovations at the edge and intersections emerging and defining the 21st century.

- Take ecommerce for instance – companies today can predict the fashion trends of the season; pre-order quantities of certain types & colour of clothes and keep it in warehouses so that when the "Sale" opens, they can ship the product to the consumer the same day. Industries like retail, automotive, banking, insurance, logistics and travel seem to have the highest potential to derive business value from AI solutions.
- In retail, marketing and sales function and business processes like pricing and promotion and customer service management are the main value areas. In banking, AI has much higher value potential to improve performance in risk (in loan underwriting, fraud detection) in the banking sector than in many other industries.
- McKinsey recently published a briefing called "Notes from the AI frontier" where it has analysed more than 400 use cases of AI across 19 industries and 9 business functions.
    - In 69% of the AI use-cases, more established analytical techniques such as regression and classification techniques are already used, but where neural network techniques could provide higher performance or generate additional insights. One example is that of predictive maintenance solution, where advanced analytic techniques can effectively combine different layers of data – equipment data, maintenance history, sensor data, images and videos of engine conditions and so on to take existing predictive maintenance systems to the next level.
    - In 16% of the use-cases which could be classified as "greenfield" AI solutions, traditional analytical models were not effective. Healthcare industry saw many green-field AI solutions cases involving disease diagnosis and improved care, and relying on rich data sets incorporating image and video inputs, including from MRIs.
- Blockchain technology is good at creating trust in information and processes in situations where there are large, heterogeneous sets of stakeholders or users – to secure and share important data and records like citizen-identity; create asset registries, in case of land title (helps property buy-sell process), patient health records or educational certifications etc.

- Deloitte has identified a set of 13 exponential technologies that are driving significant innovation in manufacturing – 3D printing, advanced analytics, advanced materials, advanced robotics and cognitive automation, artificial intelligence, biotechnology, blockchain, cybersecurity, digital design, simulation, and integration, energy storage, high-performance computing, Interface of Things, and Internet of Things (IoT).
- One significant application of IoT in government is under the category of Smart City. A wide-spread deployment of IoT sensors across the city provides real-time data on the happenings in the city; and a centralized system analyses the data and helps in governing cities by improved decision making. 'Women Safety' is highlighted as one application in India's IoT / Smart City policy.

In each of these cases, there may be an elimination of certain jobs. These are however replaced with new types of jobs for functions like data cleansing and training a machine learning system, testing the AI system, securing the cyber-physical system and so on. It is surprising but true that the following jobs did not exist ten years back – an app developer, social media manager and influencers, data scientist, gig economy worker. In Silicon Valley, there is now a new role called the "acoustical consultant", who helps with dealing with the different dings and pings from various digital devices!

JOBS THAT DIDN'T EXIST TEN YEARS BACK

App developer, social media manager and influencers, data scientist, gig economy worker

Way Forward

It is clear that we are living in a technology-powered world moving at a frenetic pace, where exponential technologies are rapidly transforming our everyday lives – the way we work, live, interact, govern and create value. While the opportunities for digital technologies to transform are immense, they are also raising fundamental questions about ethics, privacy, security and trust in business, society, and governance. How then should the society, scientific and business community react, especially in India?

Strategies that can adopted at a society-level

Among the countries that have leveraged science and technology for the benefit of their citizens, the United Stated of America (USA) stands out. While the **university – industry – military complex** in the USA powered science and technology from World War I till the end of cold war, the **university – startup complex** has been in the forefront of powering science and technology in recent years. The digital computer and Internet are applications from the university – industry – military complex era. And web search, social networking, software as a service (SaaS), current AI and ML etc. are applications from the university – startup complex. The central theme of the successive US science and technology policy makers from the era of World War I has been to turn to their scientists and technologists in their universities to solve problems of national importance. India should learn from and contextualize from the best practices around the world.

Brynjolfsson and McAfee in their book, "Race against the machine" found that the more technology any industry had, the bigger the performance gaps were, as the leaders rapidly adopted new technology and raced ahead. They also found this effect on people i.e. there emerged a huge gap between high-skilled and low-skilled people. This is particularly true as we enter the second-half of the technology chessboard for many exponential technologies[4].

Their five-fold recommendations for winning the race against the machine are:

- Invest in education.
- Stimulate entrepreneurship through higher education, vocational training and drastically reduced regulatory barriers for new businesses.
- Encourage selective immigration (like visas for highly skilled workers).
- Invest in much improved transport and communications infrastructure.
- Increase research funding for technology-related R&D institutions.

What should India do? On the technology front, India needs to increase its spending on research and development and **develop institutional mechanisms to build horizontal and vertical technology capability**. India is at a point in history where private funding can supplement government funding in research, and this includes

[4] https://www.tlfresearch.com/review-race-against-the-machine/

philanthropy. How India ramps up on its manufacturing and technology capabilities like Industry 4.0, Artificial Intelligence in the next decade will determine its growth trajectory[5].

- India needs to enable technology-led innovation in all sectors of its economy and scale-up its entrepreneurial spirit – innovations especially in emerging technologies that the industry can create and absorb.
- India must focus on developing indigenous national innovation capability (intent, investment and innovation infrastructure. Entrepreneurial activity that builds solutions and products based on these innovations is an important engine of growth.
- While we have managed to nurture an active start-up ecosystem, we need to create more deep-tech start-ups in the country, that are built in India for the world.
- We also need to create more start-up that solve India-specific challenges helping the next billion users and the under-served in India.
- Despite all its potential, the Indian start-up ecosystem only employs a million people. In order to provide massive employment opportunities, we need to focus on nurturing social and micro-entrepreneurship in the hinterlands of India.

Strategies that can adopted at a science & engineering level

As Prof. Michael Jordan argues, it would be useful to **view Artificial Intelligence and related exponential technologies as a new engineering discipline**. This discipline will be built on ideas that the preceding century gave substance to—ideas such as "information," "algorithm," "data," "uncertainty," "computing," "inference," and "optimization." Moreover, since much of the focus of the new discipline will be on data from and about humans, its development will require perspectives from the social sciences and humanities. While the building blocks have begun to emerge, the principles for putting these blocks together have not yet emerged, and so the blocks are currently being put together in ad-hoc ways.

[5] IITMAA Sangam 2019 & itihaasa Research and Digital, "Reimagining Indian in 2030"

Thus, just as we built buildings and bridges before there was civil engineering, we are proceeding with the building of societal-scale, inference-and-decision-making systems that involve machines, humans and the environment. Just as early buildings and bridges sometimes fell to the ground—in unforeseen ways and with tragic consequences—many of our early societal-scale inference-and-decision-making systems are already exposing serious conceptual flaws.This can only be solved by treating Artificial Intelligence as an engineering discipline with its principles of analysis and design.

While society will no doubt benefit from exponential technology enabled systems, care should be taken to ensure the ethical basis of these systems. Such systems may increasingly be making important decisions that will fundamentally affect the lives of humans. We should adopt the following next practices – a multi-disciplinary approach with experts from the domain, humanities, public policy, and law will be required to implement exponential technology systems. The decision made by an AI system should be explained clearly so that a digital-illiterate can understand the context, implications, and options clearly. The training data sets should include a diverse sample of all segments of humanity. This is especially relevant in the context of India.

Specifically, in the context of India, we should strive to bring about digital inclusion for the next-billion. We need a slew of measures to bring about digital inclusion. These include but are not limited to providing public access to devices that can help connect to the Internet, access to a range of digital services in multiple local Indian languages etc.

- One grand-challenge for India is to develop machine translation for Indian languages. The aim should be to provide a robust machine translation solution to seamlessly translate between the 22 official languages of India and English. While there are commercially available solutions available from the large platform Multinational Corporations (MNCs), it is worthwhile to use a domestic solution that is free to use and where the government of India is in charge of the data that is used in the machine learning.

Strategies that can adopted at a business level

In today's world, businesses are shifting from being "firm-centric" to "customer-centric". It is here that businesses can benefit by adopting a 'design thinking' or 'human-centric design' approach - to understand how customers engage with companies, why they do it, model end-to-end customer journey and identify the wow moments for a customer, anticipate unstated customer intent and help companies deliver a customized user experience. Technology is helping measure customer's reaction or satisfaction much better - the concept of A/B testing and scores like Net Promoter Score help understand how engaged the customers are. Design Thinking is helping companies globally to not only create new products (like in the case of Apple), it is also helping improve their processes (like improving the customer service process in Airbnb).

In today's digital world, characterized by rapidly changing technology forces that are enabling newer business models and customers who are more demanding and engaged, businesses have to become "Digital Enterprises" to be able to thrive. A high-level process may include the following steps:

- Instilling Digital Beliefs in the organization – dealing with leadership support to digital and building a digital friendly culture in the organization.
- Putting Digital Strategy in action – recognizing where the industry is in the digital disruption S-Curve; determining predominant business models for the organization and making the organization more customer and data centric.
- Preparing for and investing in the right Digital Infrastructure in the organization – making a judicious choice of exponential technologies and processes.
- Articulating the business value of digital investments – by defining measurable business metrics that get impacted by exponential technologies

N. Chandrasekaran, Chairman of the Board of Tata Sons presents in his book, "bridgital nation: Solving Technology's People Problem", a unique model for India to absorb AI and digital technologies – one that views AI and automation as a human aid, not a replacement for human intervention.

Here are a few case studies of digitalisation from FICCI members, Shriram Group, Neuberg Diagnostics and TAFE.

Digital Initiatives at Shriram Group

For seamless business operations and enhancing customer experience, Shriram Group is leaving no stone unturned when it comes to deploying the Digital Technologies, across all the Group entities.

Following are some of the digital initiatives implemented by the Group.

- Next Generation Branches: Transformed branches to attract customers with digital panache: self-service cash deposit machines, self-service kiosk to query on loans, service requests, information wall displays to provide better guidance for customers
- Digital Customer Advisory: Through the Mobile Apps, guide the customers in locating the nearest branch, fuel stations, etc., payment dues and reminders, promotions, personal finance management, insurance offerings to next level by providing forward looking insights.
- Customer DNA and Analytics: Understand customers by utilizing behavioural customer DNA at every single touch-point, to become more proactive in customer engagement, and able to target customers with products and services that are exactly right for their preferences, priorities and needs.
- Mobile Payments: Enable customers to pay instalments anytime, with the most advanced mobile solution on the market, simplifying payments, and strengthening the customer relationship.
- Digital Marketing, Marketplace: The solutions to help in the flexible, integrated and consistent experience that flows from one platform to another and from one session to another, allowing customers to go online, offline, and online again – to a website, mobile phone, contact centre –enabling a consistent, personalised customer experience across all channels, fostering a customer-centric approach.
- Mobile b2b applications are adopted across the Shriram Group companies. The sales executives are empowered through the mobile apps which helps them in maintaining the leads, raise receipts, cross sell, with dashboards and act as a daily dairy. More than 50 % of the new business transactions happen on Mobile today.

- Analytics : In the commercial vehicles space, there are segments of Heavy, medium, and light commercial vehicles. Leveraging analytics, we monitor the performance of the product segments and focus on high performance products & services. Similar analytical models are implemented across the entities.
- Increased use of data analytics & prediction algorithms have helped us in personalization of services and products helping in better customer insights. The customer intelligence enhanced personalization and timely delivery to enable cross/up-selling.
- Moving towards AI : The Group is adopting artificial intelligence in areas like behavioural policy pricing, enhancing customer experience as well as personalizing coverage and faster-customized claim settlement. We also use AI for customer credit analysis, sentiment analysis etc.
    - Using chatbots, the customers will experience a seamless automated buying experience. Online interfaces and virtual claims adjusters will make it more efficient to settle and pay claims following an accident,
    - Based on the customer feedback, the company is continuously fine-tuning its digital service channels on an ongoing basis and also enhancing them with artificial intelligence.

Digital Initiatives at Neuberg Diagnostics – by Sanjay Prasad, Medical Director

Digital transformation of processes and services in healthcare in general has been around for about 2 to 3 decades. It has improved efficiency in healthcare, brought newer insights and added tremendous value to the screening, diagnosis, treatment and management of diseases. In laboratory medicine, we have been actively seeking and implementing digital transformation in areas that are error prone. Digital transformation is a means to an end and not an end in itself. Digital technology is a tool that helps in minimising errors and improve efficiency.

Over the years, our experience in digital transformation has been in the areas of improving customer care, process efficiency and adding value to results being reported to patients. Some examples of improved customer care include

- Auto mailing of reports to patients as early as 2001, interfacing of laboratory instruments with Laboratory Information systems to minimise manual errors and handle larger workloads.
- Use of report vending machine to dispense reports after working hours when reports by email was still a rarity. Making available reports on website to customers was adopted in early 2000 and has been increasing ever since.
- For better management of information across the laboratory, the use of digital technologies like barcode and imaging technologies have played a tremendous role in our daily routine work. This has helped in minimising use of paper, reduce stress amongst staff and reduce errors.
- In terms of better insights and diagnosis, the use of Cameras to detect Diabetes Retinopathy screening through implementation of tele ophthalmology and Machine learning has been very satisfying. Unsuspecting patients, have been alerted and diagnosed with mild to severe diabetes related complication and helped them avert major vision impairment.
- Similarly, use of Digital ECG reporting through remote monitoring has helped us identify real time occurrence of myocardial damage (heart attacks) and shift the patient to the nearest cardiac centre where they have recovered well.
- Within the laboratory, the biggest leap we have taken is the use of digital pathology solutions that have changed the way pathology is traditionally practiced. Though not as mature as digital radiology solutions, digital pathology in histopathology has been steadily gaining ground as the digital image of a histopathology slide is the basis of computational pathology which is the future.
- Similarly, digital haematology has leap frogged from analogue technique to digital cell identification and characterisation through use of image analytics including ML and DL.

Our journey in digital transformation has been very productive and we expect its use and implementation in future to increase manifold. Use of data science will be key to better insights in disease diagnosis and patient care.

Digital Initiatives at TAFE – TAFE Team

Digital transformation is one of the top focus and priority for TAFE and we have embarked on this journey to take advantage of the emerging technologies that will provide us necessary competitive edge in terms of quality, cost, supply agility, customer experience and farmer empowerment. We are among the first few manufacturing companies with clear direction and roadmap for Digital initiatives. We have created the ecosystem to support our various initiatives to leverage s cutting edge technologies like AI/ ML, RPA, IPA & IIOT.

We are embracing Digital for our internal efficiency improvement and better quality management, external customer experience and farmer empowerment. Embarking on this journey, we had launched JFarm Services digital platform for farm equipment rentals by leveraging multiple technologies. This is India's first Farmer to farmer tractor rental platform under TAFE's CSR initiative with the core objective to empower Indian farmer and to help them to improve their income either by equipment rental or taking equipment on rent to increase their field productivity. Today, over 7.5 lakh farmers have registered on this platform with more than 4 lac tractors and implements. This has generated revenue of more than 120 crores to renters (farmers) without paying any commission or charges to anyone. We have also launched Tractor bazar, India's largest tractor exchange portal managed by OEM with more than 25000 buyers, 11000 + tractor inventory available.

Digitally matured companies are moving towards digital workforce with RPA (BOTs) adoption. Most of the companies have adopted this technology in traditional finance and HR functions. While we intend to leverage digital workforce in these areas but we have raised the bar of industry by adopting digital workforce in other prominent areas with the objective to improve efficiency, productivity & providing team an opportunity to upskill.

For any digital initiative, DATA is key. The real benefits of digital are reaped when the data is adequately churned and analysed to provide deep insights for business. We had been providing reports and dashboards to business owners but now we are moving forward to add advance analytics and AI into the data for meaningful insights and predictability.

In conclusion

As we have seen, the exponential technologies have the ability to reimagine the world and positively transform our lives. But they also pose some dangers about which we need to be vigilant. Ray Kurzweil, the American futurist believes that by 2045 we would have multiplied the human biological machine intelligence of our civilization a billion-fold. Stephen Hawking believed that AI would be the biggest and also the last event in human history! It is important to find the balance.

“Much has been written about AI’s potential to reflect both the best and the worst of humanity. For example, we have seen AI providing conversation and comfort to the lonely; we have also seen AI engaging in racial discrimination. As leaders, it is incumbent on all of us to make sure we are building a world in which every individual has an opportunity to thrive.”

Andrew Ng, computer scientist