Science and Technology in the New Normal in India

- A Public Attitude Study

January 2021

सत्यमेव जयते

Office of the Principal Scientific Adviser to the Government of India

IIT Madras Alumni Association
Reconnect • Engage • Impact

Contents

1. Foreword

2020 has been an unprecedented year! In the early part of the year, the world faced the COVID-19 pandemic and experienced one of humanity's worst medical, economic and social crises. By the end of the year, the world is beginning to see some green-shoots of recovery. While phrases like social distancing, R0 and flattening the curve entered common vocabulary in the first half of the year, words like hybrid work, support bubbles and mRNA have entered our lingua franca in the second half. How Governments, business and people respond in the near and long term will determine how the world will thrive going forward.

Image by Alexandra_Koch from Pixabay

COVID-19 has not been the only disruptive phenomenon that the world has seen in the last hundred years. When the first computers (ENIAC and UNIVAC) were created in the late 1940s, very few could imagine how digitisation and digital technologies would transform the world of business today. When the World Wide Web (1990), Google (1998), Facebook (2004), Twitter (2006), Apple iPhone (2007), were all created, very few could imagine the influence of digital

technologies in our lives and the information explosion and the AI race that we would witness. Not just in information technology, there have been disruptions in other domains too – like the World Wars and the Cold Wars; the man-to-the-moon missions and the race to Mars; and the mapping of the complete human genome and commercialized gene-editing. Humankind has successfully harnessed each of these defining moments to reshape society and our way of living. In response to the COVID-19 pandemic too, the world is discovering a state of new normal.

It is in this context that we conducted a study on the public attitude in India to the new normal and science and technology. We are thankful to the IIT Madras Alumni Association (IITMAA) and the Office of the Principal Scientific Adviser to the Government of India for their support in conducting the Survey in Nov-Dec 2020. We are thankful to Prof. Seeram Ramakrishna, FREng for his involvement in the study. We are grateful to Prof. K. VijayRaghavan, Principal Scientific Adviser and Kris Gopalakrishnan, co-founder Infosys for sharing their perspectives for this report.

The study provides an insight into the public perceptions to emerging technologies. The public in India demonstrate a sense of resilience and optimism about the future and repose their faith in science and technology to make their lives better. We believe this study will be a useful input into the science and technology planning process for India.

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2. Survey Methodology and Focus Areas

We wanted to understand the perceptions of the public in India about the new normal and about science and technology. The Survey methodology included conducting an online questionnaire-based assessment (1). Our Survey questionnaire is benchmarked with similar global surveys by the UK Charter for Science and Society (2), the European Commission Special Eurobarometer (3).

The Survey focuses on the following areas:

1. Perceptions about the state of 'New Normal' – Confidence level and Priority focus areas

2. Perceptions about the state of 'New Normal' – Extent of digitization, personal priorities

3. Perceptions about Public Attitude to Science and Technology – Understanding of science & technology, source and sharing of scientific information

4. Perceptions about Public Attitude to Science and Technology – hopes, concerns, and levels of trust about science and technology

5. Perceptions about Public Attitude to Emerging Technologies and Artificial Intelligence – Risk Vs Benefits of emerging technologies, Comfort level with applications of AI, sharing data, impact on jobs, AI Vs Human Intelligence

The Survey was disseminated among the alumni and students of IIT Madras, and to leading scientific and technical institutions in India. We had 1564 respondents to the Survey, of which 78% had a high extent of science education (under-graduate / post-graduate level). Other demographic details collected included age, gender, employment status and IIT Madras alumnus status.
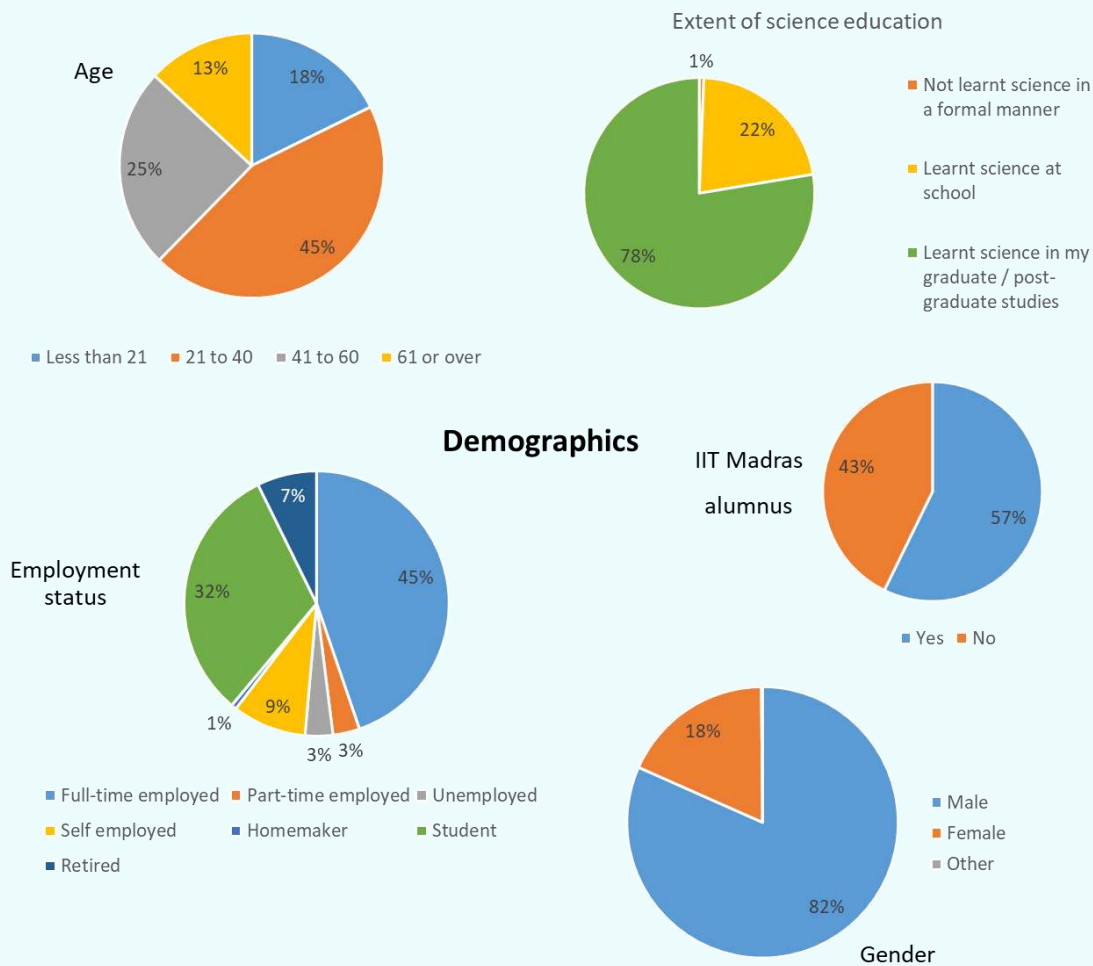
3. Perceptions about the state of 'New Normal' – Confidence level and Priority focus areas

3.1. State of New Normal

The public in our study are highly optimistic about the future. 82% of the respondents are very or fairly confident that we will drive a new normal in the next few years. This optimism about the future may be reflective of the public's recognition of the indomitable spirit of humanity in overcoming adversities and of the confidence they have in science and technology helping us achieve this state of new normal.

How confident are you that we will drive a thriving, new normal in the next few years?
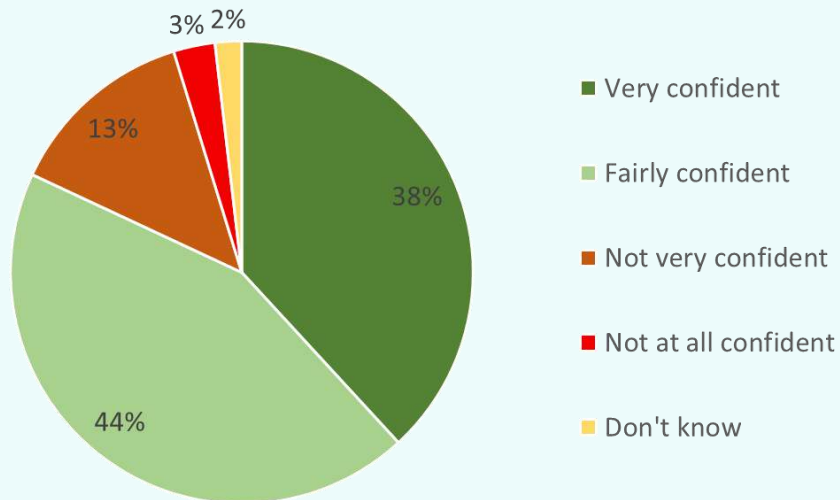
n = 1347

Among various age groups, respondents aged 41-60 are the most confident (Net score (Net score, which is sum of positive responses minus sum of negative responses) of 79% for this age group Vs. 67% overall). Not surprisingly, respondents who are full-time employed are the most confident about the new normal (Net score of 73% for those full-time employed Vs. 66% overall).

> "First of all, India has got an extraordinary history of successful vaccinations. Secondly, one can feel optimistic because typically vaccines take ten years to develop but this one has been done in one year. So, it's a huge amount of investment. But that doesn't mean shortcuts. The investment comes by allowing what could otherwise have gone in series to now go in parallel. Like you stockpile and manufacture while the trials are going on."
>
> - Prof. K. VijayRaghavan, Principal Scientific Adviser to the Government of India on how COVID-19 vaccines are inducing a sense of optimism.

3.2. Priorities for India

When asked about the key priorities for India, the public display a pragmatic, economic mind and a compassionate heart. They have identified the following as the top most priorities for India:

1. Economic growth and jobs creation
2. Health and medical care
3. Equitable growth and providing basic necessities of life (food, water, housing)
4. Education and skill development

As the World Bank suggests, policies to rebuild both in the short and long-term entail strengthening health services and putting in place targeted stimulus measures to help reignite growth (4).

What are top priorities for India in the new normal?
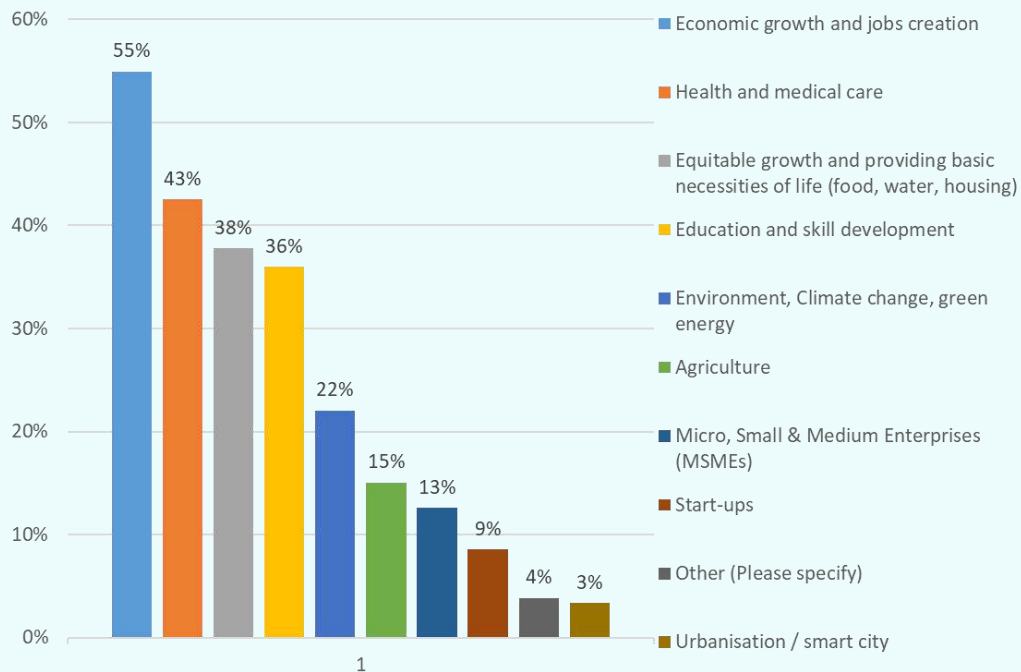
n = 3189

The Prime Minister of India announced an INR 20 lakh crore economic package under the 'AatmaNirbhar Bharat Abhiyaan' (self-reliant India) and the Ministry of Finance has announced a series of steps and interventions in this regard (5). The five phases of Aatmanirbhar Bharat are: I) Businesses including MSMEs II) Poor, including migrants and farmers III) Agriculture IV) New Horizons of Growth V) Government Reforms and Enablers (6).

Not surprisingly, in the times of the pandemic, health is identified as another important priority. In order to meet the COVID-19 challenges, the office of the

PSA has played a critical role to get together various industries, academic institutes, foundations, multilaterals, governments and embassies of various countries to 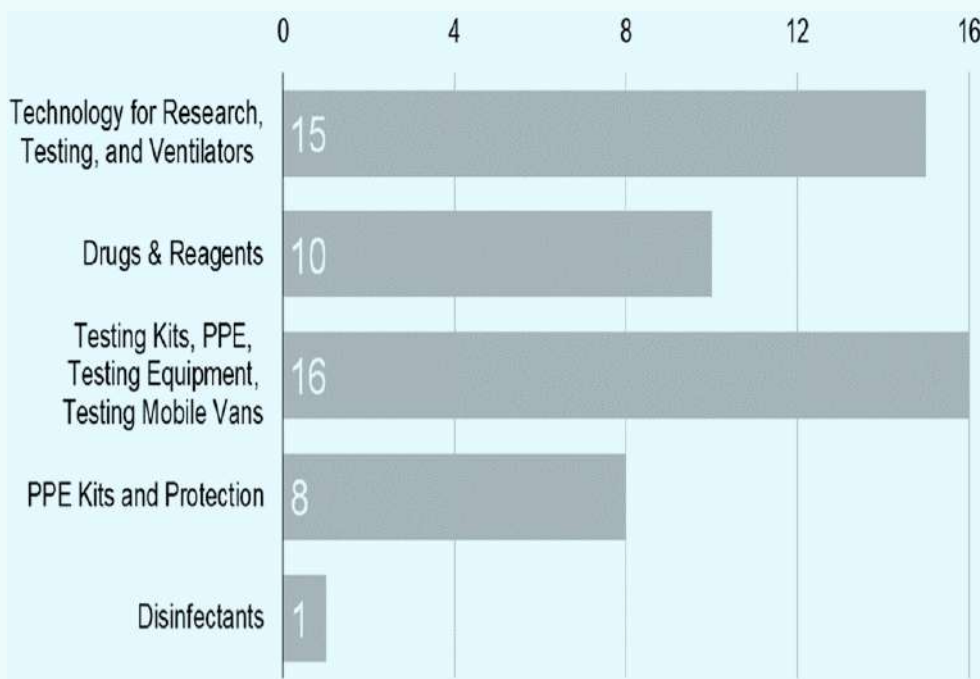accelerate decisions on dealing with research and innovation-based actions. It has constituted the Science & Technology Empowered Committee for COVID-19. Support has been provided to enable national, state and local bodies towards evidence-based action and to mobilize the scientific community for providing targeted solutions.

Research and Development outcomes include development of reagents (import substitution), RT-PCR/antigen testing kits, PPEs, masks, ventilators, mobile COVID diagnostics labs through a collaborative format, where the industry has offered its technical assistance, manufacturing capacities as well as has funded some of these key R&D interventions in academic institutes. Science has met society's needs in a fast-paced manner.

For instance, some of the funding & technical collaboration opportunities created and closed in the time of the pandemic include:
- Scale up of RT-PCR and other molecular diagnostic kits, ventilators and PPE kits.
- Engagement with MSME and Startups for components manufacturing. Over 1.5 lakh face shields manufactured and delivered.
- TCS developed National digital platform for reagents
- Mobile Diagnostic lab developed by IISc in partnership with Toyota Kirloskar, Daimler and Tata Motors. DRDO, IIT Madras, IIT Guwahati developing further labs with funding by GATES
- Significant rise in testing capacity and efficiency.
- FIND challenge for detection of antigens & a global marketplace for evaluation of antigen tests & exports –few MSMEs won the challenge

- GATES funded development of reagents in the Hyderabad Cluster
- Rockefeller Foundation funded development of Reagents for Bangalore cluster

Technology for Research, Testing, and Ventilators	15
Drugs & Reagents	10
Testing Kits, PPE, Testing Equipment, Testing Mobile Vans	16
PPE Kits and Protection	8
Disinfectants	1

Dell	Wells Fargo	Cholamandalam
PNB Housing Finance Limited	Infosys	Asian Paints
Microsoft	Murgappa	Kirloskar group
Huwaei	TATA steel	Persistent
Standard Chartered	ACTgrants .IN	SBI Foundation
Illumina	ANSYS	Tata Motors
Capgemini	Railways	Apollo
Marico Innovation	Syngene International	Cummins
Mphasis & IIIT Bangalore	Naukri.com	Toyota
Intel	ICICI Securities	Infineon
KisanKraft	Flour Danial India Pvt. Ltd.	

Office of PSA - Funding & technical collaboration opportunities with industry

3.3. Technology Priorities for India

The public has identified the following as the top technology priorities for India:

1. Information Technology including AI and Communication technologies
2. Agriculture technology
3. Environmental technology (Tech for Energy, Water, Air etc.)

What are the priority technology domains for India in this new normal?

Legend:
- Information Technology including AI and Communication technologies — 58%
- Agriculture Technology (including food production and processing) — 49%
- Environmental Technology (Tech for Energy, Water, Air etc.) — 44%
- Synthetic Biology (biotechnology, genetic engineering etc.) — 18%
- Nanotechnology including material sciences — 14%
- Climate Change Technology — 13%
- Space Technology — 8%
- Quantum technology — 7%
- Cognitive technology including brain sciences — 7%
- Other (Please specify) — 6%

n = 3005

Digital India aims to transform India into a digitally empowered society and knowledge economy (7). In India, we see policy makers and organizations like MeitY, NITI Aayog, NASSCOM and others place emphasis on Information Technology and AI (8). Office of the Principal Scientific Adviser, Government of India has been working with institutes to set up Centres of excellence on AI and

ML with the support of industry partners. Similar efforts on Quantum computing software and hardware is being undertaken.

"We have embarked on a major quantum mission. The finance minister made an announcement for INR 8,000 crores. It is not just for making a quantum computer, but also looks at a broader view of all quantum matters as such and therefore we'll have a major thrust in areas such as laser photonics. The four domains of quantum technologies include quantum communication, simulation, computation and sensing & metrology. Institutions like TIFR, IISc and IIT Madras are taking the lead here."

-   Prof. K. VijayRaghavan, Principal Scientific Adviser on the National Mission on Quantum Technologies and Applications.

On Agriculture technologies, "KisanMitr – Friends of the Farmers" is an important initiative by the Office of the Principal Scientific Adviser, Government of India. This project aims to make Indian farmers more self-reliant by giving them a choice of different agriculture technologies, livestock technologies, scientific research, agriculture financial technologies, off farm technologies. It also entails an app that provides insights and recommendations based on information from various data sources from different departments of the Government i.e., ISRO, Indian Metrological Department, Ministry of Statistics, Ministry of Agriculture, Jal Ministry etc. (9).

The Office of PSA has been instrumental in facilitating Industry – Academia/MSME/within Industries partnerships for social and industrial development. It has been engaging with industry partners on 140+ projects

ranging from Agriculture, Electric vehicles, Energy efficiency, Defence, Electronics, Networking, AI and ML, Waste management, WASH, Networking, Biomedical, Chemicals and in talks with Industry partners for Hygiene solutions, 5 G, Quantum Computing etc.

Thematic area	Name of the Companies
Agriculture	Rallis India, DCM Shriram, CISCO, Indigram Labs Foundation, IFFCO, Social Alpha, Echo network, Nudge Foundation, CISCO, Tata Chemicals
Automotive/Railways	Daimler India, Railways
AI / ML/ IT	Wadhwani, AI AssisTech Foundation, Amadeus, VMware, NASSCOM, TCS, Huawei, CISCO
WASH (Water, Sanitation, Hygiene)/Waste Management	Toilet Board Coalition, Railways, Smart Water Waste World an Indian Express initiative, USAID (United States Agency for International Development), UNEP, UNDP Plastic to Waste, IoCL
Health / Biomedical	Gates Foundation, Illumina, Project Nivaran - ICT, Mumbai, America-India Foundation, Rockefeller Foundation, Microsoft, Infineon, Standard Chartered Bank, Cognizant Foundation, PNB Housing
Electronics & Defence	BEL, Electronics Committee - CII, Nuclear Power Corporation (NPCIL)
Oil & Gas	IOCL, Ministry of Petroleum
Capacity building / Skill Development	CSR BOX, TIE, Amazon, BHEL, Deloitte, CISCO, Huawei
Differently abled	AssisTech Foundation, Youth4jobs

Office of PSA – Key Industry Partnerships in Different Sectors since Apr 2020

The Industry-Academia collaborations support:

- Joint R&D or contracted Industry R&D
- Establishment of Center of Excellence (CoE) by industry in academic institute to promote innovation.
- Funding innovative solutions for social development

The academic institutes partnering with the Office of the PSA include a vast network of IITs, NITs, IISc, IISERs, CSIR, Research Parks, AGNIi (Accelerating Growth of New India's Innovations), Atal incubation centers (60 premier institutes). The Centers of Excellence in institutes of eminence in India undertake cutting-edge research and apply it to relevant problem areas in India. For instance, the IIT Madras Center of Excellence in Wireless Technology (5G test bed), the IIT Madras Thematic Unit of Excellence on Water (nanotechnology for purification), the Centre of Excellence for Research on Clean Air at IIT Delhi (solutions to fight air pollution) (10,11).

"How can you have high standards of living for everyone and not just for a small group, and yet not affect the environment? That is the current challenge. The solution comes from our ability today to harness the sun in multiple ways or nuclear power. Basically, the availability of energy at less and less damage to the environment. Also the scientists / technologists in the electronics industry have done wonders in changing the power transistor, powering small motors, usage of DC power and so on."

- Prof. K. VijayRaghavan, Principal Scientific Adviser on a focus on the environment and sustainable development.

4. Perceptions about the state of 'New Normal' – Extent of digitisation, personal priorities

4.1. Digitisation is permanent

80% of the respondents believe that the current state of rapid digitisation that we are experiencing in our lives will become permanent.

Respondents aged 41 -60 and 61+ agree with this the most (77% for this age group Vs. 71% overall).

Will the current rapid digitisation of our lives become permanent in the new normal?
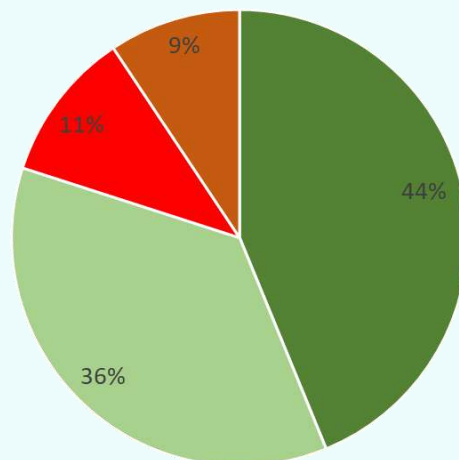
- ■ Strongly agree
- ■ Partially agree
- ■ Strongly disagree
- ■ Partially disagree

n = 1347

4.2. Future of work is 'Hybrid'

The public believes that remote working is here to stay in the future of Work (92%) and Education (69%). The respondents overall believe that a 'hybrid model', one that involves a combination of remote working and in-person or onsite working, will be dominant in the future of Work (Net score 83%) and Education (Net score 65%). The people who believe that we are likely to return to a situation as before the pandemic, think that it is 3.5X more likely to happen in Education than at Work.

How will digitization affect the future of work and education?
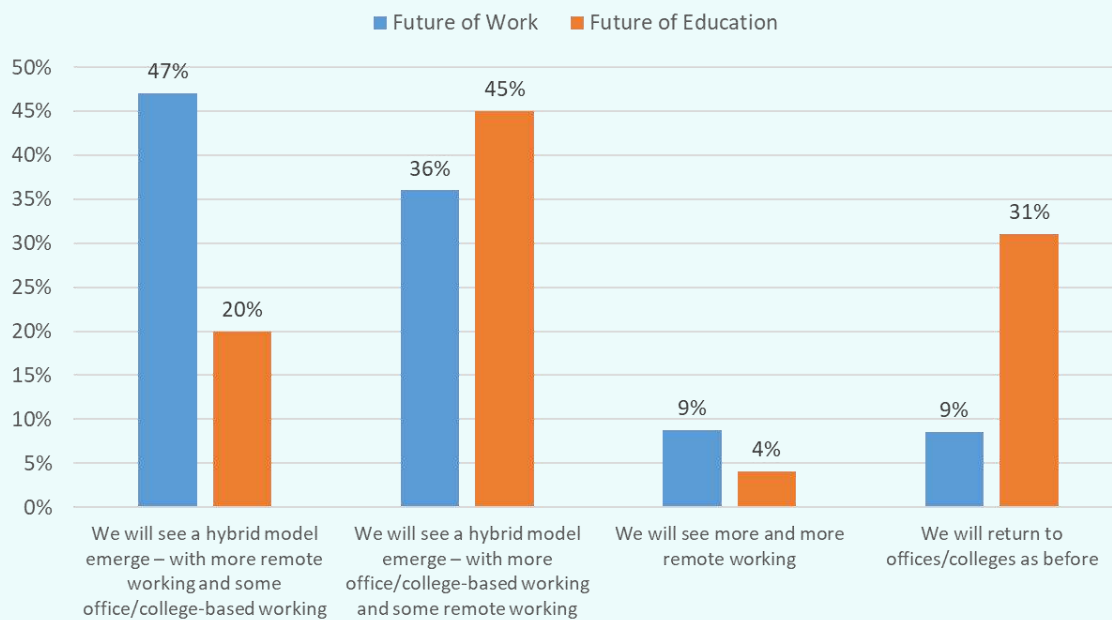
■ Future of Work   ■ Future of Education

	We will see a hybrid model emerge – with more remote working and some office/college-based working	We will see a hybrid model emerge – with more office/college-based working and some remote working	We will see more and more remote working	We will return to offices/colleges as before
Future of Work	47%	36%	9%	9%
Future of Education	20%	45%	4%	31%

n = 1329

Interestingly, the younger respondents think differently about this digitization. The Net score of those under age 21 and 21-40 are just over half that of those in age group 41-60 and 60+. Perhaps, it is a reflection of how they desire the future should be – a future involving more in-person interactions.

This finding about hybrid model of working is in line with other studies, especially in the Indian IT market (12). Policy makers and organizations should recognize this trend and create policies that encourage a hybrid model of work and education. For instance, the Department of Telecommunications extended connectivity norms in India up to 31st December 2020 to facilitate work from home. In this period, IIT Madras launched the world's first world's first online BSc Degree program in Programming and Data Science. The program will be offered in a blended way where the students will learn online, and undergo periodic evaluations in physical examination centres.

"The Indian IT services companies will adopt newer operating work-models in the future. It will be hybrid. At least 25%-30% of their employees would continue to work from home in the long-term.

While digitisation in society will increase, aspects like digital divide, connectivity, affordability etc. need to be addressed. I propose five principles for social prosperity – inclusion, equity, sustainability, robustness and resilience."

- Kris Gopalakrishnan, co-founder Infosys on digitization in the Indian business and society.

4.3. Personal development priorities

The top two priorities for personal development are 1) Professional skill upgradation and 2) Mental well-being. A greater proportion of the younger respondents – aged less than 40 (32%) place greater emphasis on mental well-being than those aged 41 and above (21%). Those aged 61+ place the greatest emphasis on giving back to society.

What are priorities for personal development in the new normal?

- Professional Skill upgradation — 29%
- Mental well-being — 28%
- Giving back to society — 17%
- Spending more time with family and friends — 10%
- Spiritual well-being — 8%
- Professional Networking — 7%
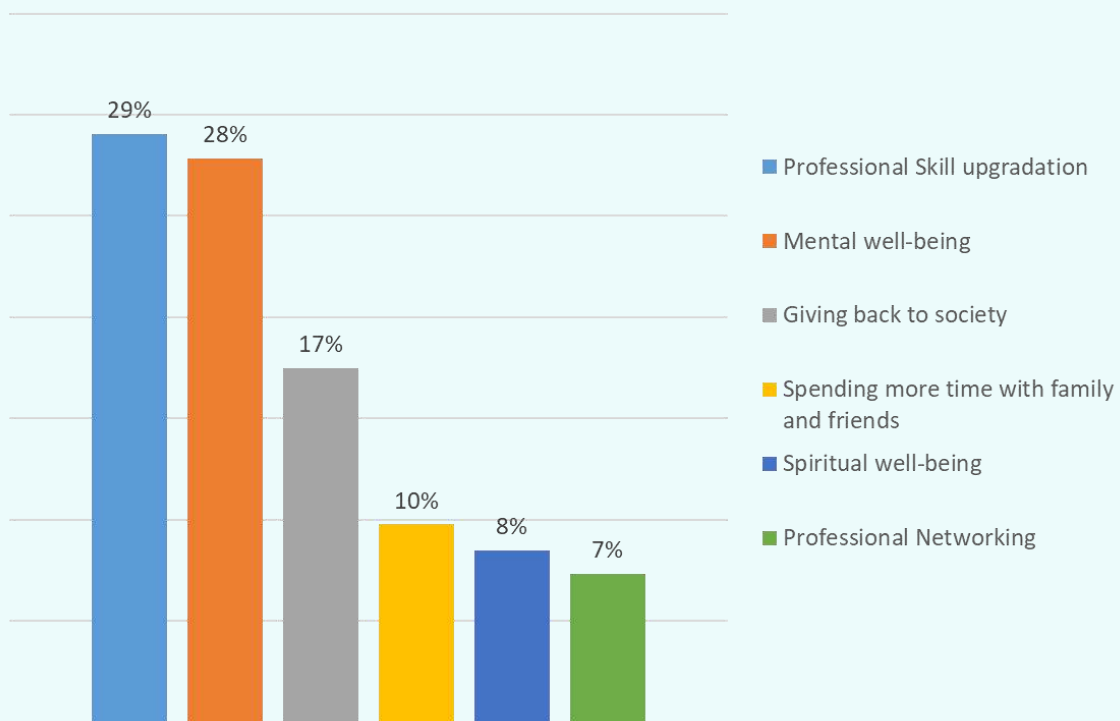
n = 1321

5. Perceptions about Public Attitude to Science and Technology

In this section, we understand the public's responses to the following questions:

1. How do you see science?
2. Where do you get your scientific information?
3. Do you share scientific information?
4. What are your hopes, concerns, and levels of trust about science?

5.1. How do you see science?

When asked what they recall when they hear the word "science", the public identify Physical Sciences like physics & chemistry (55%) the most, followed by Applied Sciences like engineering & medicine (33%). Formal sciences like mathematics (6%), Life sciences like biology (5%), and Social sciences like sociology (1%) came way below among respondent choices.

The branch of science that comes to your mind when you hear the word 'science'?

- Physics, Chemistry, Astronomy...
- Engineering, Medicine...
- Mathematics, Logic, Statistics...
- Biology, Botany, Zoology...
- History, Economy, Sociology...

Category	Value
Physics, Chemistry, Astronomy	55%
Engineering, Medicine	33%
Mathematics, Logic, Statistics	6%
Biology, Botany, Zoology	5%
History, Economy, Sociology	1%
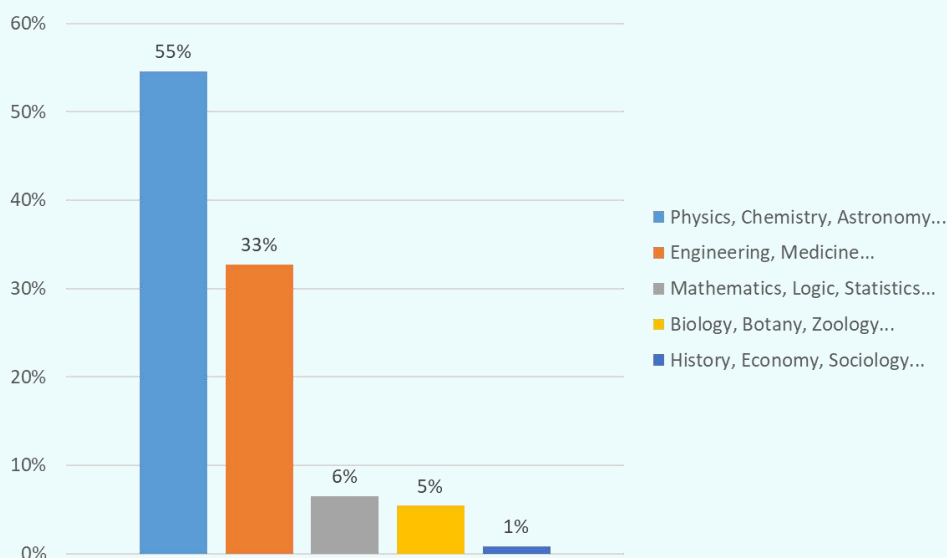
n = 1236

Such a finding may be seen as an opportunity for the policy makers to promote social sciences in science / engineering programs and promote STEAM education in schools and colleges. The National Education Policy 2020 (13) recognizes the importance of an inter-disciplinary learning and says, "The societal challenges that India needs to address today, such as access for all its citizens to clean drinking water and sanitation, quality education and healthcare, improved transportation, air quality, energy, and infrastructure, will require the implementation of approaches and solutions that are not only informed by top-notch science and technology but are also rooted in a deep understanding of the social sciences and humanities and the various socio-cultural and environmental dimensions of the nation."

5.2. Obtaining and sharing scientific information

The top three sources of scientific information include:
1. Online Websites (70%)
2. Scientific Journals (42%)
3. Social media like Facebook / WhatsApp / Twitter (32%)

It is not surprising that more of those aged less than 40 consider social media as a source of scientific information as compared to those aged greater than 40. Thus, it is important for scientific establishments in India to embrace the online and social media channels to communicate with the public.

Sources of information about the latest science and technology findings?

Legend:
- Online websites — 70%
- Scientific Journals / Science Blogs — 42%
- Social media like Facebook / WhatsApp / Twitter — 32%
- Through school or university — 16%
- Books and Magazines — 14%
- Print Newspapers — 14%
- TV — 11%
- From co-workers — 10%
- Friends and family — 8%
- Radio / Podcasts — 5%
- Others — 1%
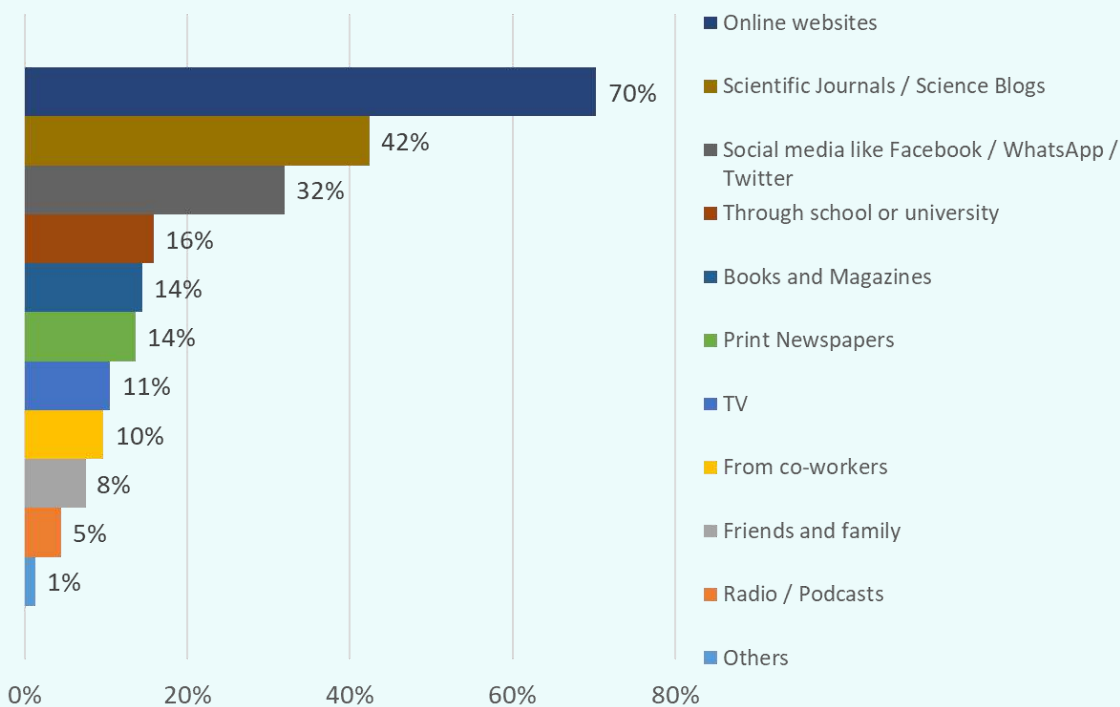
n = 2719

Further, 89% of the respondents share online scientific information they receive. Factors like attractively presenting scientific information and the presence of a friends-network come out as important ones that facilitate online sharing of scientific information. A case is made for science to do a better job in telling stories (14). Thus, policy makers should ensure that they do consistent science communication to the public through online / digital mechanisms and place emphasis on both content and its packaging.

5.3. Hopes, concerns, and levels of trust about science

The respondents have an optimistic attitude towards science. 91% of the respondents believe that science and technology make our lives better and 96% believe that they make a direct contribution to economic growth of the country. 93% of the public believe that careers in science are suitable for women.

Hopes, concerns, and levels of trust about science?

Public Attitude to Science (Net Score)

Legend:
- On the whole, science and technology will make our lives better.
- Science and technology make a direct contribution to economic growth of the country.
- Scientists and technologists should discuss more the social and ethical implications of their work.
- Science and technology careers are not suitable for a woman.
- In general, science and religion are mostly compatible and not in conflict.

Values shown: 88%, 95%, 89%, -89%, 23%

n = 1236

The attitude of the public towards women in STEM is heartening to note. However, the ground realities in India suggest there is a significant scope for improvement on this front. According to All India Survey on Higher Education (AISHE) 2018-19 by Ministry of Education, women constitute nearly 43 percent of the total STEM enrollments in the country; however, only 3 percent of women

enroll in PhD in science, and 6 percent opt for a PhD in Engineering and Technology. Further, they account for only 14 percent of the total scientists, engineers, technologists in research development institutions (15). The Ministry of Science and Technology in India has announced that it will grade higher educational institutions and research institutes that it funds on gender equality – number of women occupying science faculty positions, number of women fellows sent to different academies of science.

The respondents are also discerning – 91% believe that scientists and technologists should discuss more with the public the social and ethical implications of their work. Policy makers should create more spaces for dialog between the public and scientists. The Office of the Principal Scientific Adviser to the Government of India (Office of PSA) and the Department of Science and Technology (DST) have jointly initiated a decentralized, bottom-up, and inclusive process for the formulation of a new national Science Technology and Innovation Policy 2020 (16). They have undertaken extensive public and expert consultation process (nearly 300 rounds of consultations with more than 40,000 stakeholders) through Science Policy Forums and thematic discussion groups.

On whether science and religion are compatible, the respondents are divided in their opinions, with 51% agreeing and 27% disagreeing. It is important to maintain a dialog between the two. In India, religious groups exercise influence over vast sections of the population. In the case of COVID-19, appeals were made to religious leaders to educate their congregations about scientific facts pertaining to the pandemic response and control.

6. Perceptions about Public Attitude to Emerging Technologies and Artificial Intelligence

In this section, we understand the public's responses to the following questions:

1. What is your assessment of the benefits Vs risks for emerging technologies?
2. What is your comfort level with applications of AI, sharing data for AI applications?
3. What is your opinion on the impact of AI on jobs?
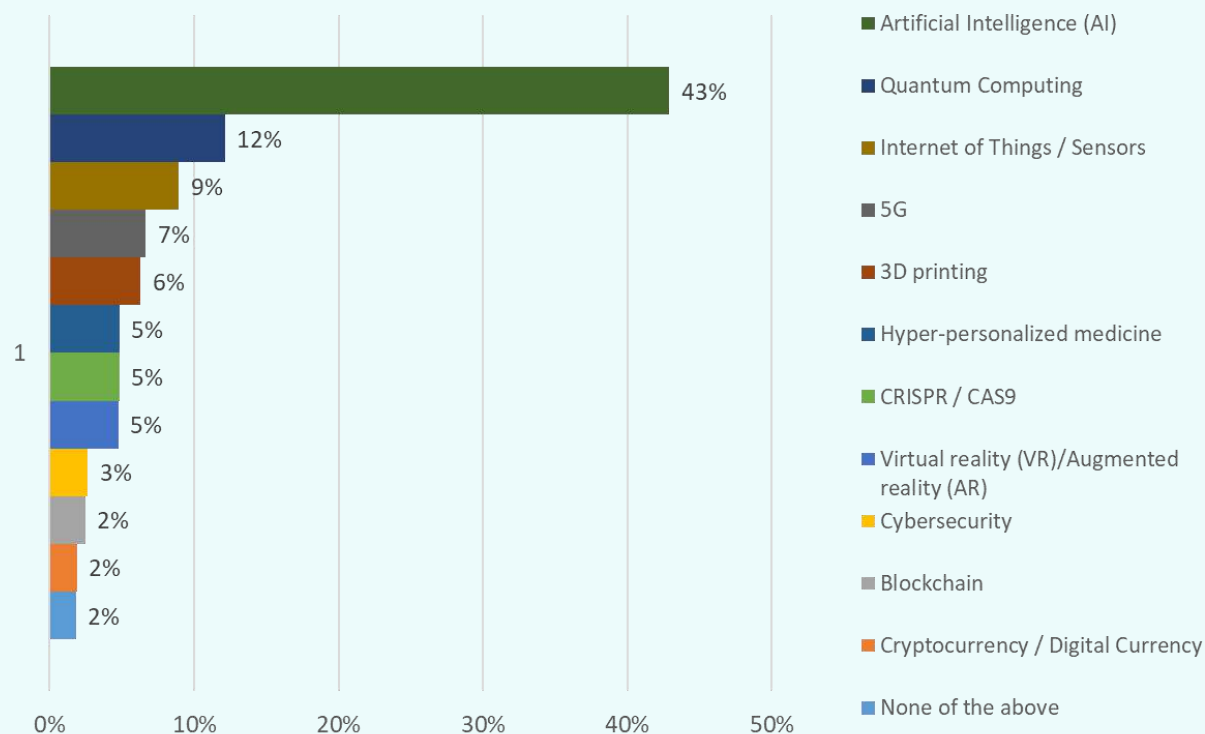4. Where do you stand on Artificial Intelligence Vs Human Intelligence?

6.1. Benefits Vs Risks of emerging technologies

The top most 'emerging technology' that the public recalled is Artificial Intelligence. 43% of them pick AI, which is as much as the numbers for the next six emerging technologies put together.

The other top emerging technologies recalled include

- Quantum Computing
- Internet of Things / Sensors
- 5G
- 3D printing
- Hyper-personalized medicine
- CRISPR / CAS9
- Virtual reality (VR)/Augmented reality (AR)

When you think of 'emerging technology', what comes to mind foremost?

Legend:
- Artificial Intelligence (AI)
- Quantum Computing
- Internet of Things / Sensors
- 5G
- 3D printing
- Hyper-personalized medicine
- CRISPR / CAS9
- Virtual reality (VR)/Augmented reality (AR)
- Cybersecurity
- Blockchain
- Cryptocurrency / Digital Currency
- None of the above

Bar values: 43%, 12%, 9%, 7%, 6%, 5%, 5%, 5%, 3%, 2%, 2%, 2%

n = 1222

When asked for their perception of 'benefits vs risks' for emerging technologies, the respondents strongly believe that the benefits outweigh the risks for sustainable technologies like Renewable Energy (Net score 87%) and Electric Vehicles (Net score 76%). They do not believe that benefits outweigh risks for technologies like Cryptocurrency (Net score -7%), Synthetic Virology (Net score -4%) and Gene editing (Net score -4%), perhaps reflective of the early stages of such technologies.

Benefits vs Risks of technologies?
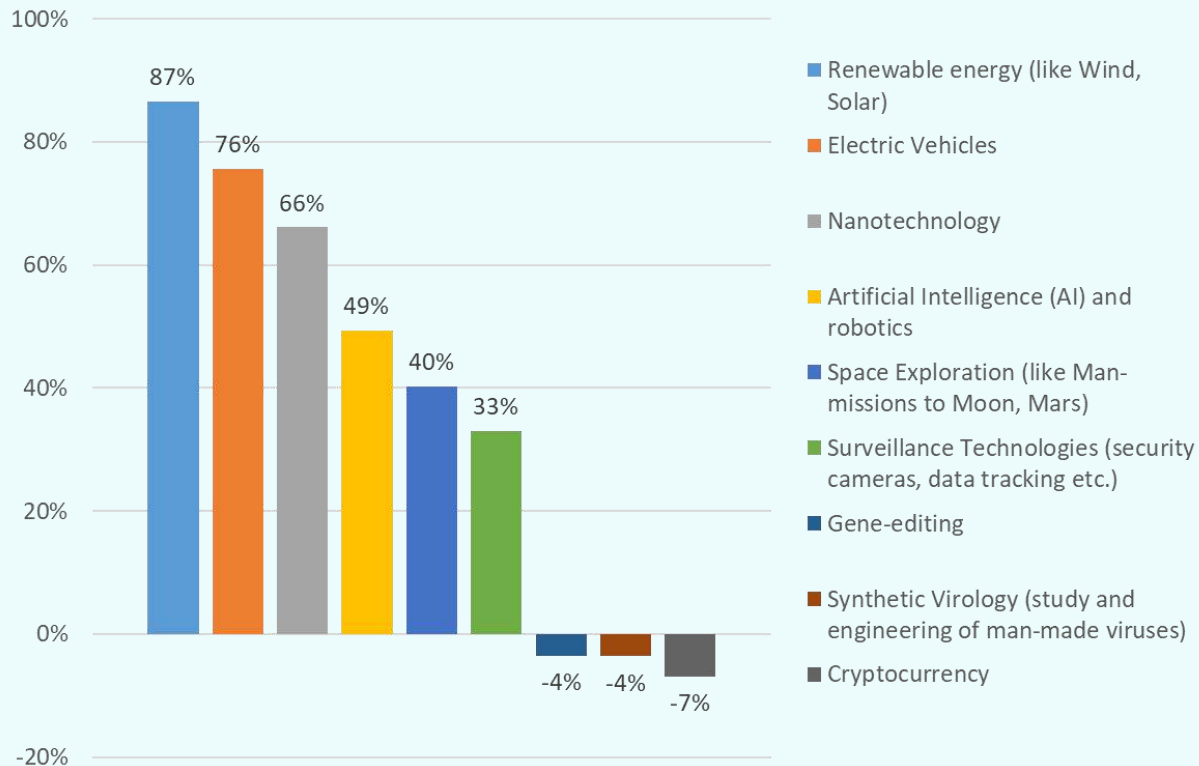
n = 1233

Age-wise analysis of Net Scores reveals interesting patterns

- Respondents in age category less than 21 and 21-40 believe benefits outweigh risks for technologies like gene editing, cryptocurrency
- Respondents in age category 21-40 are the only ones to believe benefits outweigh risks for synthetic virology and respondents in age category 41-60 feel the strongest about risks outweighing the benefits for synthetic virology (3X of the average)
- Respondents in age category 61+ feel the strongest the benefits outweigh risks for AI (59% Vs 49% average)

"One of the people who wrote extensively about why certain technologies get adopted and others don't, is the African scientist, Calestous Juma. The principal problem is not just the risk benefit, but also the timing of the benefit compared to the rest. If you get instant gratification, you tend to adopt things which may be very risky. Like smoking for example. It takes a long time to convince people that they are dangerous. But if the gratification is in the future, like saving the planet, or if it is something which makes a problem go away, like vaccination, people may adopt such technologies late."
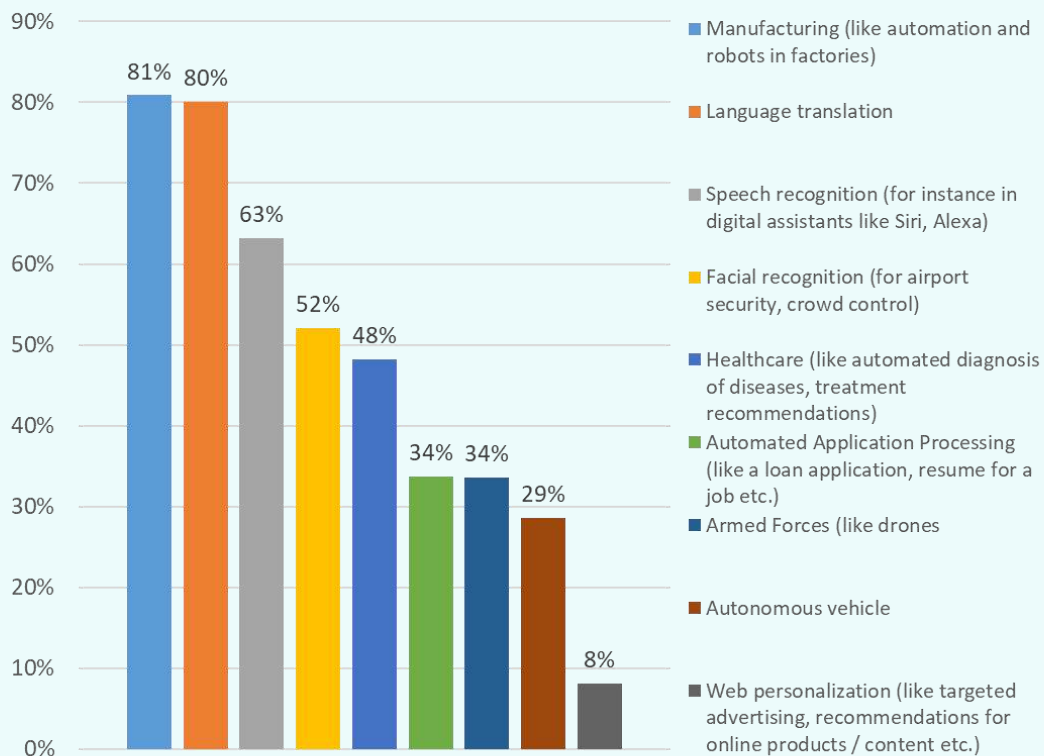
- Prof. K. VijayRaghavan, Principal Scientific Adviser on why technologies get adopted in society differently.

6.2. Comfort level with AI applications

In our study, the public overwhelmingly recall AI as the top emerging technology and one that is of top priority to India. A recent global study finds that 67% of Indians say that development of AI has mostly been a good thing for society (17). Let us analyze the public's attitude to AI in detail (18).

The public is comfortable when it comes to the usage of Artificial Intelligence (AI) in applications like manufacturing that included automation and robots in factories (81%) and language translation (80%). The public is not comfortable in applications like web personalization that included targeted advertising, recommendations for online products / content (8%), autonomous vehicle (29%), armed forces like drones and UAVs (34%) and automated application processing (34%).

How comfortable are you with the usage of Artificial Intelligence (AI) in each of the following areas?

Chart data:
- Manufacturing (like automation and robots in factories): 81%
- Language translation: 80%
- Speech recognition (for instance in digital assistants like Siri, Alexa): 63%
- Facial recognition (for airport security, crowd control): 52%
- Healthcare (like automated diagnosis of diseases, treatment recommendations): 48%
- Automated Application Processing (like a loan application, resume for a job etc.): 34%
- Armed Forces (like drones): 34%
- Autonomous vehicle: 29%
- Web personalization (like targeted advertising, recommendations for online products / content etc.): 8%
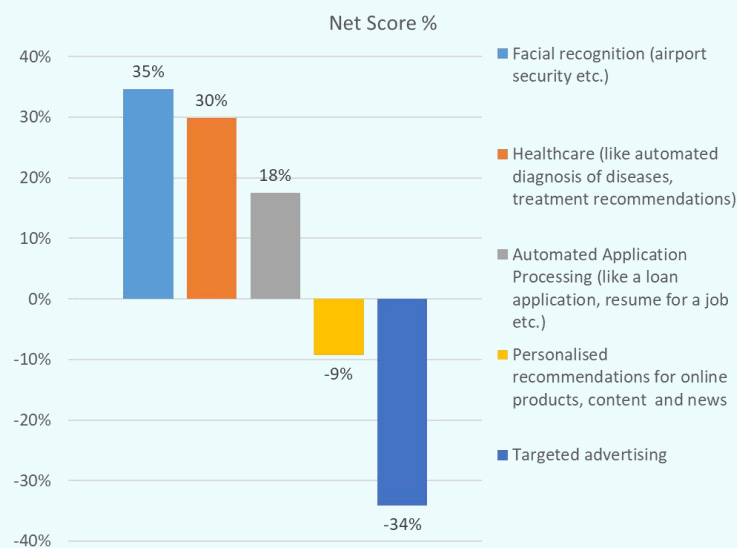
n = 1204

Interestingly, the younger respondents (age groups less than 40) are the least comfortable with usage of AI in facial recognition and armed forces, while they are the most comfortable with usage of AI in automated application processing and autonomous vehicles. The older respondents (in age category 61+) relatively feel the least comfortable with usage of AI in Web personalization (-8%), Automated Application Processing (27%), and Autonomous Vehicles (15%), and the most comfortable with usage of AI in Facial recognition (63%), and Armed Forces (58%).

"Computing is becoming more ubiquitous – in the next 10-20 years, we will have 50-60 billion connected devices in the world. Imagine a world where every one of the 7 billion people has a smart personal device. They can connect and control any one of the 50-60 billion connected devices. We are generating massive amounts of data. With new tools for pattern recognition using AI/ML we can get new information and insights from this data. Imagine a world where you can recognize anyone in the world using your smart phone, even if you have not met that person ever before. And with automated language translation, you can converse with that person in your language and she can reply in her language. "

- *Kris Gopalakrishnan, co-founder Infosys on AI and computing in the future*

The public is not comfortable sharing data for AI applications like targeted advertising (-34%) and personalized recommendations (-9%). They are moderately comfortable sharing data for AI applications like Facial recognition (35%) and Healthcare (30%).

What is your level of comfort in sharing your personal data for Artificial Intelligence (AI) applications in the following areas?

Net Score %

■	Facial recognition (airport security etc.)
■	Healthcare (like automated diagnosis of diseases, treatment recommendations)
■	Automated Application Processing (like a loan application, resume for a job etc.)
■	Personalised recommendations for online products, content and news
■	Targeted advertising

35%
30%
18%
-9%
-34%

n = 1206

Interestingly, for the same AI application like healthcare, facial recognition and automated application processing, respondents are roughly 1.5 times less comfortable when asked if they will share personal data for the AI application as compared to their comfort level with the AI application category itself.

Policy makers should consider this dichotomy as they develop strategies for creating data repositories that will benefit AI research and applications. For instance, the Committee on Non-Personal Data Governance Framework has recommended creation of High-value datasets in India (19).

"Data should be treated as a strategic asset at a national level. It is important for policy making, improving public service, and supporting a wide range of societal objectives including science, healthcare and so on.
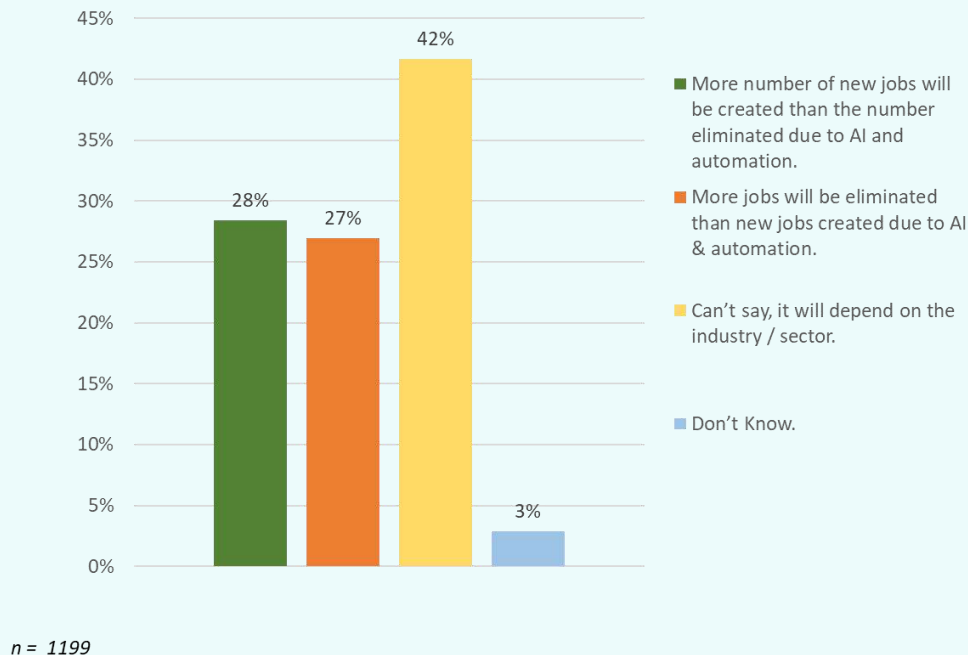Take the case of gene-mapping. Although India has 20% of the world's population, the DNA sequences of its people make up less than 1% of global genetic databases. Such data is required to create healthcare solutions specific for India."

- *Kris Gopalakrishnan, co-founder Infosys on the importance of data*

6.3. On AI and humanity

There have been several discussions in the society about AI posing a threat to humanity

and our way of living and working. In our study, 42% of the public believe that the impact of AI on net new jobs created will depend on the

Impact of Artificial Intelligence (AI) on jobs?

A bar chart showing responses with the following values:
- More number of new jobs will be created than the number eliminated due to AI and automation: 28%
- More jobs will be eliminated than new jobs created due to AI & automation: 27%
- Can't say, it will depend on the industry / sector: 42%
- Don't Know: 3%

The y-axis ranges from 0% to 45%.

n = 1199

industry, and on balance feel that, overall, more new jobs will be created than lost (Net score 1%).

Respondents in age category more than 40 are relatively the most optimistic that more jobs will be created (Net score 14%) as compared to those aged less than 40 (Net score -8%). This may be a reflection of their positive experience with respect to job creation with previous disruptions in information technology – for example, the shift from mainframe technology to client server technologies to personal computing to cloud technologies. The youth would do well to remember that the following jobs did not exist ten years back – an app developer, social media manager and influencers, data scientist, gig economy worker.

Human intelligence Vs. Artificial Intelligence?

- Humans will always be more intelligent than AI systems
- AI systems are already more intelligent than humans
- AI systems will one day become more intelligent than humans

29%

7%

63%
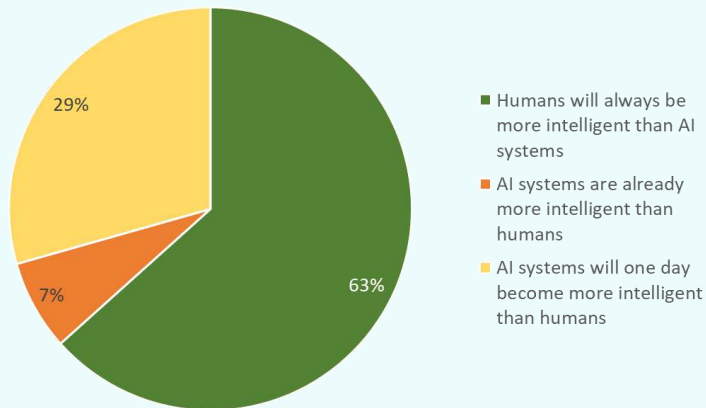
n = 1201

63% of the respondents felt that humans will always be more intelligent that AI systems, while 36% felt AI systems are already or will become more intelligent than humans. One puzzling trend that emerges in the study is about how the youngsters perceive AI. Respondents aged less than 40 are 3 times less confident than those aged 40+ that human intelligence will not be overtaken by AI. There is a need for appropriate education and communication strategies for the youth in India about AI and its positive potential.

"What happens to your ability to take decisions on your own, when you get good advice from a machine? This is a very important ethical, moral and social issue. The answer to that lies in making sure that the tools of statistics, computer science, ways of handling data are available to everyone.
When I get an AI-based advice, I should have an understanding of how that advice came to me. Also have the ability in my own circle to create tools which can look and give back that community advice in a very different kind of perspective."

- Prof. K. VijayRaghavan, Principal Scientific Adviser on the ethical aspects of Artificial Intelligence.

7. Conclusion

The public in India demonstrate a sense of resilience and optimism about the future and believe that digitisation is here to stay. Their dependence and belief in science and technology to make lives better is reinforced by the study.

The findings from this study highlight trends like continued digitisation, hybrid model of the future of work and education, sustainability, and the importance of emerging technologies like AI, renewable energy, EVs, environmental technologies (Tech for energy, water, air, etc.). These align well with the ideas proposed in the draft STIP 2020 Policy (5th Science, Technology and Innovation Policy) on mission mode programs.

- Mission mode programs with deliverables for technology and innovation will be established in the priority sectors (e.g., Agriculture, Water, Health, Energy and Environment)
- Strengthen and scale-up the on-going as well as forthcoming large technology missions such as waste-to-wealth, deep sea exploration, quantum frontier, AI mission, translation technologies for Indian language and biosciences for human health, etc. (Prime Minister's Science, Technology and Innovation Advisory Council's national missions)
- Mission mode schemes/programs will be launched to propel the development and deployment of frontier disruptive technologies such as blockchain, AI, 3Dimensional (3D) printing, Quantum Internet of Things (IOT), etc. that impact society and the economy across the sectors.

Another important area that emerges from the study is the need to create more spaces for dialog between the public and scientists. The public wants the scientists and technologists to discuss more the ethical / moral aspects of their

research. This aligns well with the ideas proposed in the draft STIP 2020 Policy (5th Science, Technology and Innovation Policy) on science communication.

- Locally relevant and culturally-context-specific models will be developed along with promoting cross disciplinary research in Science Communication.
- Science Media Centres will be established at national and regional levels to connect scientists with media persons and science communicators.
- In line with the national policy on Scientific Social Responsibility (SSR 2020), scientists and researchers will be motivated and incentivised to engage in Science Communication and Public Engagement Activities.

India should enhance its R&D spending from 0.7% of GDP and human resource capacity of 156 researchers per million inhabitants to greater numbers. For instance, the equivalent numbers for other countries are – Singapore (2.1% and 6632), United States (2.7% and 4205) and South Korea (4.3% and 6826) (14). This aligns well with the ideas proposed in the draft STIP 2020 Policy (5th Science, Technology and Innovation Policy) on STI funding.

- Hybrid funding models with enhanced participation from public and private sectors will be created through the Advanced Missions in Innovative Research Ecosystem (ADMIRE) initiative.
- To ensure systematic governance of the expanded STI financing landscape, an STI Development Bank is proposed
- Boosting fiscal incentives for industries investing in STI

Ultimately, science and scientific establishments in India have a responsibility to ask relevant and deep scientific questions that will advance our knowledge and lead to societal impact.

Supporting science and technology should become a popular movement. Every responsible citizen, philanthropist and Indian corporation will do well to contribute (time and money) and help create an 'aatmanirbhar' and science-driven India.

The IIT Madras Alumni Association, in collaboration with the Office of PSA, proposes to conduct this Survey on a periodic basis in order to conduct a longitudinal study of public sentiment to science and technology. The future editions of the Survey will be conducted under the name of "Bharat Public Attitude Survey (BPAS)" and will involve greater number of respondents from rural India / wider sections of the society across income levels. We believe such a study will be a useful input into the science and technology planning process for India.

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> **"To achieve world-class education, health, connectivity and rural solutions, today's India has data, demography and demand. Above all, India has democracy to balance and protect all this. That is why the world trusts India"**
>
> **- Shri Narendra Modi, Prime Minister of India**