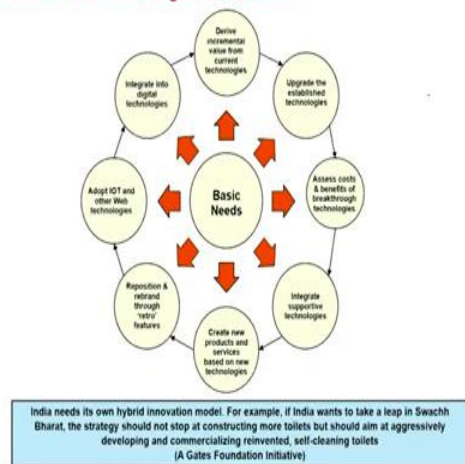


**Entrepreneurship**  
**Professor C. Bhaktavatsala Rao**  
**Department of Management Studies**  
**Indian Institute of Technology, Madras**  
**Technology, Business and Operations Strategies**  
**Part 3**

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**A Framework for Innovating on Basic Needs**



And when we look at those wave 4 technologies, we must focus on the basic needs. As I said every innovation has fulfilled a basic need. Today if we talk about digital laundries, what is it? Nothing but washing clothes, it was a basic need, if you look at food delivery, what is it except getting food supplies to house, earlier person maybe going out and buying it from a restaurant.

Today restaurant is supplying to you. So, basic needs are always basic, essential needs which are always there. What digitization is doing? It is deriving incremental value from current technologies, it is upgrading the existing technologies, getting a new cost benefit relationships through breakthrough technologies, integrating whole lot of supportive technologies under its banner.

Creating new products and services as a result, repositioning and rebranding at times keeping the retro features proper. And finally connecting itself to every other device,

every other human being therefore there is one digital ecosystem which is continuous and together. So, when we try to fulfill the basic needs, we need our own hybrid model, the hybrid model being for example, we talk about Swachh Bharat program.

Not only have we done great by constructing for the first of all by recognizing this as a social and economic problem, and for which we had to say hats off to the Modi government. India took a leap in Swachh Bharat by creating the whole number of toilets and then ensuring that this moment takes physical shape, but the next phase or even the current phase is to see how waste can be eliminated at the generating point.

Therefore, self cleaning toilets which can be installed at homes, so that there is no need to do any further treatment or the entire waste of the home can be managed within the home by means of certain zero waste technologies, how do we do that? So, innovation must focus on these kinds of things, which will reduce the transactional cost of carrying on with life's activities in a very dramatic way.

And ensure that our resources, our energies, and our quality of life activities are diverted to more pressing requirements, which is agriculture, which is energy and which is education, health, etc. So, the framework for innovating on basic needs requires a new startup thinking one would say.

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### Bill Gates' Impact Areas for the Current Times... AI, Energy, and Biosciences

In his open message to the graduating seniors of 2017, Bill Gates said, reminiscing about the impact he and Paul Allen could do with their operating system...

"If I were starting out today and looking for the same kind of opportunity to make a big impact in the world, I would consider three fields.

"One is artificial intelligence. We have only begun to tap into all the ways it will make people's lives more productive and creative. The second is energy, because making it clean, affordable, and reliable will be essential for fighting poverty and climate change. The third is the biosciences, which are ripe with opportunities to help people live longer, healthier lives."



So, to decide or to deliberate on what could be the impact areas for the current times, I thought that I should look at some stalwarts in the field. As we are all aware, Bill Gates and Paul Allen made a complete metamorphosis of the computing industry with their Microsoft company which has done phenomenal work in the disc operating systems and overall computer operating systems.

And the kind of transformation that has happened in the computing industry because of Bill Gates and Paul Allen is obviously very well known. Now, Bill Gates has moved into philanthropy and he has got the Bill Gates, Bill and Melinda Gates Foundation. In an open message to the graduating seniors of 2017 Bill Gates said I would read from this 'If I was starting out today and looking for the same kind of opportunity'.

Obviously, he meant the computing change he made. 'To make a big impact in the world, I will consider three fields. One is artificial intelligence, we have only begun to tap into all the ways it will make people's lives more productive and creative. The second is energy because making it clean, affordable and reliable will be essential for fighting poverty and climate change.

The third is the biosciences, which are ripe with opportunities to help people live longer, healthier lives.’ I think it is very reflective of the need to change with the times or change the times in a way that human life is made productive, more helpful.

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**Artificial Intelligence Start-ups**

From its listing of 100 most promising AI start-ups, CB Insights in its successive reviews, from January 2017 concludes that AI start-ups are accelerating research, improving efficiency and making many game-changing advancements in multiple industries, with the following specialisations:

- i) conversational AI/Bots,
- ii) vision,
- iii) autonomous driving,
- iv) robotics,
- v) cybersecurity,
- vi) business intelligence and analytics,
- vii) core AI,
- viii) text analysis/generation,
- ix) IOT/IOT,
- x) commerce,
- xi) fintech and insurance,
- xii) sales and CRM,
- xiii) healthcare, and
- xiv) others.

While these specialisations are not industries, they can transform a whole range of industries, from healthcare to education and manufacturing to retail.

AI and ML/DL are hot areas for start-up activity. According to CB Insights, the start-ups have raised USD 3.8 billion in aggregate funding across 263 deals since 2012, and include start-ups at different investment stages of development, from seed/angel companies to well-funded unicorns.



So, I will consider this part in terms of three significant areas which could be offering great opportunity for startups, one is artificial intelligence. Second is the whole gamut of clean energy and clean mobility and third is medical sciences. Obviously, we will not be able to dwell deep into any of these subjects except provide certain peeks into the way the developments could occur.

So, from the listing of hundred most promising startups in the AI field, as presented by CB insights from January 2017 research has been accelerating as also startup activity has been accelerating in these areas one conversational AI bots, vision, autonomous driving, robotics, cyber security, business intelligence and analytics. Core AI, text analysis generation, internet of things, industrial internet of things, commerce, FinTech, and insurance sales and CRM, healthcare and others.

In this some of them have been there for several years. For example, customer relationship management has been there ever since programming came into being and customer relationship management always was the philosophical underpinning of good

marketing. Certain things like autonomous driving are newer areas of activity for artificial intelligence.

But while these specializations are not industries by themselves, they can transform a whole range of industries from healthcare to education and manufacturing to retail. I would therefore say that artificial intelligence and machine learning, deep learning are hot areas for startup activity, these startups have raised 3.8 billion dollars in aggregate, funding across 263 deals since 2012.

And this number goes on increasing day by day and they include startups at different investment stages of development from seed, angel companies to well funded unicorns.

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**Some Examples of Global AI Start-ups**

Some examples (by no means, representative or comprehensive) are:

- 6sense (predictive capability),
- botanic.io (interactive verbal personality for code),
- Arria (complex data reading and report writing),
- Automated Insights (stories from spreadsheets),
- Banjo (disaster prediction engine),
- ID Avatars (patient-centric interactive emotional intelligence),
- Infer (data analysis),
- MindMeld (converting text interfaces to natural voice interfaces),
- Mintigo (customer DNA fingerprinting from millions of data points),
- Persado (cognitive content for execution),
- Skytree (deep analytics and predictive data modelling),
- Sense.ly (health-bots for doctor-patient interactions),
- X.ai (independent email and scheduling assistant),
- Vicarious Systems (learning interface for artificial intelligence), and
- Viv Labs (personalised virtual assistant).



So, there are some companies which have actually performed very well. So, I have provided some logos for visual impact. Obviously, as I said earlier the logos are the property of the individual companies and they are being presented only for educational purpose or visual connectivity with the concepts that are being discussed. So, you can see the kind of focus of these AI startups.

One company has predictive capability as its objective, then another company thinks of interactive verbal personality for coding. Another company looks at complex data reading and report writing, developing stories from spreadsheets, how do you predict disasters,

how do you understand the emotional intelligence of a patient through data centric approach, how do we convert text interfaces to natural voice interfaces.

How would you do customer DNA fingerprinting? Not the human physical DNA fingerprinting, but customers personality DNA fingerprinting from millions of data points. How do you develop cognitive content for execution? How do you have deep analytics and predictive data modeling fit for several fields, how about health bots for doctor patient interactions?


How can somebody do scheduling, email organization without having human requirement? What kind of learning interface can have for students for artificial intelligence? And how do we have personalized virtual assistant.

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**Some Examples of Indian AI Start-ups**

India has also logged into AI and ML/DL start-up movement:

Arya.ai (predictive modelling using neural networks),  
Boxx.ai (data analytics using AIDA product),  
Cuddle.ai (data analytics for better informed business and user interface),  
EmbiBe (AI based personalised learning experiences for students and institutions),  
EdGE Networks (AI based HR solutions provider),  
Haptik (Chatbot and personal assistant),  
Locus (intelligent logistics automation platform),  
Netradyne (driver assistance and monitoring device),  
Tricog (real time cardiac diagnosis platform),  
SpotDraft (legal contract lifecycle management), and  
Zenatix (data driven energy efficiency management).



And in AI itself, we have got predictive modeling using neural networks, data analytics using AIDA product, better informed business and user interfaces coming up with data analytics, personalized learning experience for students and institutions. This is very important.

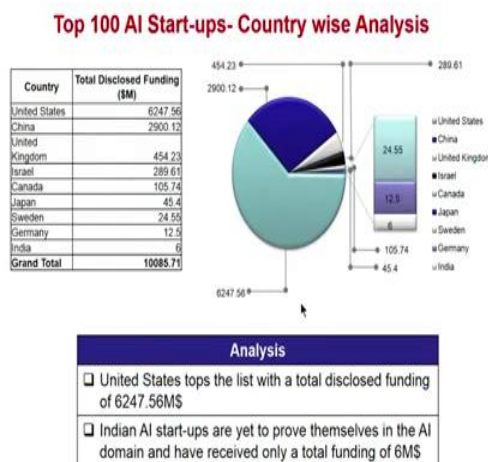
So, when we say that a tech, a tech no longer means converting from offline to online. That is, minimum now but we have to now recognize that the learning patterns of

different students are different. Their ability to absorb or their willingness to absorb and their positional context to absorb are different.

So, if you are able to understand the learning capabilities of different students and then create modules, which will customize themselves to the learning required, pattern requirements, that is the application of artificial intelligence. So, the online education is going to go up one step higher with the application of artificial intelligence and machine learning.

Then we have got chat-bot and personal assistant, intelligent logistics automation platform, driver assistance and monitoring, real time cardiac diagnosis, legal contract lifecycle management to ensure that your contracts are understood and read through intelligent means by the programs and then suggests ways and means by which you can negotiate good contracts, data driven energy efficiency management etcetera.

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So, if you look at the top 100 AI startups, the United States is leading the pack followed by China and India is somewhere below. So, the spread between India and the rest of the countries, particularly the ones which are wanting to make a global impact is very high. So, India needs to really double up in terms of developing itself in artificial intelligence and machine learning.

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Top 100 AI Start-ups- Sector wise Analysis		
Country	Sector	Total Disclosed Funding (\$M)
United States	Enterprise Tech	2721.85
	Industrials	1045.75
	Healthcare	760.83
	Auto	584.22
	Retail	315.72
	Semiconductor	239.48
	Finance & Insurance	107.09
	Government	96.94
	Agriculture	84.21
	Telecom	80.43
	Real estate	78.71
	Finance & Insurance	48.88
	Media	35.95
	Legal, Compliance, & HR	29.52
China	Auto	62.02
	Finance & Insurance	145.09
	Government	2593.12
	Semiconductor	195.08
	Semiconductor	310.00
United Kingdom	Legal, Compliance, & HR	77.03
	Healthcare	30.83
	Finance & Insurance	21.43
	Enterprise Tech	13.00
Israel	Semiconductor	170.00
	Finance & Insurance	48.61
	Auto	44.50
	Agriculture	29.50
	Enterprise Tech	21.50
Canada	Legal, Compliance, & HR	21.50
	Enterprise Tech	106.74
Japan	Retail	45.40
Sweden	Auto	24.15
Germany	Retail	12.52
India	Healthcare	6.00
Grand Total		10985.78

**Analysis**

- United States has achieved in wide variety of sectors including Agriculture, Healthcare and Media
- India has received a total funding of 6M\$ in the Healthcare sector and is yet to prove itself in other AI sectors



And if you look at the AI startups, as I said earlier, they are available for deployment in virtually every field. You have them in enterprise technology in industrials, healthcare, automotive, retail, semiconductor, finance and insurance government, agriculture, telecom, real estate, finance and insurance, media, legal compliance and HR.

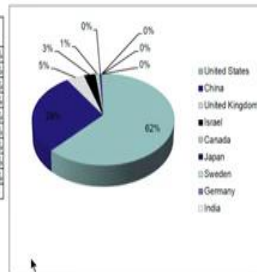
Therefore, there is a huge scope every industry, every business process, which is today digitized will be digitized to an even greater extent by a combination of artificial intelligence, machine learning and deep learning. And in some cases, augmented reality, virtual reality also will get integrated into this.



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### Top 100 AI Start-ups- Country wise % Achieved

Country	Total Disclosed funding (\$M)	%
United States	6247.56	62%
China	2960.13	29%
United Kingdom	494.23	5%
Israel	289.61	3%
Canada	105.74	1%
Japan	45.4	0%
Sweden	24.55	0%
Germany	12.5	0%
India	6	0%
Grand Total	10085.71	



#### Analysis

- United States tops the list with 62% of total disclosed funding received
- All other countries way below United States with only less than 30% of total disclosed funding received



So, given that this is the kind of potential, how do we really make this?

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### The Acquisition Rush in Artificial Intelligence (AI)

Industry reports suggest 635 AI acquisitions from 2010 to date, with acquisitions peaking from 2016 to date (exceeding 500)

Such acquisitions helped tech giants integrate new functionalities and capabilities into their devices as below:

- facial recognition and other biometrics
- voice assistance
- human-computer interaction
- speech recognition & NLP



That said, the areas of applications for AI are extending across industries, with several sub-specialisations within AI

Under cross-industry applications, the following are emerging as areas of choice:

- facial and other biometrics,
- speech recognition and NLP,
- computer vision,
- customer analytics and personalization



The application potential and commercial opportunity for AI will only increase exponentially



We can make this happen only when, within the startup movement we have, we create a new vertical for the newer technologies, the three priority areas which will gets identified and which we also identified in terms of wave or technologies earlier.

We should be able to create new sub verticals for startup movement to create a clutch of companies in the artificial intelligence area, which again comes to the basic requirement of up skilling the people who are in the computer science and in info information technology spaces and also integrating newer developments in electronics, electrical engineering and various other fields.

So, would EdTech be the first area for startup development? Or should we have artificial intelligence modules taken from already developed startups in other parts of the world and create our own products? Probably a mix of strategies have to be adopted. But whatever it is very clear that artificial intelligence must be one prime area for development for startup movement in India.

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### Artificial Intelligence: Deliverance or Apocalypse?

Although in existence for nearly two decades, Artificial Intelligence (AI) along with Machine Learning (ML) or Deep Learning (DL) has gained great depth and prominence in recent months. While technology giants like Google, Amazon, Microsoft, Apple, and Facebook have been using some level of AI and ML/DL, the concern is that the current efforts in AI and ML/DL will evolve into a domain that develops conscious, super-intelligent entities which could eventually lead to AI and ML/DL getting arrayed against human existence itself.

Equally, there are concerns that AI and ML/DL could cause large scale unemployment, especially in the IT industry, and that it could be used to trigger destructive activities or cover up nefarious activities. The ability of AI and ML/DL to make human-like decisions is generating increasing levels of data collection, raising privacy and safety concerns too. According to the father of Artificial Intelligence, [John McCarthy](#), AI is "The science and engineering of making intelligent machines, especially intelligent computer programmes."

Artificial Intelligence is a way of making a computer, a computer-controlled robot, or a software think intelligently, in the similar manner the intelligent humans think. The development of AI started with the intention of creating similar intelligence in machines that we find and regard high in humans. Machine learning is a type of AI that facilitates a computer's ability to learn and essentially teach itself to evolve as it becomes exposed to new and ever-changing data. Machine learning has truly evolved over the years by its ability to sift through complex and [Big Data](#). Deep Learning is a new area of machine learning research, which has been introduced with the objective of moving machine learning closer to artificial intelligence. It relates to study of 'deep neural networks' in the human brain and, under this perspective, the deep learning tries to emulate the functions of inner layers of the human brain, creating knowledge from multiple layers of information processing. Since the deep learning technology is modelled after the human brain, each time new data is poured in, its capabilities get better.

Under the deep learning paradigm, essentially the machine is 'trained' using large amounts of data and algorithms to give it the ability to learn how to perform the task. This data is fed through neural networks which ask a series of binary true/false questions or numerical values, of every bit of data which pass through them, and classify it according to the answers received. Today, image recognition by machines trained via deep learning is better than humans, in some scenarios. That ranges from CAT scans to identifying indicators for cancer in blood and tumours in MRI scans. Given the nature of AI, ML, and DL, rather than get consumed by worry, professionals in the Indian IT industry, and aspirant IT graduates must move into taking up these fast growing disciplines as the new core of IT. (Source of definitions: Geospatial World Blogs)

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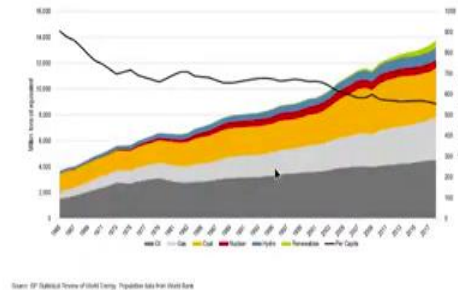
Ofcourse, there are two views, is artificial intelligence going to be deliverance or apocalypse? A person has involved in this industry of high tech as Elon Musk believes that artificial intelligence could be posing certain dangers, whereas very many other scientists and technologists believe that the dangers can be mitigated by appropriate risk mitigation strategies.

But rather than look at the philosophical undertones, I believe that professionals in the Indian IT industry, aspirant IT graduates must move into taking up this fast growing

disciplines as the new core of information technology, I think that was very important and essential.

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### Global Energy Consumption Trends



Source: BP Statistical Review of World Energy, Population data from World Bank

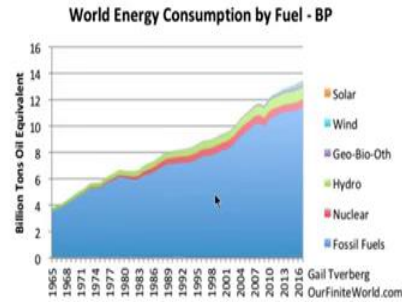


Then we come to the clean energy, you can see the kind of growth which has been there, if you look at oil, gas and coal. That is the bottom gray, light gray and the deep yellow, you will find that there still are the most dominant areas of energy development and consumption. And not only that the consumption of these fuels, the energy has been growing up going up significantly higher.

While we have got the newer generation like nuclear, which is not considered very safe anyways, we have hydro and which is subject to cyclical vicissitudes of monsoons. Then we have renewables, you can see the alarming situation on fossil fuels led energy development as well as energy consumption and renewables is but a small speck of the total energy development and consumption.

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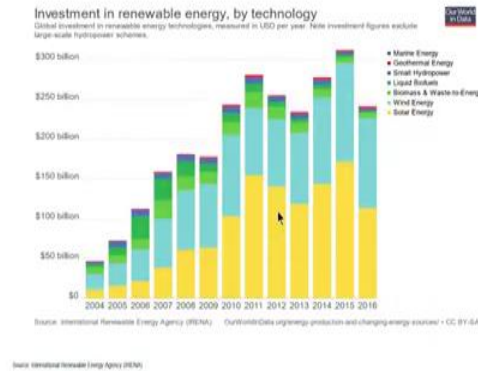
### Global Energy Consumption



And if you really look at the same situation, in terms of three years of horizon, you will get a better picture more granulated but position is the same solar, wind, geo bio, others hydro, they are still a small portion and that is where the maximum impact needs to be there.

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## Global Energy Investments

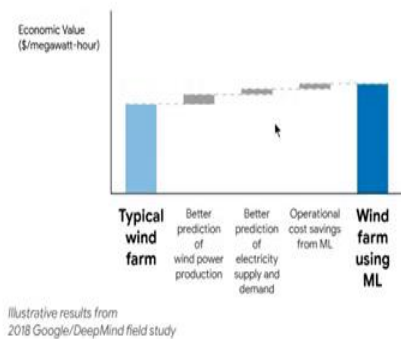


And the investments in renewable energy by technology. They are definitely going up but they are kind of oscillating within the within a particular band. There should be a higher investment in renewable energy and hopefully that would lead to more activity.

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## Renewable Energy Output Tends to be Unpredictable..

### Machine learning can increase the value of wind energy



But the issue is that even in having renewable energy, there could be application of artificial intelligence and machine learning because when you look at a country which has got as diversified as India, renewable energy cannot be produced at the same cadence

in all parts of the country. There are deserts where the renewable energy can be produced, the solar energy can be produced much more than in cooler places or cloudy regions of the country.

Even a country such as Germany, which has got more homogenous weather structure, and is possibly the poster boy of renewable energy in the world is finding it difficult to adjust the renewable energy and the fossil fuel energy developments because renewable energy is subject to the cloud cover subject to the temperature which is available weather conditions, monsoon conditions etc.

Therefore, there could be situations when renewable energy is over produced relative to the demand and the fossil fuel energy thermal plant energy has to be scaled down with all the penalties to the utilities or suddenly the renewable energy is not produced to the extent required when the schedule of thermal power energy is clocked at a particular level.

Now, if you are able to predict the requirement of renewable energy by bringing in big data and analytics in weather forecasting for several years and for the current seasons, and then have at least 36 to 48 hour advance notification of when how renewable energy production will go up or down, it will be possible for the grids to adjust their thermal power, energy production and consumption and match it exactly, properly.

And that would be very helpful for saving millions of dollars of investment. So, machine learning is a completely different subject as we have seen today, but when it comes to optimizing clean energy machine learning has got a position.

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### Smart Grids

As machine learning improves predictive capabilities continuously, countries are gradually moving towards establishing a 'smart grid', a 'fully automated power delivery network that monitors and controls every consumer and node, ensuring a two-way flow of electricity and information'.

Since 2010, the US Department of Energy has invested over \$4.5 billion in establishing smart grid infrastructure. They have installed over 15 million smart meters, devices on the consumer end that monitor energy demand and supply.

Additionally, they are investing in devices known as "synchrophasers". These brief-sized boxes measure the instantaneous voltage, current and frequency at specific locations on the grid. These sensors would communicate with the grid and modify electricity flow during off-peak times, lowering prices for the customer while also relaxing the workload of the grid.

Even Google has applied this AI technology in an effort to reduce their total power consumption from its data centers, saving millions of dollars in the process.

But even with a smart grid, there is a potential source of concern. A central system that collects data about the energy usage habits of millions of users can emerge as a target for malicious cyber-attacks.

This could potentially destabilize a grid while also damaging precious consumer data. UK researchers feel that blockchain protocols could be the solution. Using the same technology as Bitcoin, a decentralized ledger system could avoid the security risk of having a single point of storage for user data.

Interestingly, as newer digital technologies open up avenues for smarter utilisation of energy they also bring forth some new risks. Digital technologies themselves can offer compensatory solutions for cybersecurity.

Start-ups will find the energy field an appropriate domain for coming up with an entire spectrum of energy solutions from clean generation to smart utilisation.

Source: <https://towardsdatascience.com/how-machine-learning-can-transform-the-energy-industry-caaa965e282a>

50



Similarly, we can use these kinds of developments in creating smart grids. Smart Grid means connecting every home with the grid by means of demand and consumption. Right now, it is a push factor. The grid pushes out electricity, makes electricity available for the entire society and all the residences all the factories etc. Because it thinks its responsibility is to produce and generate and then transmit this level electricity.

But if only the utility knew, if only the grid knew, that the demand pattern is going to vary like this, it would be able to optimize its own production. So, smart grid is a grid, which is a fully automated power delivery network that monitors and controls every consumer and node ensuring a two way flow of electricity and information.

Information goes out from the user points and electricity comes in from the generator and the transmitter. So, it is no longer you know push out system, it is a kind of pull system is akin to the Japanese way of manufacturing automobiles rather than push type demand management, it is a pull type supply management. So, smart grids are being conceived as part of smart city programs the world over.

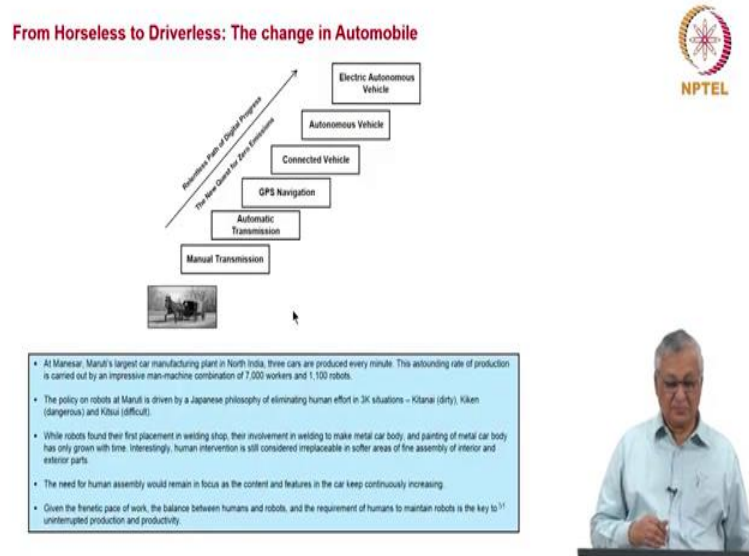
Additionally, people are developing synchro-phases, these grid size boxes measure the instantaneous voltage, current and frequency at specific locations on the grid. These

sensors would communicate with the grid and modify electricity flow during off peak times, lowering price for the consumer while also relaxing the workload of the grid.

Even Google has applied this AI technology in an effort to reduce their total power consumption from its data center saving millions of dollars in process. Now, institute's, technological institutes, institutes, startups, they can develop these kinds of meter synchro phases, other information providers on electricity usage and generation and also provide smart bridging solutions for these smart grids.

So, these are the areas where startups can work in ensuring that apart from production of clean energy, through better solar energy and wind energy and other forms, whatever is produced by various means optimize and the demand for energy and the supply of energy or optimized in the relationship.

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Now, we come to the other portion of energy, which is the consumption, which is the mobility. From horseless to driverless the change in the automobile has been continuous and one way towards sophistication. And originally it was manual transmission, then automatic transmission came then we have got GPS navigation.

Then we are having connected vehicle and eventually we will have electric autonomous vehicle. In this there has been a relentless path of digital progress. And more importantly,



there is a new quest for zero emissions as we go forward. And in this process, we also have got maxi robots working in Maruti plant, I believe, which is Maruti's largest car manufacturing plant in North India, three cars are produced every minute.

And that is accomplished with a combination of 7000 workers and 1100 robots and they are being deployed in three situations. One where work is kitanai (dirty), kiken (dangerous), kitsui (difficult). First, the robots find their way in to the welding shops because they were the most hazardous areas in the automobile manufacture. But now they are into various forms of assembly, this assembly.

But finer parts are still made by human hands. Will micro robots come into those areas? Just as surgeons' hands are replaced by the surgical robot, will micro robots come and help fit the glass and the interiors, we do not know but it is a possibility. So, this could be an area where a startup could think how to make micro robots for finer car assembly.

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### Regulatory Mandates/Guidelines on Electric Vehicles



Country	Target
Norway	No new gasoline and diesel vehicle sales by 2025
Ireland	No new gasoline and diesel vehicle sales by 2030
Israel	Ban on import of all gasoline or diesel vehicles by 2030
Netherlands	All vehicles to be emission free by 2030
France	No new gasoline and diesel vehicle sales by 2030
United Kingdom	No sale of conventional petrol and diesel cars and vans by 2040 Reduce national vehicle emissions to Zero by 2050
Taiwan	No new non-electric motorcycles by 2035, and four-wheel vehicles by 2040
China	Likely phase-out of combustion engines by 2030
Germany	Ban on sale of all internal combustion engines by 2040
Some US States and Canada Provinces	Reduce national vehicle emissions to Zero by 2050

India is still tentative on electric vehicle transformation. The Government of India did formulate a scheme titled Faster Adoption and Manufacturing of (Hybrid & Electric) Vehicles in India (FAME India) in February 2016 under the National Electric Mobility Mission Plan 2020. In September 2017, Union Minister for Transport, Nitin Gadkari said that the industry must switch to an all-electric vehicle fleet by 2030 but the Government itself did not come out with any strategic policy mandate in that direction. The Government followed up with FAME 2 Scheme in February 2019. These schemes envisage incentives to manufacturers and buyers of electric vehicles. However, unlike the Chinese Government and the Chinese automobile industry, the Indian Government and the Indian automobile industry are not looking at electric transformation as a strategy to gain global leadership. While a couple of manufacturers have undertaken electric car production, it has been on a low scale and only to government agencies. Given that India has some of the highest levels of pollution, including carbon dioxide emissions, an aggressive policy on electric vehicles is overdue in India.



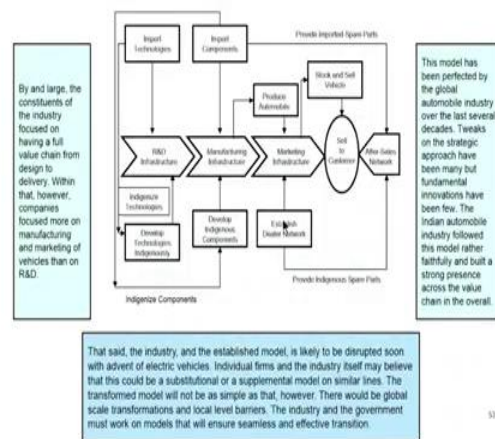
Now, when we think of electric vehicles, clearly the world is moving towards electrical vehicles, some countries specify that there should be zero emissions by this day. Some countries say that there should be phase out of diesel vehicles by this date and phase out of petrol vehicles by this day, but whatever it is secularly, it is very clear that everybody wants the phase out of IC engine vehicles and the concomitant pollution that is happening.

In India we have had certain ambitious goals earlier that it should be all electric by 2030 not really put in the form of a guidance or mandate. Another guidance recently more recently came saying that we should have some electric vehicles in two wheelers and three wheelers far ahead 2020 to 2023. Again, not a mandate or guidance.

There are also subsidies and incentives by the Government of India frame to policy to support the electric vehicle development these things are happening.

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### Conventional Indian Automobile Industry Paradigm



When we look at the conventional automobile industry paradigm, we have R & D, we have manufacture, we have marketing and this cell and there are two components always in the automobile industry given that the automobile industry in India has been recipient of technologies from outside. We had imported technologies and imported components. We also have indigenous technologies and indigenous components.

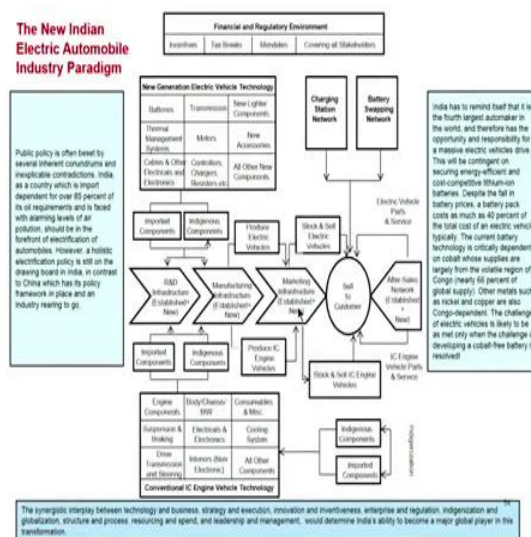
In the 50s, 60s and even the 80s when the new generation of Indian automobiles companies came in, the imports were far higher than the indigenous components. But today you can say that the import dependence of automobiles is very less and largely it is indigenous industry and the industry is also able to produce to global requirements and export its products.

But this industry, as we know is likely to be disrupted very soon with the coming in of electric vehicles. And electric vehicle is not like an additional product or a new product. Electric vehicle is the same product to be used by the same customer in the same manner, but using different kinds of technologies.

And there is no way in which you can predict at this moment whether the customer would go in for IC engine vehicle or an electrical vehicle, how would he respond or how would she respond to different kinds of cost and price parameters and the operating parameters of the vehicle.

So, this itself the whole gamut of demand forecasting and supply management for electric vehicles, and the substitution is a huge quantitative predictive analytics exercise for the Indian automobile industry. And this itself is one area where startups can own their approaches in terms of developing.

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But if you see the hardware, which is shown in this slide, you will find that you will have a mirror image of the current Indian automobile industry in terms of the electric automobile industry, we will continue to have all the parts which we have today, which is engine components, body, chassis, BIW, consumables, suspension, braking, electricals,

electronic, cooling system, all of these things will be there, which is I put them under one bracket, conventional IC engine vehicle technology.

It will have indigenous vehicles as well as imported vehicles, and we will be using them to produce IC engine vehicles which we sell to the customer. But at the same time, we will also have new generation electric vehicle technology having completely different parts, they will have different batteries, they will have different transmission systems, the components will be lighter.

Even if have to be a little stronger they have to be designed to be stronger, there will be new thermal management systems, motors, new accessories, complete rewiring, cables and electric systems will be different, controllers, chargers, resistors will be new and all the new components which are associated with the new generation electric vehicle technology.

And then once the vehicles are put into the market, you require a charging station network, you need a battery swapping network, which means that the entire electric automobile industry is going to run in parallel with the IC engine vehicle system. And you can imagine that the companies will have to manage double the investment which they are actually managing now.

And with half the demand for each of those classes. And we are also getting into a situation, we cannot drive demand of any particular segment beyond prudential norms because the planet also cannot take more, the roads also cannot take more in the Indian situation.

So, the interplay between technology and business strategy and execution, innovation inventiveness, enterprise and regulation, indigenization and import dependence or globalization these are becoming big activities by themselves also, it is not that solutions are apparent at this stage, technologies have to be developed within ourselves.

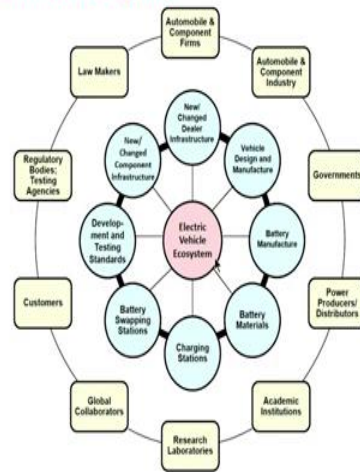
The Indian automobile industry in the past particularly in the 80s and 90s took technologies from abroad indigenous, today, probably the whole world is only at the

similar level as far as electric vehicle development is considered, we do not have models which can be brought in and indigenized because technologies are still evolving.

So, India has an opportunity to develop its own electric vehicle ecosystem, which means that India also has an opportunity to be a global leader in this electric vehicle development phase which is occurring. Again, a great opportunity for startups to be there.

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### Electric Vehicle Ecosystem



So, when we look at electric vehicle ecosystem, we have battery infrastructure, delivery infrastructure, charging stations, testing standards, then we have a whole series of people like lawmakers, component firms, governments, power producers, academic institutions, global collaborators will be involved in this ecosystem.

So, we require an industry level effort so, these others sub vertical which could be considered for initiation of an accelerated and time titrated the startup development activities, so that some of these problems which are inherent in this kind of industry transformation are addressed.

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### Digital Automobile Revolution

- With the advent of self-driving electric vehicle we may see a return of concepts of body-on-frame with a rigid frame housing the drivetrain and battery.
- With the growing pressure for electric vehicles, the automobiles of the future could be entirely game-changing.
- In the early years of automobile manufacturing, component space had been the ideal and only space for start-ups for set up units and expand. Today, a whole new generation of start-ups are set to transform fundamentally the automobile into a self-driving electric vehicle.
- Over 250 start-up companies are innovating in multiple digital spaces to transform not merely the automobile as a clean, intelligent, connected, self-driving vehicle but also the automobile industry itself as an electric vehicle industry.
- The matrix of start-ups under different heads leading the digital automobile transformation follows

56



Now, therefore, there will be a digital automobile revolution, there are 250 startup companies which are already investing significant amounts of money in developing clean intelligent connected self driving vehicles. And automobile industry itself is becoming an electric vehicle industry as we go through.

(Refer Slide Time: 28:54)

### The Digital Automotive Transformation: Start-up Spaces

Services	Route Planning	Parking	Car Hailing/Pooling	Repair, Rental	After-Market
<b>Safety &amp; Security</b>	Car Safety	Driver Safety	Accident Detection	Emotion, Fatigue & Alcohol Detection	Cyber Security
<b>In-car Intelligence Assistance</b>	Vehicle Diagnostics	Predictive Maintenance	Sensor-based Vehicle Movement	Passenger-Assisting Sensors	Infotainment Display
<b>Autonomy</b>	Automation Systems	Mapping	Simulation	Image Recognition, Annotation	Voice Assistance
<b>Infrastructure Connected Car</b>	Sensor Networking	Mobile LPWA, Cellular, WiFi	Connected Car-data, Platform, Software	Fleet + Traffic Management	Navigation Assistance, Traffic Analysis & Communication
<b>Intelligent Manufacturing</b>	New Advanced Materials	Rapid Prototyping	3D Printing, Modularisation, Open Source	Car Software, Smartphone Enablement	Telematics
<b>Onboard Sensors</b>	Location (GPS, Precision Positioning, Path Planning)	Vision/Camera	Lidar	Advanced/Automated Assembly Line	Material Characterisation & Testing
<b>Vehicles</b>	2-Wheelers	Public Transport	Trucks/Freight	Flight	Other: Hyperloop, Personal Mobility
					Flying Car


Adapted from - Mapped - The Top 263 Companies Racing Toward Autonomous Cars : Transportation 05.10.17 - Jack Stewart



So, if you look at the next slide, you will find that a whole set of startup spaces are available for digital automotive transmission, one in safety and security. Second is in car

intelligence systems, autonomy, infrastructure of connected cars, intelligent manufacturing, onboard sensors and these are all segmented according to the vehicle type, great set of opportunities which are available.

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### Apple Technology - Environment Policy



"Environmental responsibility is built into our design and engineering process" – Greg Joswiak, VP of Product Marketing

"People said you couldn't use recycled rare earth materials – our new iPhones prove you can."

"Our charge is to do what Apple does with every innovation which is to do things that have never been done before and then use in scale in the marketplace and relationships with suppliers to bring it forward for the world. We are innovating down to the details." – Lisa Jackson, VP of Environment, Policy and Social Environments

Apple's new product innovations will avoid mining more than 280,000 metric tonnes of aluminium-bearing bauxite and more than 34,000 tonnes of tin ore over the next year.

The intent of bringing up Apple iPhone and Apple Watch technologies being environment-sensitive and protective is to demonstrate the opportunities for modern technologies to provide environmental solutions



58

We talked about clean energy generation of clean energy, distribution of clean energy in an optimal manner. And we also talked earlier about zero waste, but what about established products which looked like being driven by strong consumer trends? But then it is possible, if you look at the Apple technology, the latest environment policy statements.

The VP of product marketing says environmental responsibility is built into our design and engineering process. People said you could not use recycled rare earth materials our new iPhones prove you can, our charges is to do what Apple does with every innovation, which is to do things that have never been done before and then use in scale in the marketplace and relationships with suppliers to bring it forward for the world, we are innovating down to the detail.

According to them, Apple's new product innovations will avoid mining of more than 280 thousand metric tons of aluminum bearing bauxite, and more than 34,000 tons of tin ore over the next year. The intent of bringing up Apple iPhone and Apple Watch



technologies being environment sensitive and productive is to demonstrate the opportunities for modern technologies to provide environmental solution.

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### Technology Can Be Environment-Sensitive

New Apple iPhones 11, 11 Pro and 11 Pro Max demonstrate that new technologies can be protective of environment

- Taptic Engine, a component that powers haptic feedback on new iPhones has about 25% of the total rare earth materials used in the phones recycled
- Apple Mac PC MacBook used recycled aluminium; now, new Apple Watch has 100% recycled aluminium.
- Brand new Apple batteries use cobalt recycled from iPhone batteries by disassembly robot Daisy plus scrap from final assembly lines
- The enclosures for iPad and Apple watch are made with 100% recycled aluminium
- All packaging for new phones and watches are with recyclable, majority-fibre materials

Apple's vendor Wistram is engaged in a programme of Zero Waste to land fill with 100% waste recovery

59



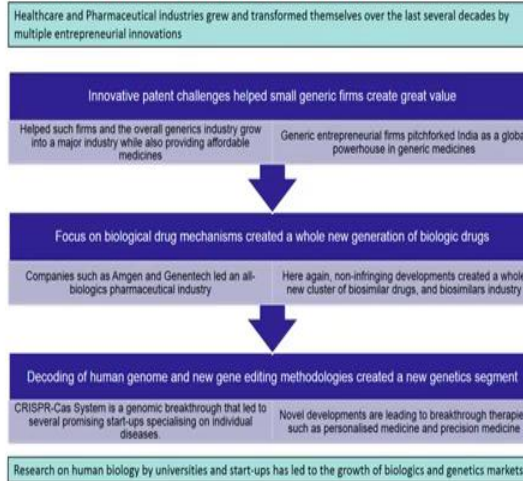
As I said, even recycling of material could be a startup opportunity. Some examples here, the taptic engine, a component that powers haptic feedback on new iPhones has about 25 percent of rare earth metals which are used in the recycled phones. Apple Mac, PC MacBook use recycle aluminum, now Apple watch also has got 100 percent recycled aluminum.

Brand new Apple batteries use cobalt recycled from iPhone batteries by disassembling robot Daisy plus scrap from final assembly lines. The enclosures for iPad and Apple watch are made with 100 percent recycled aluminum, all packaging for new iPhones and watches are with recyclable and majority fiber materials.

Therefore, there is some technology which is getting established, integrated in the established manufacturing space as well to ensure that technology is environment sensitive again opportunities for startups.

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### Healthcare and Pharmaceutical Innovations



We have considered until this stage several examples of products in engineering industry, products in electronics industry and certain service in infrastructure, benefiting from technological innovation and creating new entrepreneurial ventures, the interrelationship between technological innovation and entrepreneurship has been very well established by way of those examples.

Now, we will turn to two industries which are very intimately tied up with human living. These are healthcare industry and pharmaceutical industry. These are especially distinguished and differentiated because they make living enjoyable for people, they cure diseases they avoid wellness, for long science was considered the mainstay of these industries however in recent times, we have seen biology getting merged with engineering.

And engineering contributing a whole lot of new developments to pharmaceutical. The pharmaceutical industry over the last several decades has transformed itself from small molecule based industry into an industry which is based on global generics growth and industry which is based on biologics growth, and more recently, into an industry which is based on genomic sciences.

The global generics industry has grown based on the legal protection and potential provided by the Hatch Waxman act in the US for generic companies to enter the generics industry on an exclusive basis based on the unique patentability of their products or processes that has enabled several startups in the generics field to create great value for themselves and also create a whole new generics industry.

It has enabled the generics industry fund itself admirably and provide a huge range of affordable medicines to the world. And in this process has also pitchfork India as the global generics powerhouse.

The other structural change that has happened in the pharmaceutical industry is the biologic research. Several companies are today in engage in the biologics research compared to two decades or three decades ago. Amgen and Genentech were the early pioneers which focused on biological pathways to cure vexatious diseases.

And today those biological mechanisms are considered much more significant in curing certain diseases which are hard to cure by the regular small molecule mechanisms. The third development is the decoding of human genome and the acquisition of technology to be able to edit the genes which means that the problematic genes can be edited by certain enzymes, supplicating the CRISPR mechanisms that have been discovered.

And together they can conduct better biological research and together they can also help cure certain long standing diseases and unpredictable diseases such as cancer. These novel developments are also helping the pharmaceutical industry, create new avenues for personalized medicine and precision medicine.

Wherein, a person is able to be given the kind of drugs which are suitable for the person's genetic profile. So, for which cancer which medicine out of the suite of medicines available could be very well provided by the personalized medicine.

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### Healthcare and Pharmaceutical Innovations

Newer areas of research in pharmaceutical industry are enabling new start-ups take root..



Immunotherapy which is based on tweaking body's own immune system to attack and clear malignant cancer cells has emerged as one of the most promising cancer therapies



CAR T-cell technology is a highly promising platform that has led to scores of promising start-ups



Microbiome, Precision Medicine, Antibiotic Rediscovery, Artificial Intelligence and Data Analytics, Robotic Surgery and Medical Cannabis are the other breakthrough platforms of game-changing start-ups.

Research on human biology by universities and start-ups has led to the growth of biologics and genetics markets



Apart from this, there is a new branch of knowledge which is focusing on utilizing the human immunogenicity in utilizing the human immuno capabilities to tweak the body's immune system to attack and clear malignant cancer cells. This has emerged as one of the most promising cancer therapies. CAR T-cell technology is a very highly promising field in this area.

Quite apart from this focus on gut based microbiome, antibiotic rediscovery, artificial intelligence, data analytics, medical cannabis besides robotic surgery all emerging as new frontiers in pharmaceutical and healthcare industries.

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### Diagnostic Technological Innovations



- Converting a niche idea to serve life or nature into a product using new or existing technology and influencing customers to use them is the core characteristic of technology-driven start-up firms.
- Large firms have the ability to innovate new products in a linear fashion, for example from simple Positron Emission Tomography (PET) to PET combined with Computed Tomography (CT) or with Magnetic Resonance Imaging (MRI). In each combination, the number of slices could increase across generations of equipment (say, from 64 to 360) or the efficiency of 3 D imaging could be enhanced.
- These developments are best done by the medical equipment giants such as GE, Philips and Hitachi. However, the very basis of PET in the original past had been university level researches in the late 1950s (University of Pennsylvania, Washington University School of Medicine, Massachusetts General Hospital and Brookhaven National Laboratory, for example).
- Futuristic radical biomedical technologies in this domain would be non-linear. Nuclear medicine and imaging studies require a radio-isotope tracer (or, a radio pharmaceutical) being injected into the blood stream for imaging. If there were to be new technologies that make a constituent of the blood itself or the blood volume and flow rate themselves descriptors of the imaging study, there could emerge a totally new generation of non-interventionist, bio-friendly non-nuclear medical diagnostic equipment.

4



In terms of the diagnostic technological innovations, we always saw the smaller diagnostic capabilities which are based on analytical chemistry that is which do the blood picture analysis. We also saw X ray imaging as one of the fundamental diagnostic tools that was available for surgeons.

But today we have PET scanners, PET CT scanners and MRI instruments and these are all developed, these equipments are high cost equipment. These are all developed by giants such as GE, Philips and Hitachi. However, when you dig deep into these developments, you will find that much of this technology has been developed in the universities, University of Pennsylvania, Washington University School of Medicine, Massachusetts General Hospital and Brookhaven National Laboratory for example.

So, the point here is that it is possible for a group of scientists and for clusters of laboratories to develop a newer diagnostic methods which could evolve over period of time into mainstream diagnostic technologies capable of making fundamental changes to how the disease are diagnosed or how the body's systems are understood.

Over a period of time there could be many more developments that could occur in terms of the radioactive or non-radioactive imaging. And in also understanding the soft tissues situations much better, which cannot be done with except through the dye contrast

mechanism at this stage, and the overall real time 3D body imaging, and also non-invasive testing for several disease conditions. All these things are potent areas for startups to work on.

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### University-based Medical Research

Novel genetic and immuno-markers could predict risks of cardiac, neurological, and cellular diseases. Newer, non-linear technologies in any domain make for life-changing efficiency.

However, technological efficiency requires financial sufficiency to germinate and grow. As seen by the PET example, public funding of such universities and research grants made such technological innovation possible.

However, firms which licensed the technologies had the financial capability to mass-produce the products and also achieve increasing levels of technological efficiency in such equipment.

In a technologically virtuous world, the universe of collective technology ideas would be far greater than the canvas of individual funding opportunities.

The academic, industrial, and business ecosystems must evolve in a manner of combining technological efficiency and financial sufficiency.

Many AI and ML/DL start-ups are based on cutting edge research and development which could spur great financial interest.



5

So, University based medical research has been a big boost to medical developments and pharmaceutical developments, in a technologically virtuous world if startups and the universities combine, and they take these University based research areas to commercial fruition, it would be a great contribution to the pharmaceutical and healthcare industries.

(Refer Slide Time: 37:53)



Da Vinci – Robotic Surgical System



The other thing which I mentioned briefly earlier was the robotic surgery, laparoscopic surgery was the first embodiment of robotic surgery but it was virtually done with significant human intervention. But today we have robotic surgery, wherein the human intervention is at for lower degree and the surgical manipulation of the operations is at a far higher level. And how is this made possible?



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### Surgical Robotic Tools - 1

Surgical robotic tools are supposed to enhance the surgeon's capabilities in performing otherwise impossible or demanding surgical tasks.

Achieving superhuman precision, but with sufficient stiffness and dexterity, within spaces that are naturally hard to operate for a human operator would impose a great challenge regarding the design and fabrication of surgical robotic tools.

From a design optimization perspective, achieving all these criteria would require solving a game whose natural solution is typically a Pareto frontier and whose optimum solution only exists for the targeted procedure.

To further complicate matters, every surgical robotic tool must comply with the safety requirements that may include anticipating sensor/actuator redundancy, implementing a safe operational speed cap, complying with testing protocols such as ISO 9000, etc.

One significant aspect of a surgical tool that must be contemplated at the early design stage is sterilizability. Autoclave, gas, and soak are the most common methods for sterilizing surgical instruments; of these, gas and soak seem better options for surgical robotic tools.

For image-guided systems, other design considerations could emerge. For instance, integrating a surgical robotic instrument with an imaging modality such as magnetic resonance (MR) imaging would require the robot to be made of non-ferromagnetic materials to avoid creating artifacts in the captured images.

Source: <https://www.sciencedirect.com/topics/nursing-and-health-professions/robotic-surgical-instrument>

7



This is made possible by a number of developments the science behind the robotic surgery is given in this slide as well as in the next slide.

(Refer Slide Time: 38:31)

### Start-up opportunities from Surgical Robotics



9



But what is relevant for us is that the surgical robotic development is offering number of opportunities for imaging systems, high definition imaging systems, number of opportunities for sensors which are sensitive to whether the surgical probe is going to be



affecting any of the tissues and sensory mechanisms and the deep learning mechanism related to that.

The fixtures and pivots because you require complete degrees of freedom to be able to manage the movement within the body, but at the same time these fixtures have to be both physical as well as virtual, physical in terms of the robotic arms and virtual in terms of the software programming.

Then we also need ultrasonic devices or magnetic devices and the materials that are used in the surgical instruments have to be completely non-magnetic, the magnifying systems have to be a different level, they will magnify different types of tissues, the blood composition and the molecular structures in the body in much more sophisticated way than the motion programs.

How do you program the motion of the or the movement or the kinetics of the surgical instrument, the biocompatible devices that are required as part of the robotic surgery, the pre-designed algorithms and the simulations that could take place before a robotic surgical device is finally made available for commercial use. These are all the opportunities which are available for startups in the surgical robotic field.

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### Technological Bets that Paid Off - 1

- Many of such amazing acquisitions are seen to be bets placed by the acquirers on promising start-up technologies and rapidly revving up businesses.
- When such technologies succeed in shaping new user functionalities and behaviours, more especially and more strongly under financially stronger acquirers, they become truly game changing, both as technologies themselves, and as drivers for the acquirers' businesses.
- While such acquisitions seem to be technology bets given the need for such new technological functionalities, they actually signify a wise appreciation by the larger acquiring firms of the futility of trying to organically emulate what the successful start-ups could accomplish in newer technology domains.
- The time-point when a technology ceases to be a futuristic bet and instead becomes a business booster is a case by case occurrence.



10



### Technological Bets that Paid Off - 2

- From a strategy perspective, acquisition of such promising niche technologies and businesses is validated by the superior performance of such acquired entities and acquiring firms, post such acquisitions.
- Such acquisitions point to huge bets on novel technologies becoming game changers for businesses. Some of these have been huge bets in a technical sense (technology was not yet proven but the acquirer placed the bet with financial ease) while some have been huge bets in a financial sense (technology was well proven but the acquirer placed rather high financial bet).
- In the former category we have Google's acquisition of an unproven Android at a relatively low price while in the latter case we have Facebook's acquisition of WhatsApp and Microsoft's acquisition of LinkedIn at very hefty price tags.
- It is also interesting that in most cases, the branding of the acquired entities continued to be maintained indicating that niche technologies have their own market following and brand equity.



11



So, we have seen the electronics developments, we have seen the mechanical developments, we have seen the electromechanical developments, we have seen the service developers in the logistics area, and a whole number of new developments that are taking place in the pharmaceutical and healthcare fields.

All of these things have created value in terms of this startup scenario. And when big companies have seen these startups creating value, they have begun to make

technological bets on such startups. One of the very fundamental bets that has taken place was when Google acquired the Android operating system.

At that point of time, Google had no presence in the mobile telephony. Yet it saw acquisition of an operating system, which will work with mobile devices as integral to its having some kind of hegemony in the evolving smartphone ecosystem. Similarly, its acquisition of the YouTube was another path breaking activity, Facebook acquiring WhatsApp, Microsoft acquiring the business social media network, LinkedIn, acquiring the hotmail several years earlier, Skype later and Oculus.

These are all examples of mainstream companies focusing on value building startups to create new technologies that would supplement their core businesses. And several of these bets have paid off from a strategy perspective acquisition of such promising these technologies and businesses is validated because the acquired businesses have performed in a superior manner after the acquisition.

The market share of Android has grown substantially and overshadowing the other mobile operating system that was there at that point of time, that is the Windows Mobile system, and now it shares the ecosystem with Apple's iPhone system. So, there is a lesson here that the bets on novel technologies tend to be game changers for businesses.

And for doing that, there should be a clear understanding that this technology is going to add value to the core mainstream technology that the company has. And depending upon this bet, the valuation that is placed on the acquired companies varies significantly.

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### Technological Bets in the Established Industrial Space

- It is not that all start-up bets occur only in the digital space; even established industries are set to undergo a massive structural transformation
- The first automobile boom was fuelled by the invention of new internal combustion engine and drive train technologies
- Successive industrial revolutions gave start-ups at that time the chance to engineer and build the first automobiles with a limited amount of funding
- For example, in the 1920s, the main construction method was body-on-frame, which allowed a much more modular construction and the combination of parts from different suppliers
- The subsequent unibody designs led to highly integrated cars with more expensive set-up and development costs, *albeit* with economies of manufacture
- As considered earlier, electric and autonomous technology bets will be transformational to the automobile industry over next two decades



12

The same level of technological bets do not happen in the established industrial space, but even here, there are occasions where certain novel ways of manufacture or the novel developments could be from the startup area when bus body manufacturer was being undertaken in small scale, use of integral construction akin to the car monocoque construction was brought in.

And that has helped bus body makers develop buses which were lighter, more strong and also having different kinds of floor construction. In future as we discussed earlier electric and automotive technologies are going to be completely different based on the contributions that would come from startups.

Similarly, the autonomy in the automobile business is also like to be transformational based on the contributions that would be made by the startups. Therefore, every industry has to be watchful of the technological bets that it could take over a period of time that is emerging and ensured that the core industries are transformed in the right manner possible.

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**Technological Innovation + Commercial Success Boosts Financial Valuation**

Acquirer	Acquired	Year	Domain	Valuation (USD Bn)
Microsoft	LinkedIn	2016	Professional social media	26.2
Facebook	WhatsApp	2014	Social networking	19.0
Google	YouTube	2006	Online video streaming	1.65
Google	Android OS	2005	Mobile operating system	0.05
Microsoft	Hotmail	1997	Email platform	0.50
Microsoft	Skype	2011	Video calls	8.50
Google	Instagram	2012	Social media	1.0
Yahoo	Tumblr	2013	Micro blogging website	1.10
Apple	Beats	2017	Music streaming	3.0
Microsoft	Mojang	2014	Game developer	2.5
Amazon	Twitch	2014	Video game streaming	0.97
Facebook	Oculus VR	2014	Virtual reality	2.0
Google	Nest	2014	Home automation	3.2
Walmart	Jet.com	2016	Ecommerce	3.3
Cisco	AppDynamics	2017	IT operations analytics	3.7
Adobe	Marketo	2018	Marketing automation software	4.75
Microsoft	aQuantive	2007	Online ad network	6.3



As I said earlier, depending upon the potential for Business Edition, the potential for strengthening of the core business, the valuation bets are placed, and they are not only based on the chronology but also based on the potential. In certain cases, the companies could be for fortuitous in having certain path breaking innovations acquired at reasonable prices. Whereas, in certain cases hefty valuations have to be paid for getting those companies integrated.

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### Importance of Retaining Founders' Innovation Touch



- A TIME analysis of start-up founders' LinkedIn profiles found that about two-thirds of the start-up founders that accepted jobs at Google between 2006 and 2014 have been still with the company
- Amazon has retained about 55% of its founders over that time period, while Microsoft's rate is below 45%
- Facebook, with a 75% retention rate for founders, is beating its older competitors, but the company only began acquiring companies in significant numbers around 2010 or so
- Apart from monetary incentives, at the core of Google's pitch to founders is the opportunity for bountiful resources, and scaling up on ideas and operations
- While these can be secured independently, but going it alone requires a lot more time, money, and luck than hitching the start-up wagon to one of the richest companies on Earth
- As companies buy innovation through acquisition of companies, retention of founders to retain the founders, and with them the acquired companies' technological edge has become important. (Source: Time, April 15, 2015)

14



But all through these acquisitions, it has been established that the companies have been able to retain the founders touch even after the acquisition, the acquired companies and the acquired the technologies grew in a much more significant and in a much more helpful manner. Big companies have understood this philosophy and have begun to retain the founders in their ecosystems even after the acquisition.

At times analysis has proved that about two thirds of the startup founders that accepted jobs at Google between 2016 and 2014 has still been with the company which means that Google has been able to create and sustain an ecosystem which is based on creativity and which is still inspirational for the acquired company founders so that they could continue to do their work at Google and ensure that their own brainchild grew further under Google's parentage.

Amazon has retained about 55 percent of its founders over the same time period while Microsoft retained at around 45 percent. Facebook had a much higher retention rate for its founders at 75 percent is beating the old competitors in this game. Apart from the monetary incentives, the core of the Google's pitch for founders is the opportunity to use its bountiful resources and scale up their ideas and operations.

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**Investments by Global Tech-Giants in Indian Tech Start-ups**

Acquirer/Investor	Acquired/Invested	Year	Domain	Valuation
Facebook	Meesho	2019	Ecommerce	Undisclosed
Facebook	Little Eye Labs	2014	Mobile app developers	\$9 million - \$15 million
Walmart	Flipkart	2018	Ecommerce	\$16B
Amazon	Tapzo	2018	Aggregator app	\$40M
Mercer	Mettl	2018	Talent assessment	\$2.5B
Samsung Venture Investment Corporation	OS Labs Gnani.ai Silvan Innovation Labs	2019	Technology	\$8.6M
Tradus	BuyThePrice	2013	Ecommerce	Undisclosed
Twitter	ZipDial	2015	Marketing platform	\$30M
Yahoo	Bookpad	2014	Cloud data services	\$15M
Ibibo Group	Redbus	2013	Online bus ticketing platform	\$138M
Oracle	Bitzer	2013	Mobile app service provider	Undisclosed
Hitachi	Prizm Payment Services	2013	Payment services	\$250M
Brillio	Marketelligent	2014	Data analytics	\$70M
Amazon	Junglee	1998	Shopping comparison site	Undisclosed
eBay	Baazee	2004	Ecommerce	\$50M



This trend of mainstream companies acquiring the companies is no longer confined only to the Silicon Valley or the other innovation clusters and hubs in the US. Many of the global tech giants are looking at Indian startups to see how they can add value to their own mainstream businesses. We have had Walmart acquiring Flipkart, which is one of the largest acquisitions in India.

But we also have Samsung venture Investment Corporation investing in OS labs, Gnani.ai and we also have a Ibibo group acquiring Rebus. So, there are a number of acquisitions that are happening in the Indian startup space of companies which are tech based.

As Indian startup companies go more product oriented or come up with more market savvy digital applications, this trend of global tech giants taking a piece from the Indian startup scene to strengthen their global businesses only bound to enhance in future.

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### Technological Innovation Plus Financial Sufficiency

- Successful start-ups have technological efficiency but they need financial solvency to convert their ideas into commercial products
- The examples of Google-Android, Facebook-WhatsApp etc., are dramatic indicators of the huge potential in the technology space
- That said, routinely hundreds of decrepit as well as robust start-ups get acquired or co-share and license their technologies at more humbler levels, or even wither away
- It is a virtuous, even if occasionally chaotic and brazenly capitalistic, world as technological efficiency and financial sufficiency need the synergy of each other
- The point at which the synergistic marriage gets made in each case is a matter of not only the underlying technology but also reasoned judgement and risk-taking.
- In many cases, start-ups fail to objectively introspect on their strengths and weaknesses while large firms fail to perceptively prospect on the risks and rewards.
- Wise technological and financial bets go a long way in nurturing a growth-oriented sustainable start-up ecosystem



16

Technological innovation is very important, and so does financial sufficiency. So, however brilliant technological startup is the financial requirements for the operationalization and later commercialization of the idea, and the prototype could be significantly higher than what the startup can ever manage.

So, those were the points of inflection which made the companies which we discussed earlier, cede the control to the global giants and benefit the overall tech ecosystem in that process. Similarly, Indian startups have to be wary of they are trying to do all by themselves for a greater length of time.

If the Indian financings system which we will consider at a later point of time is strong enough and robust enough to support startup founder's dreams that is well and good. But if there are financial constraints, startups have to look at an appropriate merger of the technological innovation they have with the financial sufficiency that the mainstream companies could provide, that would be a win-win.



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### Financial Solvency for Sustainable Technological Innovation



- Big firms set up not only major R&D Centres but also support mini-laboratories, incubators and venture teams; the objective being to clone the start-up innovation culture organically within their large monolithic structures
- However, behemoths tend to be more adept at scaling up product lines and businesses rapidly rather than patiently nurturing potential ideas and products. External start-ups would continue to be the most important resource for innovation and new business.
- The inventiveness and passion of techno-entrepreneurs would continue to drive generation and conversion of new ideas into innovative products and then onto scalable businesses.
- For start-ups to provide synergy their inventiveness must mature into practicality and their passion must accept stability. Similarly, for corporate majors to provide synergy their institutional ego must respect external technologies and their leadership teams must respect the native creativity of start-up innovators and founders.
- The synergy of technological efficiency and financial solvency delivers sustainable value when the timing is right, and mutual competencies are well-understood, well-respected, and well-supported
- This requires objective evaluation and realistic expectation-setting in the pre- and post-acquisition scenarios.

17



Similarly, for the technological innovation, to be sustainable, there should be financial solvency, it is not possible to fund technological innovation based on financial insolvency because prototype development is iterative, idea refinement is iterative. Making a big jump from an electromechanical device to a completely digital device, for example, could be expensive it requires that the startups are founded in an appropriate manner.

Therefore, the inventiveness and passion of techno-entrepreneurs, while driving the generation and conversion of new ideas into innovative products, the operationalization of such products must seek financial solvency. And to be able to do that, we have to see when the timing is right to reap appropriate value from the technological developments that have taken place.

So, entrepreneurship is not merely taking the product all through the lifecycle till the final and scaled up sale, it also lies in seeing when the monetization could be appropriate to be able to launch the product with much greater scale and scope. So, the choices are always intriguing whether to continue the development and take the company to the commercialization within organic organizational framework, or to look at collaboration or to look at acquisition by a more capable entity.

These are all choices that entrepreneurs would have, as they try to convert their technological inventiveness, their technological innovation into financial propositions as we go along. But without doubt the technological innovation is the foundation of entrepreneurship and the more technologically innovative Indian startup ecosystem becomes, the more financially vibrant the Indian startup system would emerge to be.