Entrepreneurship
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Part 4
Technological Innovation and Entrepreneurship

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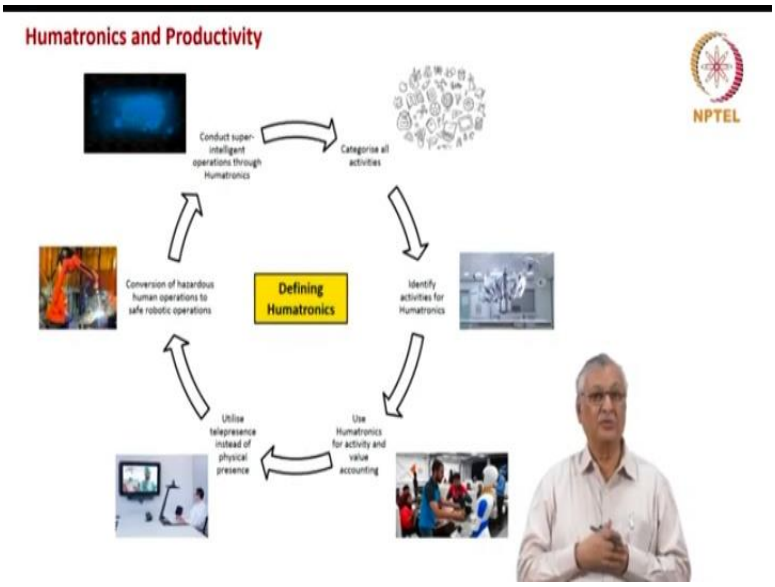

Now it is very difficult to, in today's terms to talk about start ups without understanding the human machine linkage and productivity. So how do you do that and you do that mainly by A - categorizing all the activities, B - by identifying those activities which could work well with humatronics. And when we say humatronics, we talk about human performance enhanced by robots or robot's performance made focused, more precise, more correct, more perfect and more emotionally balanced by human intervention.

So, humatronics is the best or optimal combination of man and machine. So, categorization of all activities for humatronics, identification of activities for humatronics like complex surgeries through robots. Then use humatronics where it is not necessary to have a person, for example, restaurant servicing or order taking. Then using telepresence instead of having physical presence from remote working to having remote medicine. Then converting more of hazardous and difficult to make or activities requiring greater precision to robotic use. And finally conduct super intelligent operations through humatronics.

So, there are different areas wherein humatronics could have a play, primarily in terms of ensuring higher productivity or higher precision. And these are again are very potential areas for start-ups.

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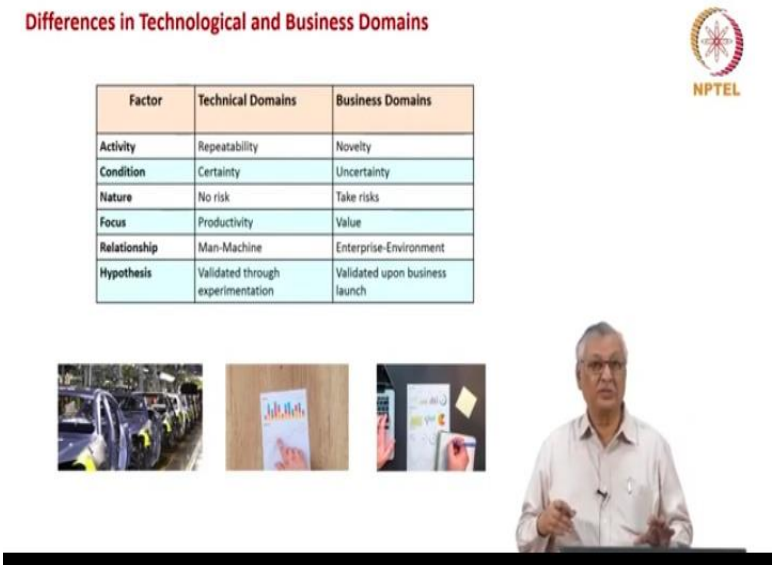

So, when do a start-up, it is important to keep the technical domain and business domain separate. We discussed earlier about a technical value chain and a business value chain. But then, technical domain has got its unique characteristics and business domain has its unique characteristics. Just as we said that, we should have a balance between technological innovation intensity and product profitability potential. We should also have the kind of synergistic fusion between technical domains and business domains because they have different characteristics and how you make a synergistic fusion is extremely important for a start-up.

So, if you look at a technical activity, it is a repeatable activity whereas business activity is novel activity. It should appeal to the people. Why does the retail showroom does not look the same every week because you would like to appeal to the customer by having a novel deployment of the same goods but in different formats. So, novelty is essential for business attractiveness.

Second, technical domain seeks certainty even if the technology is uncertain. By the time the product lifecycle is completed, the technology has to have certain inputs and certain outputs, and the whole thing should be well-defined in that particular equation. Whereas a business domain has uncertain parameters of function. There is no

guarantee that the same customer would come in tomorrow. There is no guarantee that the weather would be the same. So, there are so many uncertainties which have work in a business domain.

The nature of technical domain is that it does not accept risk beyond a point because it cannot fail. A technology is developed under an uncertain, under risky proposition situation. It is developed, but once the technology is developed, it accepts no risk. If these specifications are set, it has to perform as per the specifications. It cannot tolerate any risk. Risk of failure is not acceptable in technical domain.

Whereas a business domain takes risk, risk of failure is taken as normal. So, when we say that a start- up can fail, we are not talking about technological failure here. We are talking about risk that come out of business failure because either the technology is less developed or more developed than it could be at that point of time.

Then the focus of technical domain is on productivity where the business domain tries to convert the productivity into value for the customer. The relationship of technical domain is one of man and machine. Whereas the business domain is one of enterprise and environment. In terms of technical domain, we can validate any complex technology through repeated experimentation. Whereas a business domain can only be validated, only upon business launch.

Like a movie can be made, technologically in a brilliant way by deploying the highest quality of cinematography equipment by choosing the appropriate ways of creating the graphics et cetra et cetra. That is technology, and it could be validated through experimentation. But as a business whether the movie would succeed can only be known upon launch.

Therefore, the success of technical domain can be proved through alpha-testing beta-testing. But its commercialization success can only be validated upon business launch. Which is why in the product stair case which we keep discussing from ideation to commercialization. Commercialization is one one step is extremely important for the start up to keep itself on the focus.

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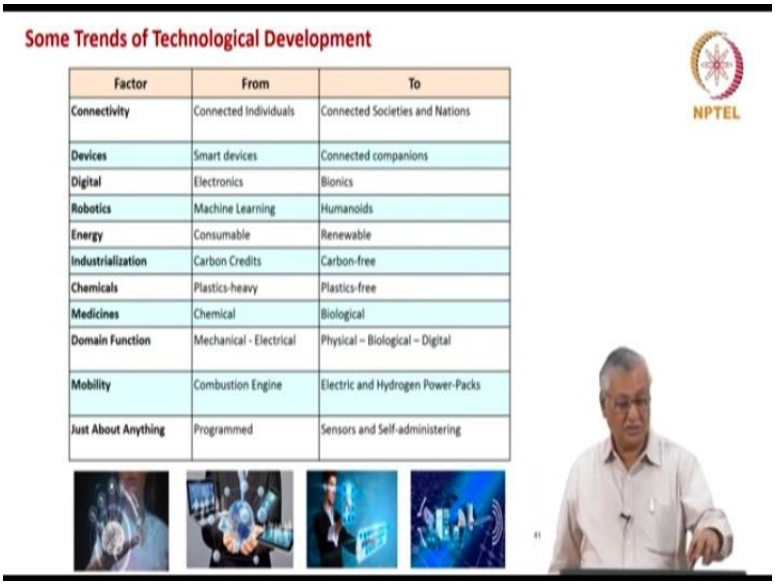

So, we talked about several tends of technological development, and in each of these trends, there are huge opportunities for start-up. You may say that from connected individuals when we go to connected societies and nations, it is a huge opportunity for technology. Many established companies like TCS and Infosys are having verticals for smart cities. Why? Because connected cities and nations are the way to go for future and tomorrow connecting cities with the rural habitats will be the trend tomorrow.

So, start-ups have got a position in this area. Similarly, when devices move from being smart device to a connected companion, which is your own alter ego. Which is your permanent companion, which defines your personality, which measures your personality, which corrects your personality then it is a companion for you. Then when digital electronics becomes bionic electronics that is another change. When robotics become humanoids, it is another opportunity. Renewable energy, another opportunity. Carbon free industrialization, most essential opportunity and a challenge.

How do you make the world plastic free? It is another opportunity. Yes, you can use mud pots but the moment you do it with terracotta lining then it cannot be recycled. So, how do you break this barrier? So, what seems to be a circular economy of making a pot out of mud under using it for cooking is again stopped by chemical treatment that happens in between. So how do I kind of break up that barrier and make anything go back to earth as easily as it has come from? Then medicines,

domains, mobility. So, just about anything from programming to sensing by itself and self-administering. This is the way to go.

Now, how do we think of this situation? For example, how do I optimize? You know that you need to operate your fields. Therefore, you need a certain amount of water. So, you decide that if you have 1hour of operation of your pump, you will get this level of water and therefore you program. But then you had earlier a switch. So, you physically come after 1 hour and switch off. That is 1 level of development.

Later on, you have a switch which times itself. After 1 hour you do it. Then, you have another development which says that there is no point in developing it further, I mean pumping the water further, when there is already a level of water in the field. So, you may have a camera. It says that if this level of water is achieved, it switched the motor off even if the time of operation has not been exceeded. But ultimate thing is that the plant itself judges the kind of moisture which is there is in the air and then gives a feedback to the motor saying that you got to switch yourself off because I do not need more water than what is already there in the system.

Now that is the ultimate. That is you are sensing and self-administering and who is sensing and who is self-administering? The plant is sensing and self-administering a living being which is supposedly non-communicative, is communicating with the machine and telling it what to do and what not to do. So that is in a way, is the currently imaginable ultimate of how one can self-administer oneself. And in these kinds experimental, in these kinds of futuristic technologies that start-ups have got a great play.

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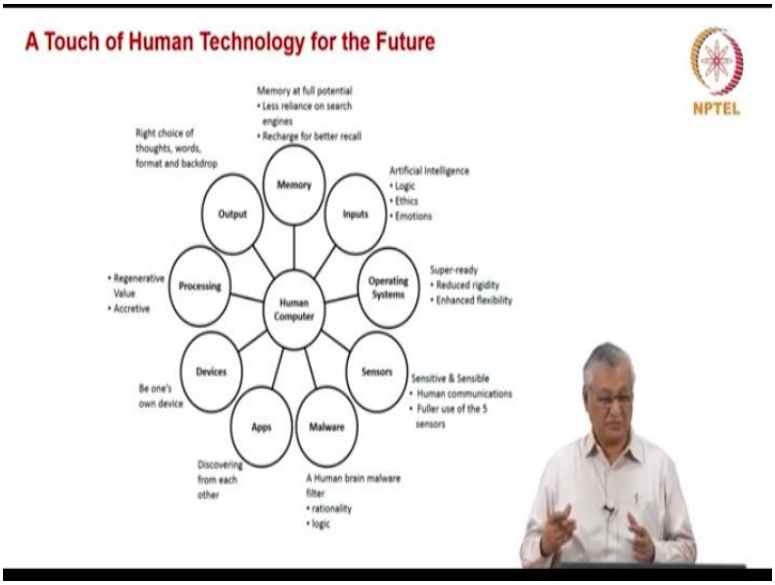

So, we come to the fact in everything which we do in the future, there is going to be a touch of human technology. And that human technology could be in memory, it could be in inputs, operating systems, sensors, malware, apps, devices, processing. There is going to be a different level of human touch which will to be incorporated in all our devices. And that sensing, that interface between the man and machines through the sensors, through the sensor technologies could be a potential area for start-ups.

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Now, how do the start-ups work on basic needs? Now, let us take example of an automobile. Now you have a current technology of an IC engine. So, you develop more efficiency to the car. You make a smaller car, more fuel efficient car that is

deriving incremental value from the current engines. Then you upgrade the established technologies to make a car into a sports utility vehicle like S-presso. Yes, that is something which you have done recently.

Then you integrate that into digital technologies like Nissan kicks vehicle, more simulation incorporated into the vehicle to the extent of calling itself an intelligent vehicle. Or you take up an old vehicle and reposition and rebrand itself like Beetle. Then you integrate supportive technologies like you bring in a motor electric motor technology into your car. Make a combination of IC engine and electric technology that is another way. Then you bring in batteries and see whether they are effective. Then you create totally new electric car. You create a completely autonomous vehicle by bringing in radars, camera sensors, self-programming computers.

So, the basic utility is only one, which is moving from one place to another in a safe, protective manner with least cost. That mobility has a basic need. Is sort to be met by different kinds of automobiles in different ways and several of them progressing in a linear function. But certain things coming as disruptive activities also.

So, each of these has certain start up elements which is involved in this. Things which is altering, how this basic mobility function is being fulfilled by a product. And superimposed on that is the activities which are performed by ride hailing agencies or mobility companies such as Uber, Ola which says that you do not need to own a car or a vehicle to be mobile. We will provide you that mobility as a service rather than lock money in a car. So that is taking this whole proposition to a different level.

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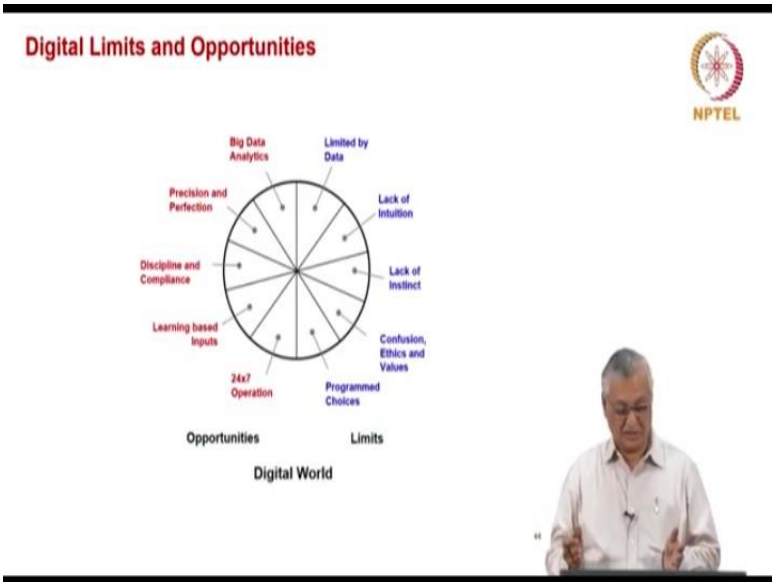

So, there are digital opportunities. There are digital limits, and you look at the digital world is limited by data. The more data you collect, the more precise and helpful you are. But the lack intuition is one limitation of digital, however, machine learning the total machine is, the lack of intuition is something which is extremely human and the lack intuition could determine whether a digital product will be successful or not.

Similarly, lack of instinct is an issue. Confusion in ethics and values is an issue. Programme choices is a track. It says the digital machine to go in a particular way. But then, all these things are offset by the fact that they have got enormous power for big data analytics. They are going to be precise and perfect. They are going to be unbiased. They are going to be disciplined and compliant. Learning is based on inputs and not on biases and they are available 24 by 7.

So, the emerging digital world will have a balance between what are essentially non-exchangeable human strengths versus non-replaceable machine strengths. When these two things are combined, probably you will get a much better human digital world and there again start-ups can function in very significant way.

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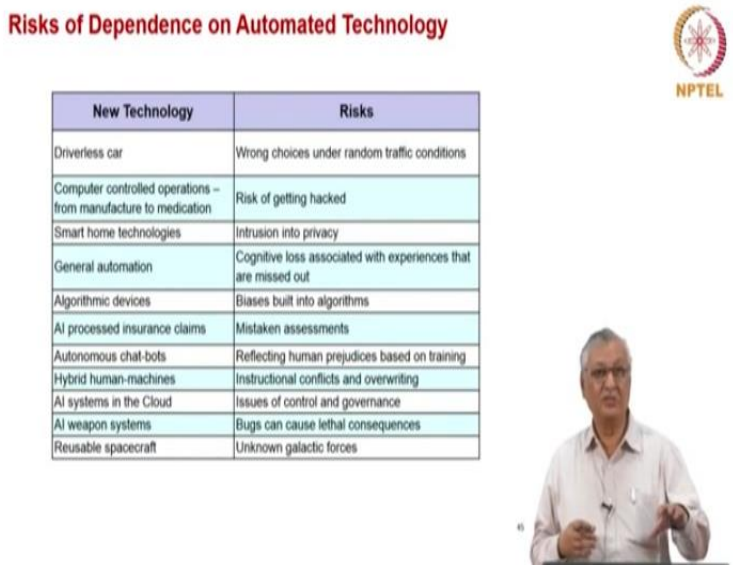

So, whenever this new technology comes, it comes with certain risks. So, a start-up will be successful when it has a solution for these kinds of issues. So, if there are ways in which the ethical dilemmas which are faced in driving an autonomous car. If there is a solution for that, that itself is a start-up opportunity. You do not have to do an complete autonomous vehicle which is best left to the Teslas and the Toyotas of the world. But if you are able to develop a program or a method of understanding the profiles of different beings and different traffic situations and develop a solution based on ethical considerations, that itself is a start-up opportunity.

Similarly, when you have computer-controlled operations, how do you kind of avoid the risk of getting hacked? So, you can create a huge, strong infusion pump which can put in 4-5 medicines into the same thing. How do you keep the risk hacker-proof? So that could be a start-up opportunity. Then how do you ensure privacy in the start home technology. So, doing a start home technology product is one start-up activity or an established company activity. But how to overcome the risks which are associated with these start-ups. The biometrics, for example, they come with their own risk. So how do you ensure that risks are mitigated. That itself is a huge start-up opportunity.

Similarly, how do you ensure that the AI based insurance claims, they do not end up in wrong assessment. So, the more innovative a product is, it could also be less perfect in terms of fallibility. So how do you ensure that there is no fallibility in a product?

How do you ensure that the cyber risks of a product are minimized. Those themselves could be huge start-up opportunities.

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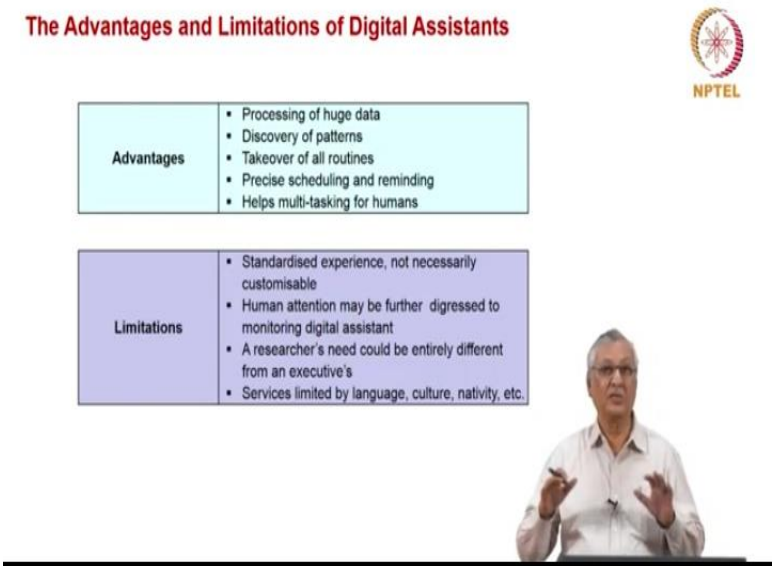

Similarly, when you do digital assistants, when you say that the entire activity of executive assistants receptionists will go away so, you have digital assistants that process huge amount of data. They can meet certain tasks in a much better manner. Then there are limitations. So how do you make a digital assistant which can overcome the limitations and have better advantages offered, so that is another area.

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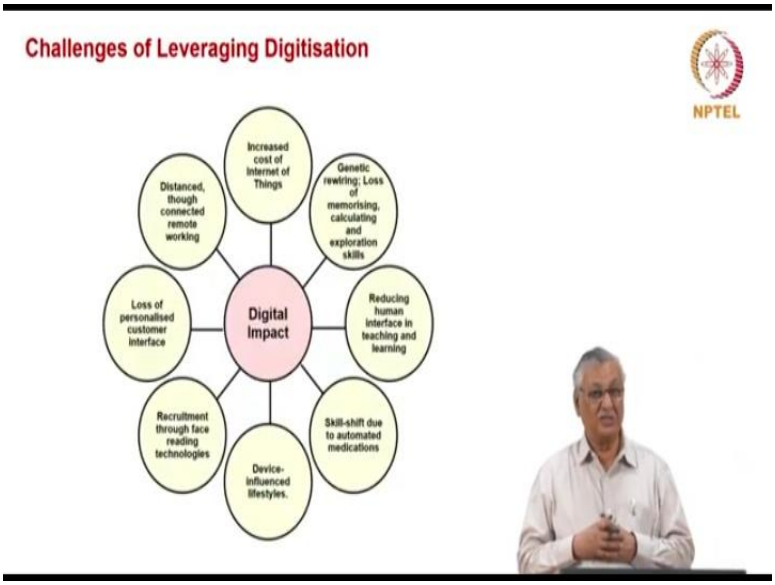

So, when you have digitization all across today, you have digitization in any process. Every process is digitized and most of the start-up opportunities have come up because of digitization of the normal basic processes. Whether it the getting into the taxis or whether it is ordering the food or whether even a cloud kitchen, it is digitization of an operation which is already there.

So that service is a new product but the service itself is not new. We have to do something in completely different way. In the sense that when you do digital impact assessment, you have to see what is the kind of rewiring of the human situation its having. That is, when you have a smart city, you do that kind of inter connectivity at a huge infrastructural cost. And what is the ultimate benefit out of that? Is it really helping?

When you have a huge search engine such as Google providing instant answers for everything then what is the digital impact of that? Loss of memorizing, loss of thinking in the way you have been used to think as a human being. Then when you have online education, when the human interface goes in terms of teaching and learning, how do we do that? How do we really improve upon those aspects which are de-humanized because of digitization? How do I do?

Similarly, skill-shift that occurs when you do automated medication. The kind of lifestyles which are modified because of devices. How when you when you do recruitment through face reading technology? How you miss the subtle human nuances which happen when you interview a person in depth for 1 hour also or when a panel of experienced leaders interview a person, how does that change when you go entirely on face reading technologies for recruitment? And then what happens when somebody, a robot serves you the food, and what is the loss of personal contact between the customer and the person?

And then, when remote working is the order of the day, what happens to the organizational homogeneity or culture or the teamwork when remote work happens, and A can work with B or A can work with Z. That is a good thing but then there is no emotional connectivity between the people. How does that have, so when we do products, either as a established company or as a start-up through digitization, there are challenges, how do we leverage digitization in such a way that the digital, adverse digital impact is minimized. And any product which does that as either an add on or

as an embedded action within the product development, that itself would have good impact.

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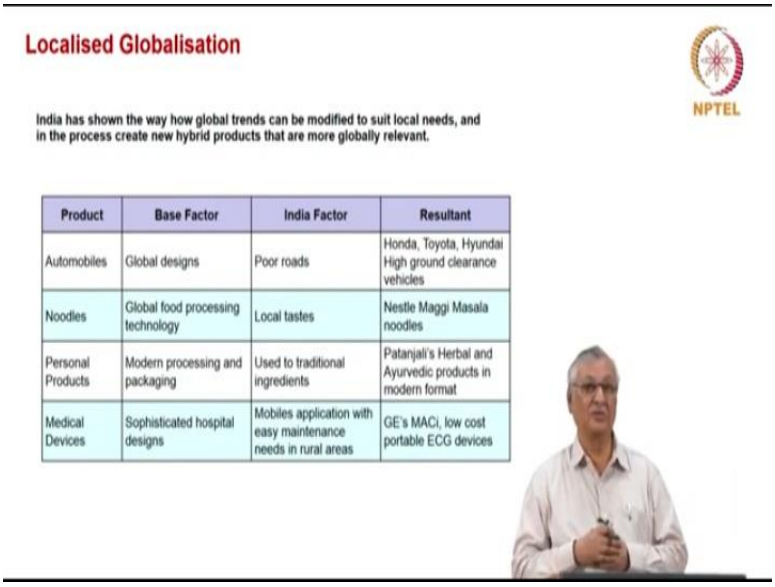

Then we have got localized globalization as an opportunity. We have seen automobiles. Global automobiles coming in to India. But when we develop solutions which can meet Indian potholes roads, when you have opportunities to redesign the cars to navigate into narrow roads, that is, with better turning circle better turning radius, and ability to have quick reverse parking, those are global designs adapted to the Indian needs. How do we do that?

So, when you do that, the companies will have additional ability. So, having a reverse parking system or having a rear view mirror system wherein the distance between objects and the driver is not humanly assessed but also empirically shown. That look, you are 1 metre away, you are 2 metre away. Normally, it is left to the driver to judge because the objects in the rear view mirror are different from the way actually specially they are positioned. So how do you combine these two?

So, if a start-up comes up with a solution for that, it is a new development. Similarly, noodles. How do you make it to be acceptable to the palette of different localities of the nation? Similarly, personal products, how do they use the traditional ingredients? Then the medical devices which can be maintained in the rural area. So, localized globalization is extremely important.

So, one way is to see the raw pressed cold raw cold-pressed jewels which is being sold in safe way in US. And say that this country needs that product. That is one method of start-up. But the other method of start-up is to say that yes, I would like to have that advantage but I would also need something which would stay on without gold chain or without having the long distribution cycles which happen in India. So, what you take up as the requirement of localized globalization? That is also another area of, both of great challenge as well as great opportunity for start-ups.

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Ultimately, as for established companies as also for start-ups, the balancing of domestic and export markets supports economic independence. Interestingly, about 90 to 95 percent of the revenues which are earned by the top 3 or top 5 companies, technology companies or information technology companies is derived from their overseas services offered. Of course, they do employ a large organization of people in India but the services are established and sold, marketed and deployed abroad. So that is a normal.

Similarly, when we think of newer areas like smart cities or having fully connected electricity grids, much of these service offerings are for export markets than for Indian markets. But there is a huge potential for all of these activities in India. So, if India has to be economically independent, a balancing of domestic and export markets supports economic independence. Why are we saying this? We are saying this because start-up's role is not just to earn some revenues. It's role is not exactly to achieve market valuation.

Although these two objectives are important, a start-up is trying to solve a problem which cannot be solved by other kinds of companies so easily. And because it feels passionate about solving the problem of the society or the nation. I would therefore say that solving a problem of national economic independence is itself a big opportunity for start-ups and start-up products that can serve as effectively as in India as they would in overseas countries, that could mean a see change to India's industrial competitiveness and also India's economic independence.

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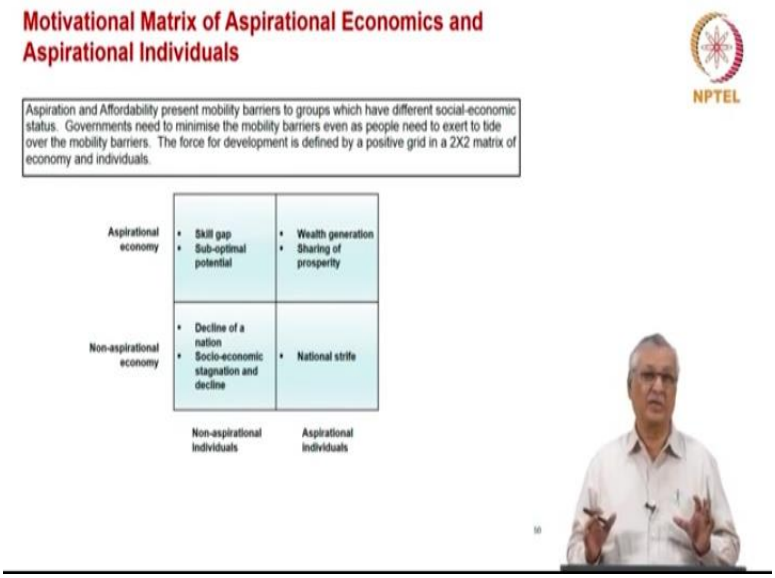

So, if you look at an industrial situation. Industrial situation is nothing but aggregation of individuals which is talent, and it is also aggregation of individual markets and markets themselves comprise individuals. So, if you look at this matrix, we have non-aspirational individuals, aspirational individuals. We have a non-aspirational economy and aspirational economy. And as India, we would like to be having aspirational individuals and an aspirational market place, That is where India would like to be.

If India would like to be a 5 trillion dollar economy, it happens only when it comprises people who have aspirations and an economy which is aspirational for such goal. And once upon a time, the country may have been under oversees rule, and the aspirations may have been lowered down. And the economy would not have been aspirational. But today, as India seeks its rightful process in the global committee, obviously we are all aspirational and the economy itself tends to be needs to be aspirational.

So, wealth generation is important. Sharing of prosperity is also important which means that we need to have a kind of vibrant industrial economy which can help in this objective. And that is why I would say that start-ups have got a great role to fulfil.

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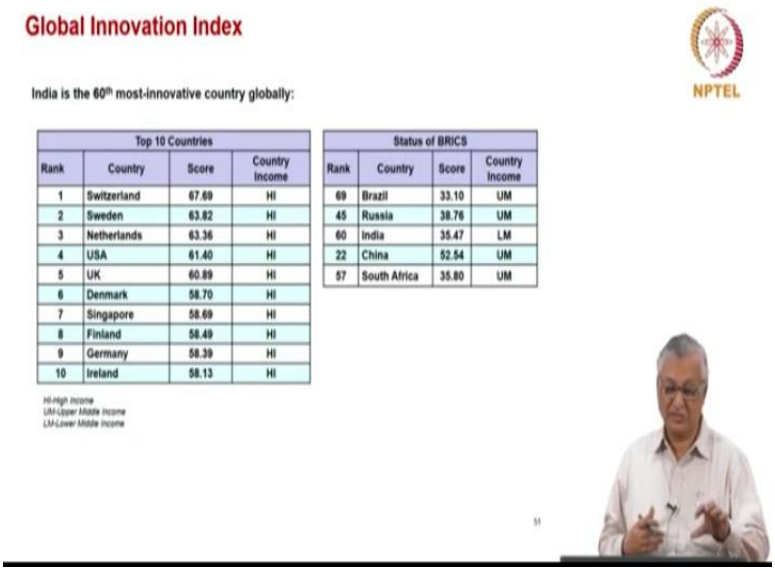

And, to be able to do that, we need to really move up in the rank of innovation. As of now, India is 60th in the rank of innovation globally. Global innovation index is an index which is accepted globally to measure the innovation intensity in various countries. You will find that the top 10 most innovative countries are Switzerland, Sweden, Netherlands, USA, UK, Denmark, Singapore, Finland, Germany and Ireland.

Interestingly, if you go back to the earlier discussions on global unicorns where we found that some of these countries did not figure in the unicorn list to the extent as India, but they have top rankers in the innovation and India is number 60 in innovation so there seems to be a paradox, but there is not a paradox. As I said, as one of the flip hypotheses, the established companies are far more into the innovation game than unicorn in other countries number 1. Number 2, established companies are able to absorb the start-up ecosystem into itself and take on technological innovation with its whole system, obviating the needs of global unicorn in the start-up ecosystem.

So, the overall innovation intensity in any economy or in any nation is a combination of the innovation intensity of the established companies as well as the start-up system. So, there is probably all the merit in emphasizing start-ups as one step towards

solving our innovation puzzle. But it should not be read as the only step and the only determinate step for us to solve the innovation puzzle.

We need the established companies also to gain themselves up in the innovation play, which means that they have to do 2 things. One, have high level of innovation within their own corporate labs or support the industry systems become highly innovative or publicly and privately funded, innovation labs to be set up and provide inputs. Or they should encourage the start-up system in such a manner that it is not 7,000 start ups which are looking at the innovation, it would be 70,000 start ups which are looking at innovation.

So, there are two ways therefore, one the established industrial system in India has to innovate itself to further levels of innovation. And it should also support the start-up system several times over so that the overall start up ecosystem is so dense and so rich that the innovation intensity is felt very obviously on the established industrial system. That also has to happen.

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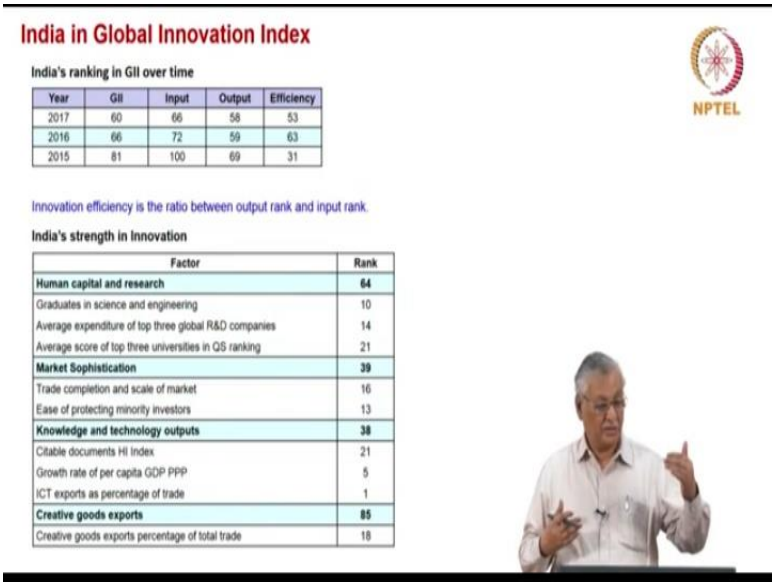

And, strengths in innovation happen because of various factors. One is the human capital and research, market specialization sophistication, the knowledge and technology inputs, creative goods exports. Each of these things have a has a role in ensuring the innovation intensity, and we need to work on all the things.

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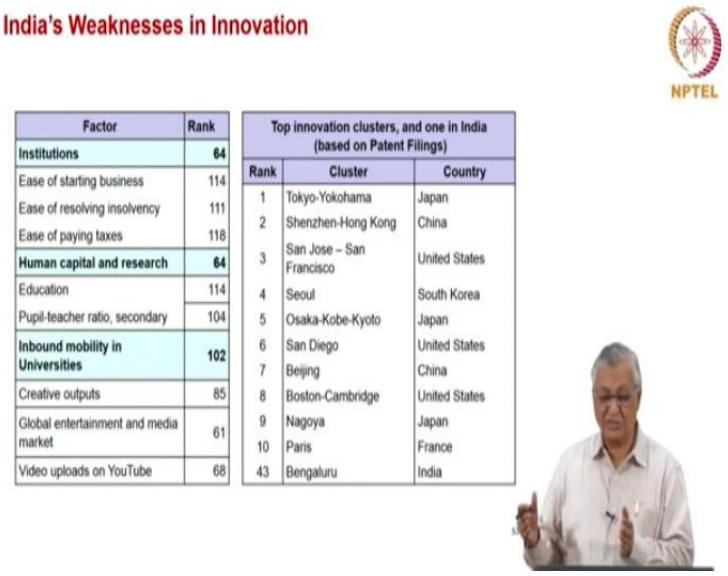

Factor	Rank
Institutions	**64**
Ease of starting business	114
Ease of resolving insolvency	111
Ease of paying taxes	118
Human capital and research	**64**
Education	114
Pupil-teacher ratio, secondary	104
Inbound mobility in Universities	**102**
Creative outputs	85
Global entertainment and media market	61
Video uploads on YouTube	68

Top innovation clusters, and one in India (based on Patent Filings)		
Rank	Cluster	Country
1	Tokyo-Yokohama	Japan
2	Shenzhen-Hong Kong	China
3	San Jose – San Francisco	United States
4	Seoul	South Korea
5	Osaka-Kobe-Kyoto	Japan
6	San Diego	United States
7	Beijing	China
8	Boston-Cambridge	United States
9	Nagoya	Japan
10	Paris	France
43	Bengaluru	India

If you look at the top innovation clusters based on the patent filings, you will find that we are not on the top 10. We are there one, top 43 cluster, but then that is not sufficient.

We have Japan leading. We have United States, China leading in these areas. Korea is also there, but India is not there in the top 10. So, one of the goals of the Indian innovation drive must be to get into the innovation intellectual property generation in such a manner that we are in the top 10 innovation clusters.

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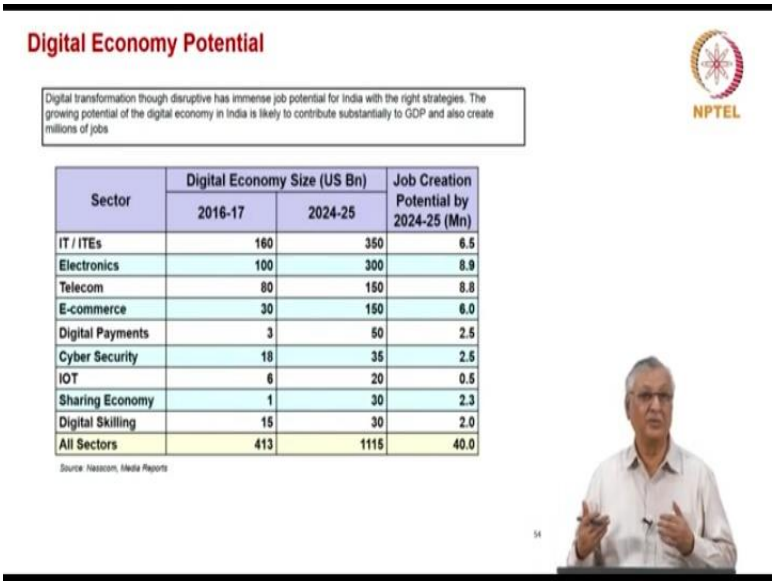

Digital transformation though disruptive has immense job potential for India with the right strategies. The growing potential of the digital economy in India is likely to contribute substantially to GDP and also create millions of jobs

Sector	Digital Economy Size (US Bn)		Job Creation Potential by 2024-25 (Mn)
	2016-17	2024-25	
IT / ITEs	160	350	6.5
Electronics	100	300	8.9
Telecom	80	150	8.8
E-commerce	30	150	6.0
Digital Payments	3	50	2.5
Cyber Security	18	35	2.5
IOT	6	20	0.5
Sharing Economy	1	30	2.3
Digital Skilling	15	30	2.0
All Sectors	413	1115	40.0

Source: Nasscom, Media Reports

Then, digital transformation. Yes, there is potential but we discussed. How do we really do it really across the board not necessarily converting a basic process into a digital process, be it ride handling or cab hailing or be it clothe cleaning. We had our food delivery. We need to move beyond all these things and make sure that digitization revolution which is occurring in each of these sectors like IT ITES, electronics, telecom, E-commerce, digital payments is part of our start up ecosystem and we do physical products made into digital products. Not just physical processes converted into digital processes.

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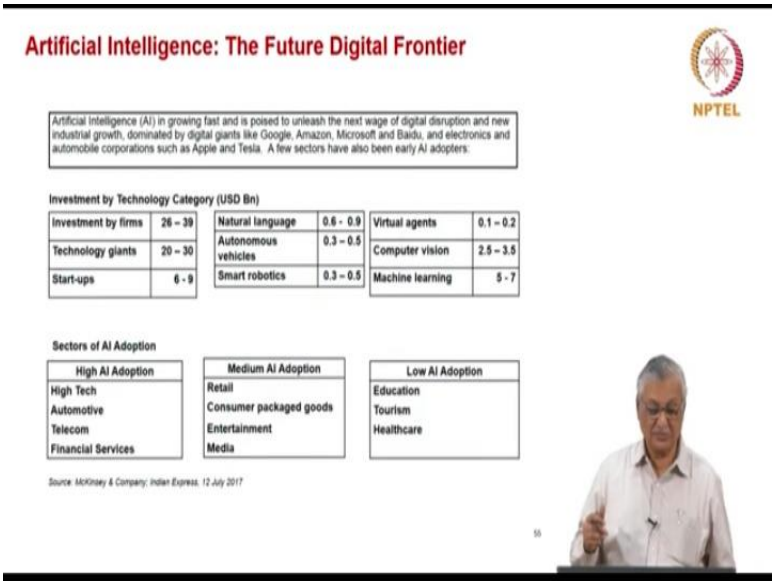

And if artificial intelligence is the future digital frontier, we need to have a system by which we rank high in the artificial intelligence start-up ecosystem just as China has endeavoured to become. That is another important thing.

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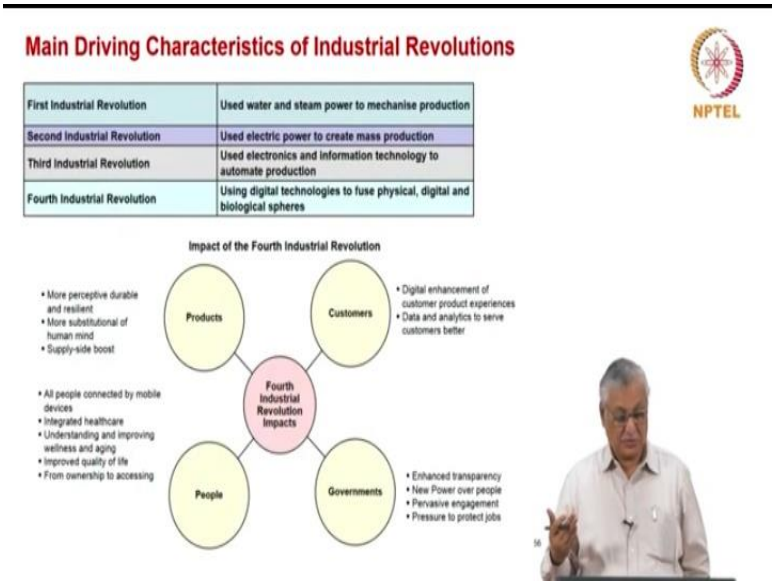

So, when you look at the 4th industrial revolution impact, we looked at products, how it impacts. We looked at customers. We looked at people. We also looked at how the technology is a bridge between the governments and the people. How it is a link between public policy and the industrial policy? How it is link between equity and growth? We have looked at all of these things.

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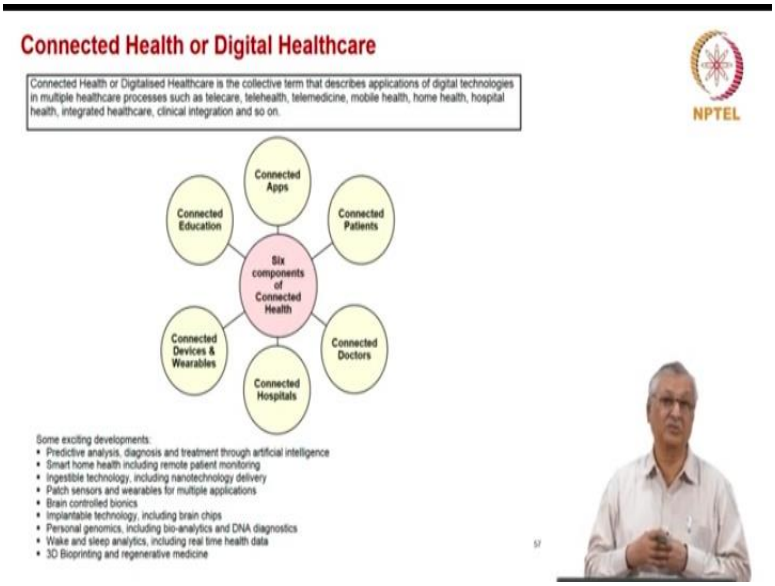

And, for that how do we really change our mindset and how do you for example look at connected health? We understand that we are not very high on health care index globally. So, how do you get connected health? So, we need to connect everybody as part of an ecosystem. We need to have connected apps. We need to have connected

patients, connected doctors, connected hospitals, connected devices and connected education. That is the goal. So, to be able to do that how do we do that? It is just not telecommunication when you talk about connected health care. It is through certain specific products and services. For example, predictive analysis, diagnosis and treatment through artificial intelligence.

Looking at the wave pattern of our heart, if you are able to predict what is the likelihood of the heart muscles weakening or what is the likelihood of stress determining how strong our heart would be? That is a contribution. That is the connected health care requirement which is requiring.

Similarly, smart, making or home smart so that the patience ambulation within the home is monitored and you get a report. So, as opposed to a 10 minute interview in a doctor's chamber, you get a 24 by 7, if not 365 day review, at least a 30 day review of a patience's ambulatory condition. Or even of a good person's or borderline person's ambulatory conditions in the home and you are able to sense his capability.

Then ingestible technology, it could be another way in which you can see. Patch sensors and variables, brain controlled bionics, wake and sleep analytics. Then 3D bio printing and regenerative medicine, implantable technology. So, when we look at connected health or digital health care, it is not just some kind of digitization of medical records or fixing appointments or say, scheduling task. It is much beyond that. It is kind of embedded hardware and fused software development for solving some of the health care problems in a very precise manner using the digital technologies.

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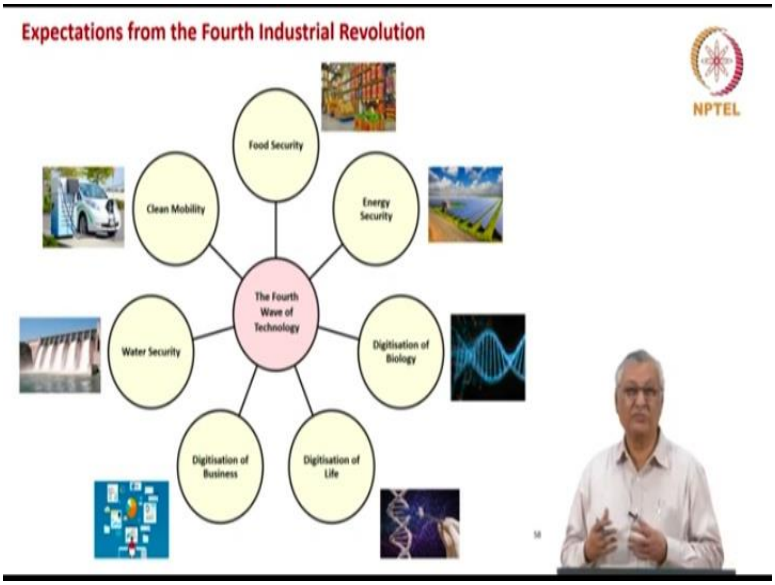

So, when we these things happen, the society has certain expectations from the so-called fourth wave of technology. One we all want to food security, which means that the plant should have good nutrition. It should have its products which are safe, which are pesticide free, chemical free, which are organically nutrient. Then you should have energy security, you should have maximum solar power which comes. Water demand for example, it should be easily managed. Not only by having more water bodies but also ensuring that water consumption is metered well and also ensuring that water is recycled well and waste is treated as source for example.

Then the digitization of life itself. Understanding our own genetic nature and ensuring that we have a purposeful life based on good health. So, there are a number of ways in which there are the opportunities that can be fulfilled by digital technologies in going forward.

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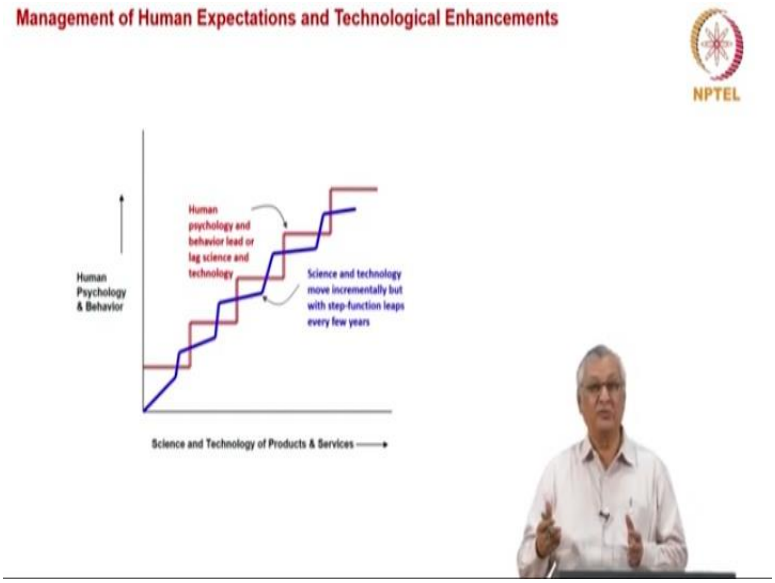

But when we look at all these things, the marriage between opportunity and value is not always very synchronous. There are times when technology moves ahead of human requirement and there are times when human requirements move ahead of technology. So, this red line, for example, indicates that human psychology and behaviour lead or lack science and technology. There is also an opportunity where science and technology move incrementally but with step function leaps in very few years.

So as a result of this, either technology is over available in a sense or is under available. But probably this is the time when technology is far ahead in terms of digital capability to transform several aspects our life. So far it has transformed several aspects of our connecting ourselves. Transformed the way the processes are conducted. Transformed the way the data is collected and analyzed. But lot more can be done as we discussed from let's say water free irrigation, virtually water free irrigation to timing the use of resources through self-sensing to understanding the human health in a much better way. Understanding products which will be renewed every year but also recovered almost fully every year.

So, from a consumption oriented economy if we need to move to a climate and environment oriented circular economy, how do we really manage this transformation. And obviously established companies with huge resources have a big role to play in this. But also, start-ups which have open to sky thinking, which do not have any biases and inhibitions, which are prone to experimentation and which want to solve

problems which are not been solved hitherto, they are also best placed to solve this issue. And when technology is available in a much more democratized way as we move forward, I think start-ups will have a great role to play in transforming India to a huge global economy. Thank you.