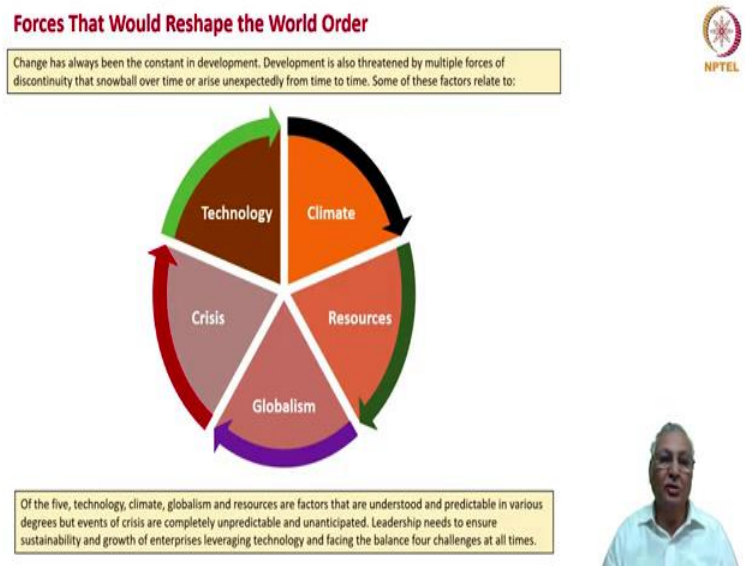
Leadership for India Inc: Practical Concepts and Constructs
Prof. C Bhaktavatsala Rao
Prof. Ajit Singhvi
Department of Management Studies
Indian Institute of Technology, Madras

Week – 03
Leadership for Sustainable Growth
Lecture – 11
Technology Leadership

Hi Friends, Welcome to the NPTEL course on Leadership for India Inc. Practical Concepts and Constructs, we are in week 3 discussing Leadership for Sustainable Growth. In this lecture number 11, we will discuss Technology Leadership.

(Refer Slide Time: 00:26)



Early on, I discussed with you the fact that leadership is not just revenue maximization, profit maximization, market share increase or even market capitalization, it is something more than that. There are certain forces that shape and reshape the world order. These are technology, climate, resources, globalism and crisis.

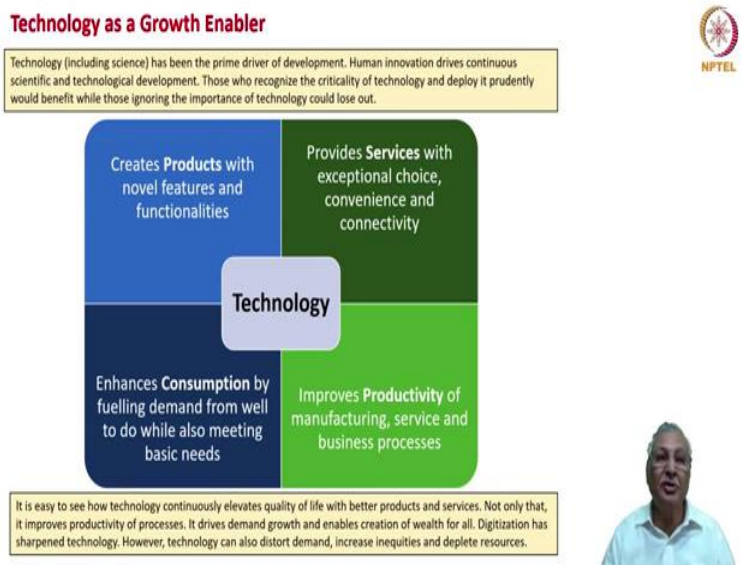
In order to be able to cope with these forces, the leader has to be very agile and very broadminded and universal in outlook. The ability to harness these forces to the advantage of the firm, the nation, the society and the broader world order, is a higher order leadership capability. We will discuss during this week several aspects of these forces as well as the way the leadership can respond to that.

The crux of this is sustainability, how to ensure sustainable growth that could be the key philosophy, that would underline the course material this week. Change has always been the constant in development; however, development is threatened by multiple forces of discontinuity, that snowball overtime and at times unexpectedly lead too.

Some of these factors are technology, climate, resources, globalism and crisis. Amongst these five forces, technology, climate, resources and globalism are tangible and can be predicted and can be responded to appropriately. However, crisis is something which is going to be completely unanticipated, unexpected, and the severity may be something calamitous as well.

It is important for a leader to understand, how to manage these five occurrences that would happen in the leadership journey. Fundamentally, it is very important for a leader to leverage technology. So, that he or she is able to manage the other four factors and ensure sustainable leadership.

(Refer Slide Time: 02:35)



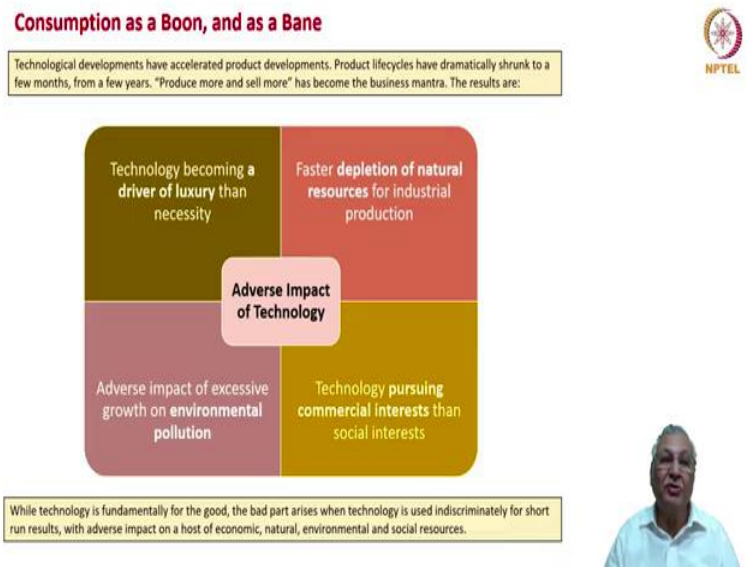
What does technology do? Technology is a great growth enabler, without technology societies and the nations would not have progressed the way they have. When I say technology, it also includes engineering as well as the science. Technology is the prime motivator and prime driver for development.

Human innovation drives continuous improvements in technology, those who recognize the criticality of technology and deploy it prudentially and wisely would benefit. While those ignoring the necessity or importance of technology are likely to lack behind.

In terms of the deliverables, technology does four things. One, it creates products with novel features and functionalities. It provides services with exceptional choice, convenience and connectivity. It improves the productivity of manufacturing service and business processes. It enhances consumption by fuelling demand from well to do as well as those who have basic needs that are yet to be satisfied.

So, technology does many things for the society's development. It always tries to elevate the quality of life with better products and services. It makes things more efficient and more effective, in that manner, technology is a very effective aid and companion for leadership and management. However, technology can also disturb and distract from the path of sustainability, it could distort demand, create inequities and also deplete resources. Some of these aspects also we will consider in this lecture.

(Refer Slide Time: 04:14)

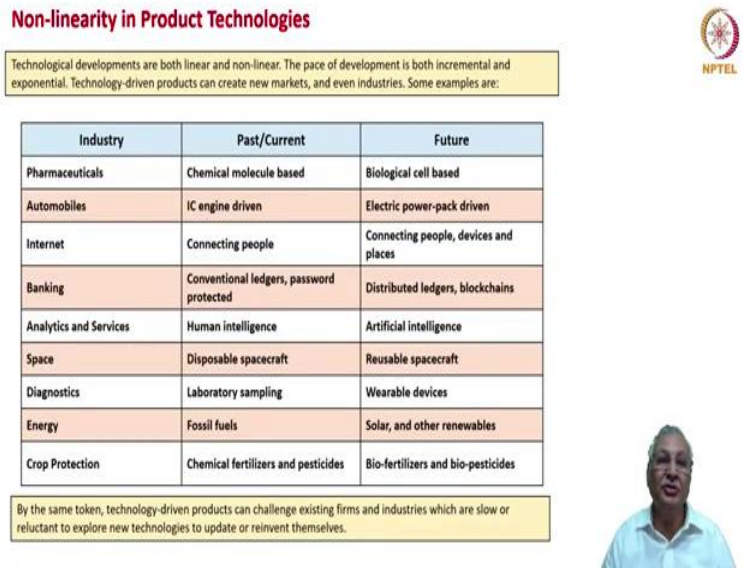


Consumption is the primary driver of development. You always evaluate your firm's growth, we always evaluate our nation's growth by the improvement in the gross domestic product and by the improvement in the revenue or profit. However, this is based on the premise that we need to consume more and for that we need to produce more.

So, constantly and continuously increasing scales of production and consumption, have underpinned the developmental philosophy of the nations over the last few centuries. However, in recent years, technology has become more a driver of luxury than of necessity. It has also resulted in faster depletion of natural resources for industrial production because, product lifecycles have become shorter. It is requiring more products to fill the consumer demand.

Technology is pursuing by and large commercial interests than social interests. And as a result of the excessive growth, there is also an adverse impact on environmental pollution. These are the four adverse impacts of technology, while technology is fundamentally good for a nation and for the consumers. The bad part arises, when technology is used indiscriminately for short run results with adverse impact by host of economic, natural, environmental and social resources.

(Refer Slide Time: 05:42)



But, before we go into some of these issues, let us look at what is happening to the technology as an overall discipline. Generally, technological developments in the past have been linear, that is if a car developed a particular level of horse power. The next model of the car developed a little higher horse power.

So, this kind of predictability in the growth path is called linearity, but today we have technological developments that are promising non-linear developments. While the place of development continues to be incremental in most ways, and in most sectors,

technology is also driving non-linearity in product technologies, let us consider a few examples.

Let us take the pharmaceutical industry example. In the past every drug that has been developed and manufactured was made on chemical basis. That is organic chemistry has been the key driver of developmental synthetic molecules which could be used as drugs. Today, most of the drugs are biology based, they are cell based, whether it is mammalian cell culture or other cell culture.

If you look at automobiles, the trend is fast coming up of IC engines getting replaced with electric power packs. So, automobiles will be more of electric vehicles in future than IC engine driven vehicles. Internet used to connect people, today's internet the internet of things, connects people, devices and places. It makes the world and all the constituents of the world be it the people or the devices or the places, roads, traffic conditions, industrial machinery houses everything one inter connected world.

Banking used to be done through conventional ledgers and password protected usually. Today, we have distributed ledgers based on block chain technology, data analytics and services were based on human intelligence. Today, artificial intelligence and machine learning are helping higher level of analytics and services.

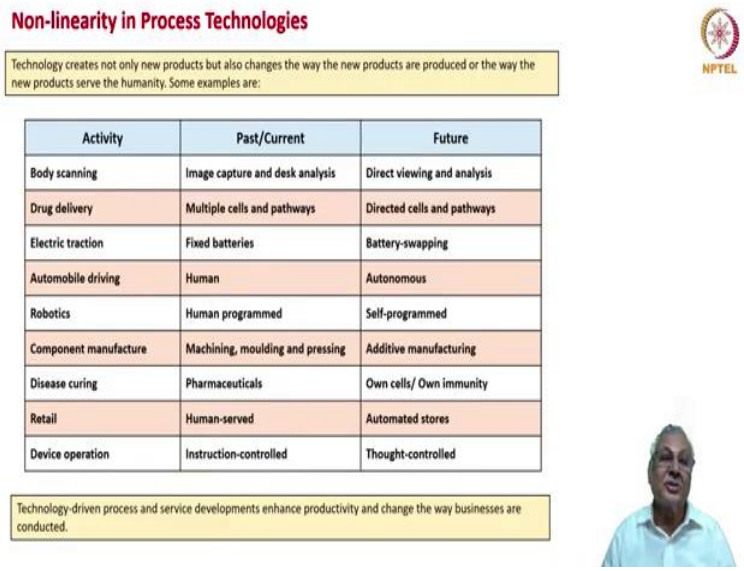
When you look at space exploration, it was all disposable spacecraft, that is you launch a spacecraft, it is not of any use even after coming down to earth or coming down to the sea. Today, we are thinking of reusable spacecraft in which people can travel to the planets and come back again.

In diagnostic space, we used to have laboratory sampling and today we are also having not only a laboratory on a chip, we are also having wearable devices which are keeping a continuous track of our health parameters. Energy was entirely based on fossil fuels earlier and of course, even now but solar and other renewable energy sources are fast taking over. Crop protection is used to be based on chemical fertilizers and pesticides. And, there it is a big no, no as the future develops, bio fertilizers and bio pesticides need to be integrated into the forming practices.

Because, of these kinds of non-linear changes, the technological developments can challenge, the existing industrial structures and the existing firm positions and newer

firms and newer industrial structures can come. It is important therefore, that firms utilize technologies to reinvent themselves from time to time.

(Refer Slide Time: 09:00)



It is not that only products are impacted by technological developments, even processes that is the way in which is the products are delivered, is also getting impacted by newer technological developments. Let us take body scanning, the linearity earlier was that it used to get 64 slice CT, later on 128 slices came, then 240, now we have 340.

So, it is an incrementalism in the level of radiation that is required, minimization of the radiation to be exact. And, also the speed with which the images are captured, but tomorrow it would be possible to directly view not only the hard tissues and the hard vessels, but also the soft tissues directly and make an immediate real time analysis of what is going on in the body.

Drug delivery used to be through multiple cells and pathways, for example, there are some drugs which will act through the gut process, some which will act through the lung processes and so on.

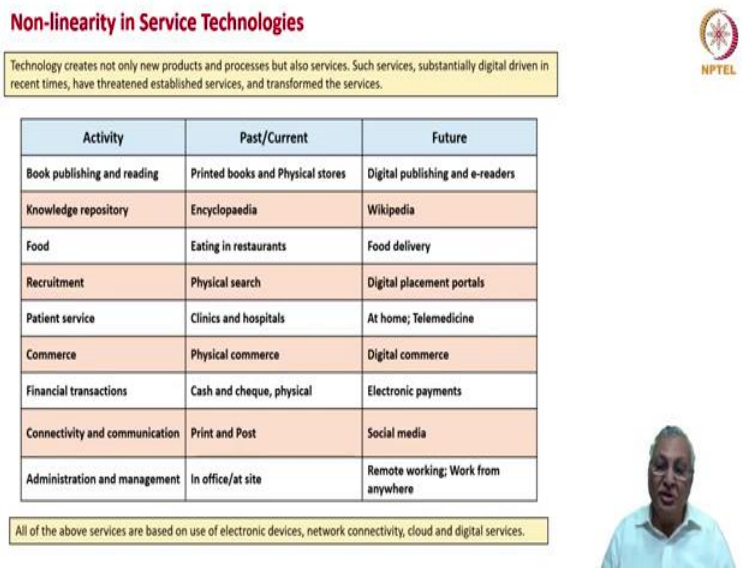
But, in future there would be directed cells and directed pathways. Developments in nanotechnology will be utilized to deliver the drugs exactly in the same manner as they are thought about. Electric traction used to be based on fixed batteries and, today batteries swapping is coming up as a delivery mechanism for those products.

Automobile driving, even today it is entirely human and in future, it would be autonomous. Robotics are human programmed whereas, self programmed robots are on the anvil. Component manufacture used to be machining, molding and pressing. Whereas, additive manufacturing will be the order of the day, in a few years hence, diseases used to be cured only through pharmaceuticals.

But, today we are thinking of raising the immunity in our own cells, vaccines had been a perfect example of that, but newer methods of developing the vaccines based on mRNA technology and other ways are coming up. Retail is serviced by human beings until now and automated stores are coming up fast.

Devices used to be operated by instructions, but there could be thought controlled in future. Therefore, technology driven products as well as the ways and methodologies by which these products are delivered through certain technological processes is enhancing productivity and is changing the way business are going to be conducted in future.

(Refer Slide Time: 11:26)



Even the services have undergone lots of changes and would continue to undergo further changes. Book publishing and reading, from printed books and physical stores, it has already about to digital publishing and e-readers. Increasingly these digital means will mimic the physical feel, look and feel of books, so that, it would be another step function increase in digital reading and publishing habits.

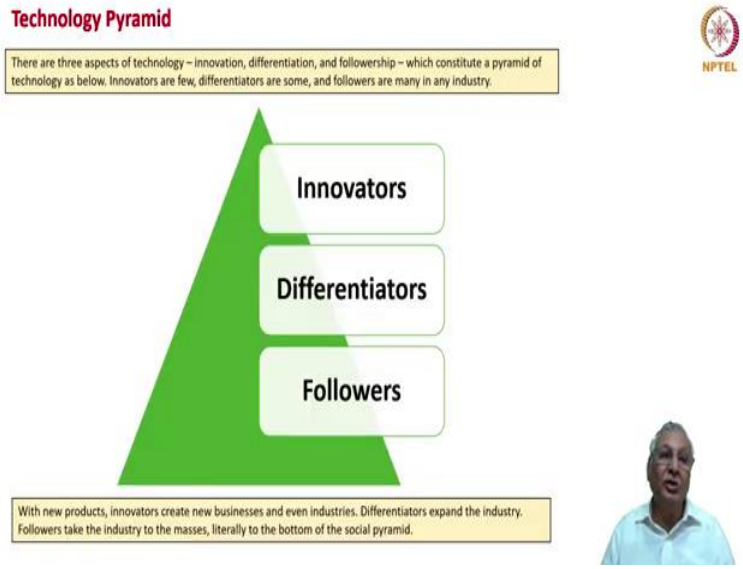
Knowledge repository used to be Encyclopedia, today everything is available through Wikipedia and other cloud sources. Food, from eating in restaurants, we have moved to food delivery. And sooner than later we will go probably into cloud kitchens as well, recruitment used to be through physical search whereas, now digital placement portals are the order of the day.

Patient service required people to, that is the patients to go to clinics and hospitals. Today, whether because of COVID or otherwise we have treatment at home and tele medicine is going to have a much larger share of medicine in future. Commerce was only physical and today preponderantly digital commerce is playing a role. Financial transactions were by cash and cheque and physical, now electronic payments are the order of the day.

Connectivity and communication, print and post has moved to social media. Administration and management used to be in office and at site, and we have already experienced lot of remote working and very soon it would be work from anywhere. It does not mean that the futuristic trends which have been discussed will be the sole futuristic trends.

We could see another step function increase in those things or a combination of the current physical systems with the future digital systems. All of these things are based on electronic devices, network connectivity, cloud and digital services which have technology as the backbone.

(Refer Slide Time: 13:13)



So, if these are the kinds of changes that are being brought in the areas of product, process and service, how is that technology is helping these kind of changes? I would say that there is a pyramid of technology, which we all must recognize. It is made up of innovators of the top crust, differentiators in a broad middle and followers at the bottom, when new products are discovered or invented for the first time innovation happens.

And innovation creates, new businesses, new firms and even new industries, it happened with search engine, it happened with social media. And, it happened with chips and it would happen with any number of new technological innovations that are going to happen. Differentiators are those companies or those invention pools that follow the innovators, but come up with distinctly superior ways the products can be developed, can be utilized and can be effective.

So, let us take an example of a pharmaceutical product. The innovator might have discovered a new molecule that would go through a particular pathway, and cure a disease like never before. A differentiator would still use the same pathway, but create a molecule, which is substantially different from the innovator molecule. And which would also have additional properties.

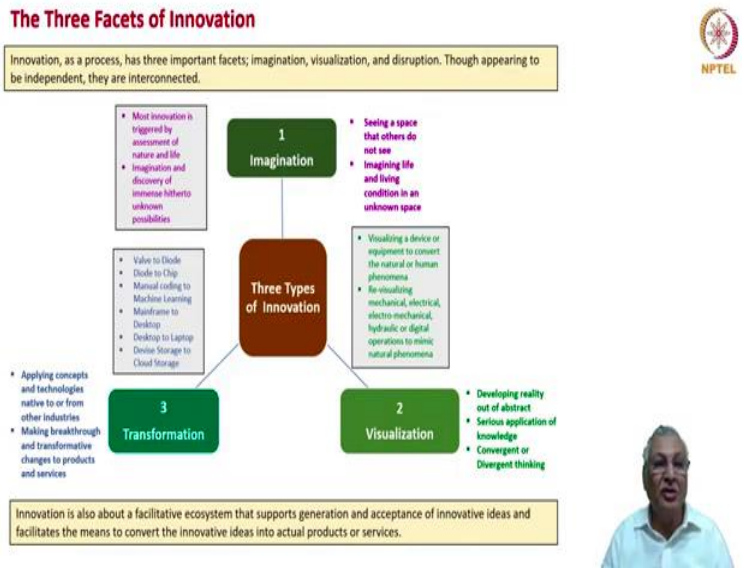
Those additional properties could be more efficiency in therapeutic curing, it could be lower drug level, it could be faster elimination from the body or slower elimination from the body as required. Reduced side effects, no drug-drug interactions and probably a

different way of ingesting the drug, instead of let us say being an injection being an oral drug or vice versa.

So, differentiators are also innovators although they follow the path of the innovator, their products are significantly different from those of the innovators. Then, come followers who try to mimic both the innovators and differentiators and develop products, which are almost similar to the products of the innovators and differentiators.

Innovators create a new industry or a new business or a new firm as I said. Differentiators expand the scope of the industry, whereas followers bring the industry literally to the door steps of the masses. So, for an orderly progress of a nation or a society, we need the technology pyramid in its full form, that is, there should be innovators, there should be differentiators and there should be a large group of followers.

(Refer Slide Time: 15:47)



Let us discuss innovation little more detail. Innovation as a process has three important facets. One imagination, second visualization and three transformation. What I am trying to say is that innovation is not just serendipity or just a spark of creativity which comes from out of nowhere.

There is also a science, there is also an art behind innovation. When we talk about innovation, it is seeing a space that others do not see. When somebody thinks of

travelling to space, as we travel in airplane from city to city. The gentleman who has thought about that has seen a space that others did not see.

It also involves imagining life and living condition in an unknown space that has been discovered by the individual. Most of such imaginative innovation is triggered by assessment of nature and life, people could think of an imaginary situation where you do not need any wires to transmit electricity that seems to be an extreme imagination. But, one day it could be possible because, nobody thought that a phone could be charged without a physically connected charger.

But, today we have wireless charging not only that charging from one charged instrument to another charged instrument. Therefore, the more you imagine a space which has not been discovered or imagined so far, you develop a pathway of innovation. And it creates several unknown possibilities in the realm of innovation.

The second type which gives a shape and physical appearance to imagination is visualization, you create a reality out of the abstract that we have imagined. It involves serious application of knowledge and it is either a convergent thinking or divergent thinking.

How do we do that? We visualize a device or equipment to convert the natural or human phenomena. When, people see a bird flying and think of an aero plane that is visualization of a device, which could convert the natural or human phenomena into physical phenomena.

Similarly, inventing a submarine, people looked at a whale or another under sea creature and then developed the concept of the submarine. So, re-visualizing mechanical electrical, electro mechanical, electronic, hydraulic or digital operations, to mimic natural phenomena constitutes visualization.

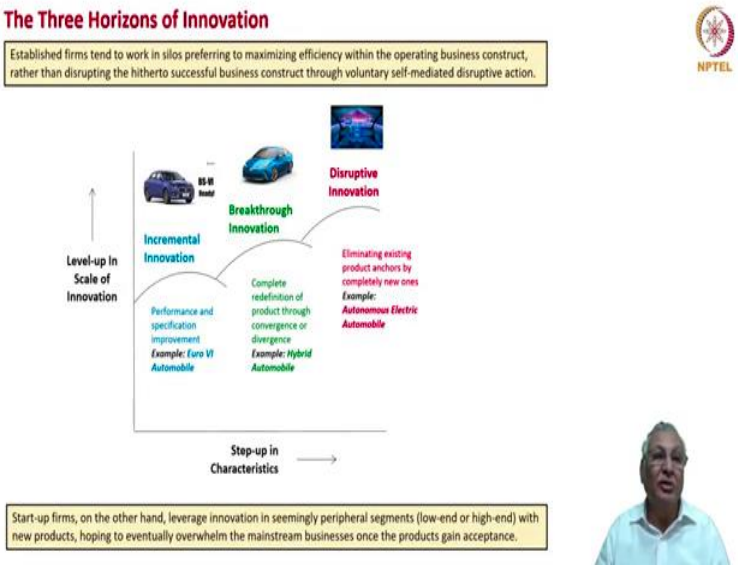
The third is transformation, that is we apply concepts and technologies that are available, and that are native to other industries and other products to develop certain break through products. These kinds of developments transform industries, when valve was changed to diode, diode changed to chip, the entire semiconductor industry came into being. And the way the radios are made, the computers are made, underwent enormous transformation.

Similarly, from manual coding to machine learning is a great transformation, from mainframe to desktop, and from desktop to laptop, and laptop to handheld phones, it is a big transformation. Similarly, from device storage to cloud storage is a great transformative innovation that has happened. However, innovation requires a facilitative ecosystem that supports generation and acceptance of innovative ideas. And, also facilitates the means to convert those innovative ideas into actual product or services.

We are discussing innovation and aspects related to innovation as well as imitation or replication, because a leader must understand that there are several pathways, beyond driving just the business or just the revenues and profits. These are actually the foundational drivers, the core prime movers for a business to first of all coming to being and then for the business to remain competitive and sustainable.

It is therefore, important to understand leadership in these kinds of broader facets, than just dealing with people or getting work done through people as certain leadership theories told us in the previous week's lectures. This is very important perspective that you must keep in mind.

(Refer Slide Time: 20:10)



Let us look at the three horizons of innovation, generally this three horizon concept is an extremely useful aid when we look at the future. This is like present, immediate future and the distinct future. So, when we look at a step-up in characteristics and a level-up in scale of innovation of an automobile on x and y axis respectively.

We can say that an automobile which has been converted into BS 4 to BS 6 that is the Euro 6 fuel efficiency norms. It represents incremental innovation because everything is same, but fuel injection pump has got more electronics built into it. And, then the diesel engine in rail system has got common rail diesel engine system, probably the number of valves have also been increased the so, that there could be better combustion efficiency. So, the performance specification improvement marks incremental innovation.

Then, what is breakthrough innovation which is the next horizon. It is a complete redefinition of product through convergence or divergence. Years ago may be decades ago Toyota came up with hybrid automobile Prius; this involved having a motor along with the IC engine.

When there is a higher requirement for power, the internal combustion engine would operate, but also would provide storable power for the motor. And when there is no need for higher power and torque, the motor would take over, and motor would run the car. And, all this is controlled by an on board computer, this is a breakthrough innovation, but it did not transform the way the automobile industry looks and feels or the way the automobiles are used.

But, the disruptive innovation is going to come, when the entire spectrum of existing industry anchors are eliminated. Because, electrification of the automobile as a native automobile, as a native electric vehicle takes place. And the level 6 autonomy that is there is complete absence of a driver, and the vehicle is on complete autonomous mode takes place.

It is completely disruptive, the existing automobile makers would not be in the business if they do not embrace this disruptive innovation, and reinvent themselves in terms of this disruptive technologies. Established firms typically tend to work in silos. They are comfortable in doing what they have been doing and be happy with the kind of success they ever had through.

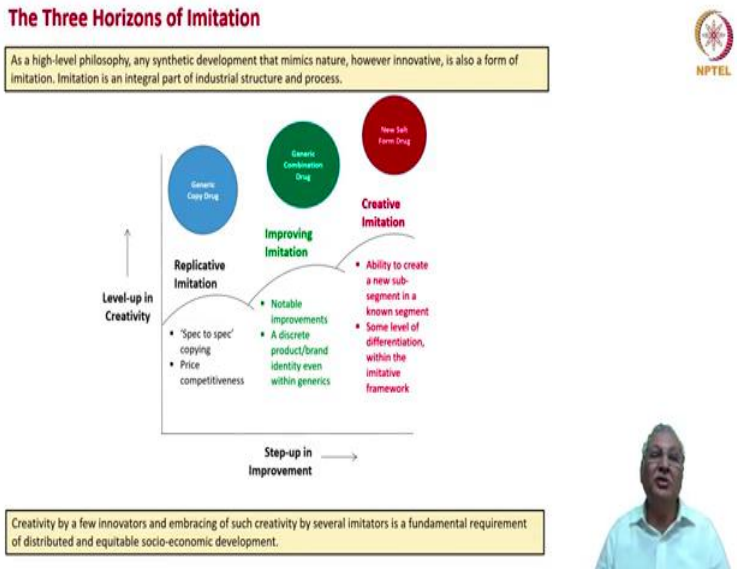
So, the existing successful business construct a rarely disturbed by them in the interest of bringing in newer technologies. Otherwise electric vehicles could have come much earlier, similarly hybrid motors or fuel cell based vehicles or hydrogen based cars would have come much earlier. Because, companies are having a vested interest, so to say, in ensuring that they existing industrial structure is protected and the costs are controlled

and the revenues are reaped. Industries are loathe to change the structures on their own and destroy the edifies they have built with huge amounts of capital investment.

On the other hand, startup firms, they do not have these types of legacy issues, or already established syndromes. They continuously leverage innovation to develop something new and disrupt the existing technologies; usually they come in the peripheral segments.

The startups come with rarely break through disruptive technology at the high end, or they come up with the low end, something which is very disruptive and eventually either way they occupy the main market space through their technological efficiency and effectiveness. These are the three horizons of innovation.

(Refer Slide Time: 23:56)



Like we have three horizons of imitation, we also have three horizons of imitation, I spoke about follower firms which try to develop a product which is almost similar if not exactly similar to the product of the innovator or the differentiator.

Let us take the example of the pharmaceutical industry. If, you make a drug which is an exact copy of the innovators drug after the patent has expired, then you are saying that you have a generic copied drug. It is a copycat drug; it is a spec to spec copying. The advantage of this generic copied drug is that probably, it is made with a patent free process or even if it is patented process over a period of time the cost efficiencies in producing the drug have improved so, much there is price competitiveness.

And also a generic copy maker does not need to invest so much money in research and development as the new drug maker would need to and therefore, there is so much little of the R&D expenses that are put on the cost of development of the generic copy drug. So, there is a price competitiveness.

Then, there is an improving imitation even within imitation, that is there are notable improvements. Let say we have got a drug for controlling nausea and, it is counter intuitive that you could take a drug when you are having severe nausea.

So, if you are able to change this identity by putting it as a patch on your body, then you have enabled a better improvement. But, typically more drugs in this category or combinations. If, you need to take two diabetic drugs with different dissolution profiles and with different pharmacodynamic properties within the body.

If you are able to develop those formulations in such a manner that, the one which has to be taken before food, and the one which has to be taken after food are combined into one drug yet, they act in the same manner as the individually taken drugs. Then you have improved the imitation is of an improvement to variety. Therefore, you can create a particular brand variety even in generic pharmaceuticals, by having novel combination technologies.

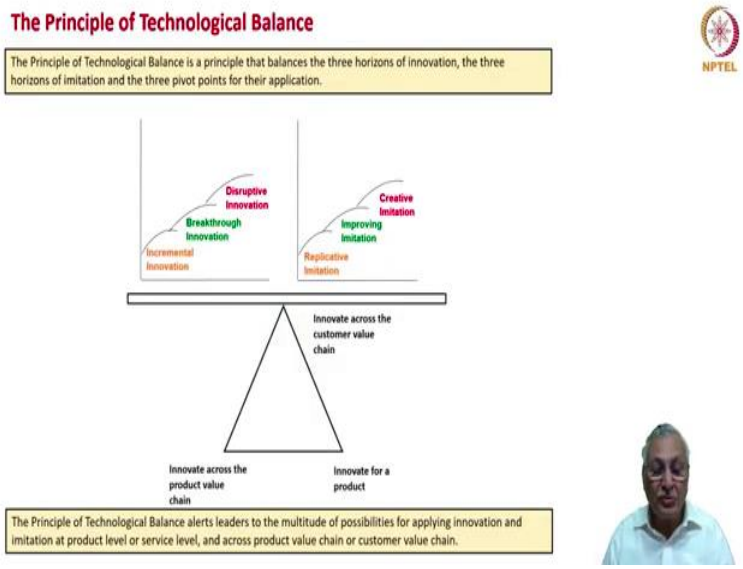
Then, you have creative imitation, that is you have a salt form for the first time, when you develop a drug. But, that salt form could be posing certain difficulties either in terms of the manufacturing process, or in terms of the body absorption characteristics.

So, you develop the same drug in a novel salt form and it could be patentable. Then, you create a new sub segment within the overall therapeutic segment and there is some level of differentiation, even within the imitative framework. So, creativity by a few innovators, embracing of such creativity by several imitators is a fundamental requirement for distributed and equitable socio economic development.

If, every product has to be supplied only through new product development and patent protected for several years, the society cannot develop because, the society cannot have access to affordable products. It is very much important that you have imitators, who operate at different scales of imitative innovation. And provide the masses, the people at

the bottom of the pyramid with the products and services they need that is the importance of the horizons of imitation.

(Refer Slide Time: 27:18)



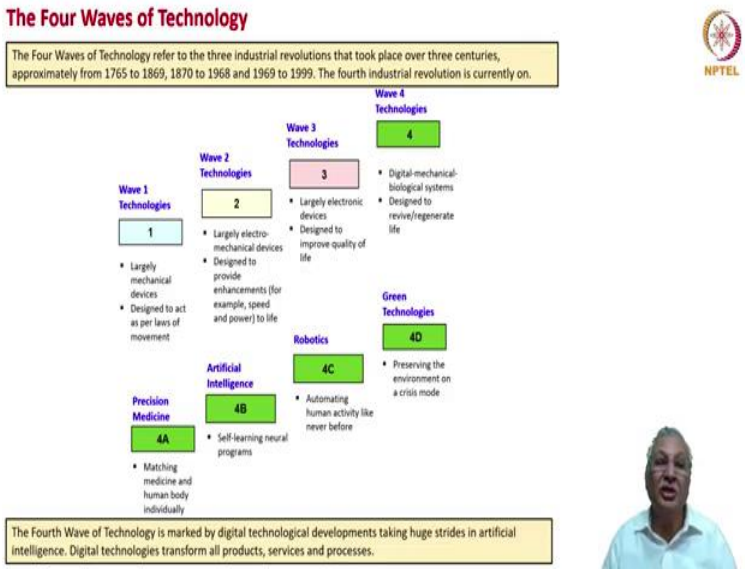
So, there is a technological balance which leader has to keep in mind, when he thinks of using technology for the development of the firm or the industry. So, how to balance incremental innovation, breakthrough innovation, disruptive innovation on one hand, and the replicative imitation, improving imitation and creative imitation on the other hand.

Around the three pivot points which is whether we innovate across the product value chain, innovate for a particular product or innovate across the entire customer value chain. These are the three pivot points or the anchor points for focusing our technological efforts.

So, there is a beautiful combination of innovation and imitation and the pivot points that could be used by leaders to develop a particular technological niche for a firm, which is probably quite different from the one which would be developed by other leaders for other firms.

Therefore, this principle of technological balance has to be kept in mind by leaders. So, that they appreciate the multitude of possibilities that exist, to apply innovation and imitation at product level or service level or at customer level, across the product value chain or the customer value chain.

(Refer Slide Time: 28:31)



Now, let us look at how technology has been developing over last few centuries. When the industrial revolution took place, we had the Wave 1 technologies. These technologies were largely mechanical devices designed to act as per the loss of movement. Then, we had electromechanical devices coming in these are the Wave 2 technologies, these were designed to provide enhancements for example, speed and power to life.

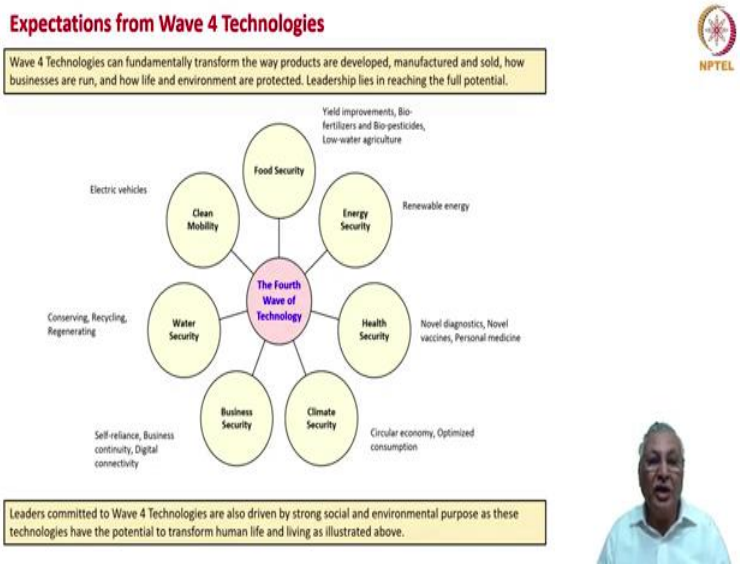
Then, we had the Wave 3 technologies which are largely electronic devices, which are designed to improve quality of life. And finally, today we are having wave, I cannot say finally, because this could also be pre-final or even midterm technologies, when at some point of time in future Wave 5, Wave 6 would come.

Anyway for the present, we have Wave 4 technologies which are digital-mechanical-biological systems, designed to revive, regenerate life. And within Wave 4 technologies, we can look at three or four technologies example. We have precision medicine coming up, that is the gene editing technologies, that is you can edit your DNA profile in such a manner that you are free of the diseases.

Or you can use gene editing to develop a new drugs, or you can match the medicine exactly to the genetic profile that you have, precision medicine. We can have self learning neural programs driving artificial intelligence and machine learning and deep learning.

Then, we can develop robots which are human like with several faculties robots, which can think and act and execute like humans. And most importantly green technologies, to preserve the environment which is now facing a crisis situation. The 4th wave of technology is definitely marked by digital technological enhancements, and they are taking really huge strides. These digital technologies are bound to transform all the products, services and processes.

(Refer Slide Time: 30:25)



Some examples, we have clean mobility through electric vehicles coming up. Food security, through yield improvements, bio fertilizers, bio pesticides and low water agriculture, energy security through huge renewable energy, we need to be proud that the largest solar energy, green energy projects are coming up in India. And, we are likely to have one of the world's biggest bank of renewable energy going forward.

Then, in respect of health security, we are having novel diagnostics, novel vaccines and personal medicine. As far as climate security is concerned, we are moving away are higher from carbon trading to ensure circular economy, optimized consumption, and reducing the temperature increases in the climate.

In respect of business security, we want to be self reliant; we want to be business continuity ingrained in our businesses. We want to ensure appropriate digital security given the pervasive nature of digital operations. In water security we are looking at conserving, recycling, regenerating, including use of sensors for thinks like starting or

stopping of motors in the agricultural fields and, also ensuring how much water should be consumed by different types of plants.

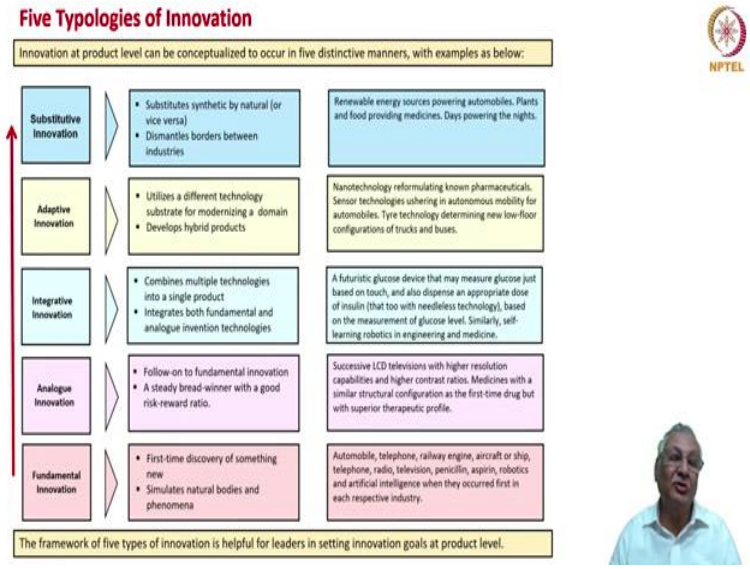
So, these are the ways in which Wave 4 technologies are helping day to day life. These are driven by strong social and environmental purpose, and it is very instructive that many of these developments are being undertaken by startup companies. Particularly in agricultural development, in logistics, climate security things like that.

And, these technologies definitely have the potential to transform human life and living as a listed above. People who want to pursue leadership cannot look at only the existing silos and the existing ways of doing business. And only look at more efficiency and more effectiveness, which definitely is a laudable goal of leadership.

But, we should also keep our eyes and ears open and our mindset open to absorb this kinds of technology. Whichever industry you are in, you need to be moved on to these kinds of developments, a leader who is in automobile industry, cannot ignore the need for clean mobility. A corporation such as ITC cannot ignore the need for food security, water security, climate security, because they are operating in the agricultural field as well.

Pharmaceutical companies and health care companies have to look at health security, as one of the important aspects of improving the medicare for the larger population. We can have several examples of this nature, where Wave 4 technologies will play great part in how leadership is going to differentiate itself from the previous steps of leadership.

(Refer Slide Time: 33:08)



To be able to do that, the leader must have some level of innovative capability, I must again emphasize that a leader need not be a scientist or a technologist. However, a leader must understand the way science and technology works, and should be able to encourage as well as deploy science and technology. So, that new products and new processes and new services can be developed.

Let us see fundamental innovation as the building block. This is the first time discovery of something new, it stimulates natural bodies and phenomena. For the first time, when automobile was invented, telephone was invented, railway engine, aircraft, ship telephone, any number of operators we see, any number of devices which we see, have all been invented for the first time at some point of time decades ago or centuries ago, that is the fundamental innovation. And a leader who pursues fundamental innovation as part of the strategic portfolio, strengthens the business case for the company for the future.

Then, you have analogue innovation, which is a follow on to fundamental innovation, which is a steady bread winner with a good risk-reward ratio. That is ones you get an LCD television, you start creating better LCD televisions with higher resolution capabilities.

Similarly, if you have camera sensors of 5 megapixels, ability to go up to 100 megapixels, is a continuous analogue innovation which is taking place. Similarly, integrating different newer developments in basic technologies leads to improved end

products. From LCD people have moved to OLED and from OLED to super OLED televisions which provide better contrast ratios, better refresh ratios and better pixel density with better life.

Similarly, medicines with similar structural configuration as the first time drug, but with superior therapeutic profile also classifies as analogue innovation. Then, we have got integrative innovation which combines multiple technologies into a single product. It integrates both fundamental innovation as well as analogue innovation.

Let us think of a device such as this, when you want to test your blood sugar and have a corrective insulin shot, what you do, you take a handheld glucometer, then you pick yourself test the blood sugar then decide, what level of insulin you should take and, then take an insulin pen or normal injection and inject yourself, through a needle or a pen needle into your body the required amount of insulin.

On the other hand, let us think of a futuristic glucose device, that may measure glucose just based on touch and also dispense an appropriate dose of insulin and that too with needleless technology, based on the measurement of glucose level. This is going to be a completely new integrative innovation. And the way it occurs is that it need not necessarily be dispensation through just the skin part, it could be through any other way sublingual, lingual.

So, several technological domains have to be integrated to be able to develop such a breakthrough product. Similarly, self learning robotics and engineering and medicine, they bring together several innovative technologies, integrate them into a new product.

Then, you have adaptive innovation, that is you utilize a completely different technology substrate for modernizing a domain and it develops hybrid products. When, you have nanotechnology based on graphene or gold or any other precious materials, you can use that nanotechnology for reformulating pharmaceuticals. And make sure that they are delivered at newer places than the existing drugs or being used for.

Sensor technologies, which bring in autonomy for vehicles that is integration of a completely different technology into the automobile system, lidars, radars, various imaging technologies are getting integrated. Tyre technology determining new low floor

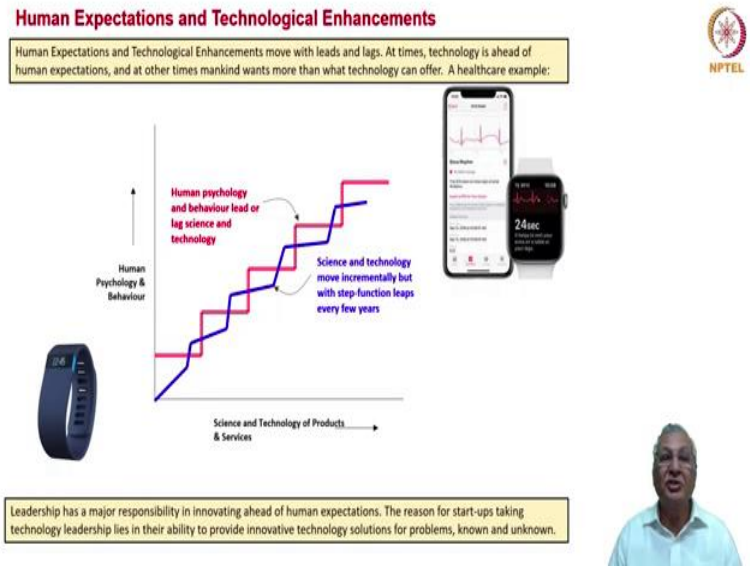
configurations of trucks and buses, one of the main reasons, why trucks are of such height is that they require a huge tyre.

Suppose, you develop a tyre as small as a car tyre, but is capable of taking the load of the bus then, you have found a way to lower the floor height of the bus without going into complex integral bus body constructions or multi-height chassis configuration. So, that is an adaptive innovation, then we have a substitutive innovation which substitutes synthetic by natural or vice versa, it dismantles the borders between industries.

If we have a renewable energy sources which power automobiles, plants and foods providing medicines, days powering the nights. We can say that one entire natural phenomenon has been replaced by a synthetic phenomenon. And, it is also possible to get the other way replacement as well.

So, these are the five types of innovation which are available for leaders, to utilize, leverage through technology. And, it is important that leaders have an innovative mindset and a flare for innovation, even if they are not hardcore technologists or scientists.

(Refer Slide Time: 38:25)



Human expectations and technological enhancements also need to be kept in mind by the leaders. At times, human psychology and behavior lead or lag science and technology based on certain factors. Science and technology moves incrementally, but with step

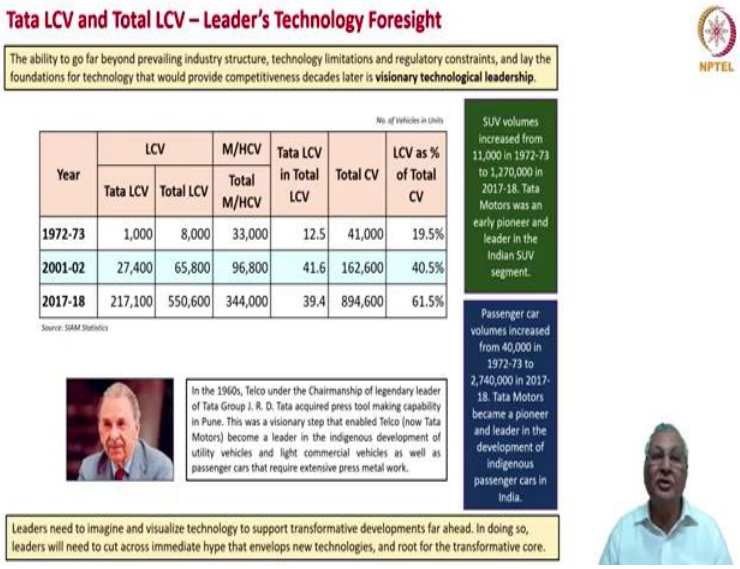
function leaps every few years; whereas, human psychology tends to be linear in its expectations, they do not have the same scientific bent to imagine something which is not there at all.

So, whatever is offered incrementally, the human mind tends to accept; whereas, science and technology while fulfilling that could take huge leaps. So, when we look at the fitness band offered by Fitbit or such other companies, it was a development that exactly gave something which the mankind wanted at that point of time. Still it was not the best solution, because the consumers or the wearers had to use a watch as well as a fitness band.

But, now when Apple offers a watch, which is completely in seamless connectivity with this cell phone and also is connected to the cloud and, is capable of taking ECGs and also warning in case there is some kind of abnormal movement on the part of the person and alerts the emergency services, technology has offered to the consumer more than what the consumer imagined.

So, the human expectations and technological enhancements have a certain lead and lag effect. A good leader tries to ensure that technology is always a head of the human expectations that is the way in which the leader would capture the market for the firm, by bringing out products and services which are far ahead of human requirements. And therefore, they delight the consumers and they provide new experiences for the consumer, they solve problems which are known and unknown.

(Refer Slide Time: 40:21)



I will take an example of leader's technology foresight, in 1960s Telco was the name of Tata motors, under the chairmanship of legendary leader J.R.D Tata acquired press tool making capability in Pune. In fact, in one of the chairman statements he said that dear shareholders, we are making an investment to acquire a press tool manufacturing capability in Pune. And several years later, you will find the importance and utility of this investment proven to you.

And look at the statistics, the commercial vehicle industry had two classifications, light commercial vehicles that is a small commercial vehicles and medium and heavy commercial vehicles which is truck and bus. In India, in the 1970s, the entire industry was dominated by medium and heavy commercial vehicles. And light commercial vehicles, were not made in large numbers and light commercial vehicles typically required a cab, that is the body in which the driver and the co-driver would sit.

In fact, no Indian company had the capability to do a cab all by itself. So, when Tata motors, then Telco acquired this press tool making capability, it also acquired the ability to make LCVs through its own design and manufacturing capability. Similarly, the ability to make sports utility vehicles, the ability to make indigenous passenger cars, all came up because the seat for press tool making and making pressed components was laid in the 60s.

So, you can see the table which is very self-explanatory, in 1972-73 Tata LCV was 1000 and total LCV was 8000. And, in 2017-18 LCVs increased to 550600 and Tata LCV

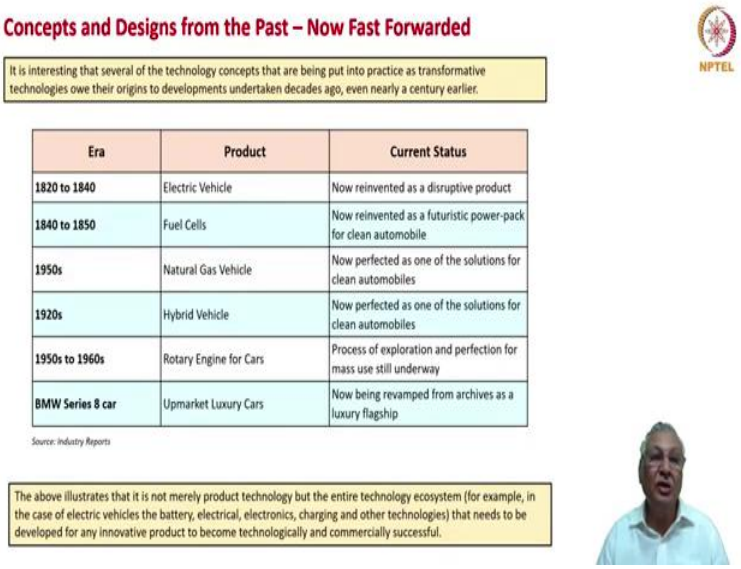
increased to 217100. From a LCV as a percentage of total commercial vehicles it was 19.5 percent at that point of time in 72-73, and it increased to 71.5 percent. That is the shift in transportation patterns in the country favored right commercial vehicles.

And Tata LCV within total LCV as a percentage share was just 12.5 percent in 1972-73, but increased to nearly 40 percent in 2017-18. Why did it happen? Because, it developed successively several LCVs which had cabs and fulfilled the definition of light commercial vehicles 407, 608, 709, later on Ace, Magic and so on. Similarly, SUV volumes it is started as a totally new concept in the 70s from 11000 which was just the Jeep at that point of time, increase now to 1.27 million roughly.

And, in this, Tata motors was an early pioneer and leader. Similarly, the passage car volumes increased from 40000 vehicles in 1972-73 to 2.74 million in 2017-18. Tata motors became a pioneer and leader in the development of indigenous passenger cars. So, what does this reflect? It reflects the technological foresight and the business acumen of a leader at the help, which was J.R.D Tata for Tata group and Tata motors at that point of time.

So, taking a cue from this, I would say that leaders need to imagine and visualize technology that is required to support transformative developments in the future, they should think technologically far ahead. So, that the business is preserved and is grown. They need to cut across immediate hype that envelops new technologies on one hand or also root for transformatively novel technologies at the other end, the leaders have to do both these things.

(Refer Slide Time: 44:02)



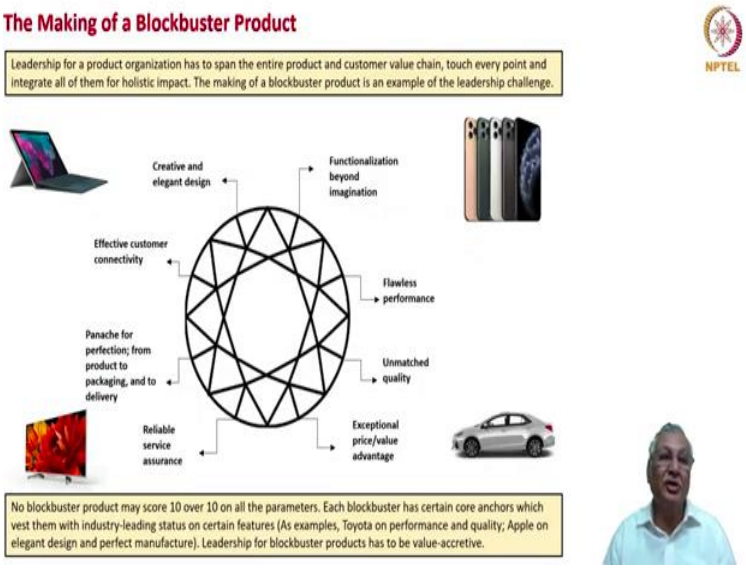
It is not that every concept which is developed would have its use immediately. It is very interesting that several of the concepts, which you see today are also the concepts which have taken place several years even centuries earlier. For example, electric vehicle was developed in 1820 to 1840 era. We are now in 2020, so 200 years ago it was first developed, it is now reinvented as a disruptive product. 1840 to 1850 saw the emergence of fuel cells. Now, fuel cells are being reinvented as an alternative power pack for clean automobile.

In 1950s, we had natural gas vehicles, they are getting perfected as LPG or CNG vehicles only now. In 1920s, we had the first hybrid vehicle, now it is being perfected as one of the solutions for clean automobiles.

Between 1950s and 1960s, we had the first rotary engine for cars. Still it is yet to be made into a perfect IC engine for the cars, BMW series 8 car was an up market luxury car. Now, it is being revamped from the archives as luxury flagship. What does it mean? It means that even if there is a unique technology or inventive technology at one point of time. Unless the total ecosystem is developed in such a manner, that the electric vehicle or the fuel cell or the natural gas vehicle is supported, that technology cannot take route, that is an extremely important point of the past.

This is an extremely important concept that technological developments need to be supported by a broader ecosystem so that they can be appropriately integrated into the main stream technological and business developments.

(Refer Slide Time: 45:47)

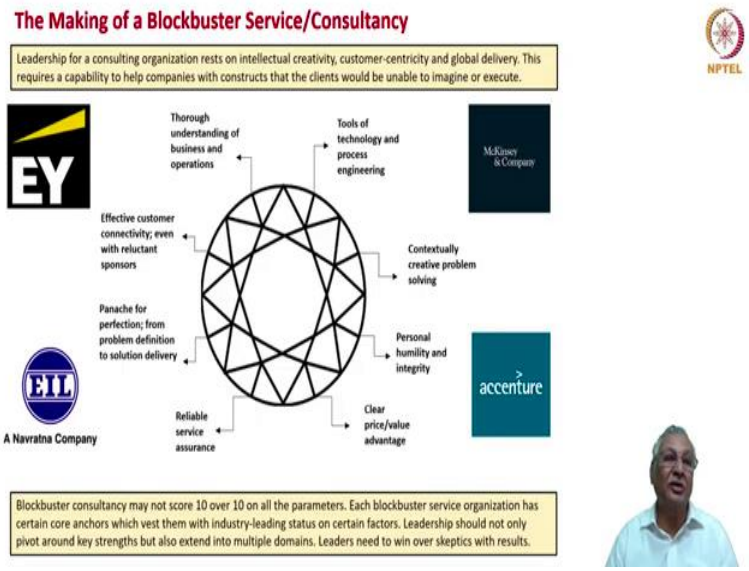


Let us look at what it takes to make a blockbuster product. Here, we have got four types of products, one surface go laptop hybrid computer, we have the famous Apple iPhones, we have got Toyota Corolla, we have got either Samsung Sony or LG LED television. But, if you want to see what has driven these products into a blockbuster status, creative and elegant design, functionalization beyond imagination.

When iPhone was brought in the kind of imagination was easily trumped by the functionality that the iPhone could provide to the customers. Flawless performance, unmatched quality, exceptional price and value advantage, reliable service and assurance, panache for perfection from product to packaging and to delivery. Again exemplified in the case of Apple products, effective customer connectivity, these are all important for making a product a blockbuster product.

Now, blockbuster product may score 10 over 10 and all the parameters, each blockbuster has got certain core anchors and several supportive anchors. Some core anchors provide those products industry leading status on certain features; for example, Toyota on performance and quality, Apple on elegant design and perfect manufacture. Leadership for blockbuster products have to be value accretive, it is not that blockbuster status can be provided only to the products, even services could take a blockbuster character.

(Refer Slide Time: 47:18)



When, you look at this, these are the big service consultancy organizations nationally and internationally Ernst and Young, McKinsey and company, Accenture, EIL. These are all big time management, financial or technology consulting companies. What do they possess? They possess a thorough understanding of their respective businesses and operations. They have got the tools of technology and process engineering. They are able to solve the problems contextually, better than what they clients themselves can never solve.

The consultants have personal humility and integrity; they offer a clear price-value advantage. Because, you avoid the fixed cost of having a special crack team to solve a problem, continuously embedded in the organization. So, you pay more but you pay only particulars point of time. Therefore, over a lifecycle of a new product innovation or a new project consultancy, you have a high startup cost.

But, over when period of time it pays for itself therefore, the lifecycle cost of consultancy, tends to be much cheaper than having in house consultant equivalent employees, that is the price value advantage which consultancy provides. They offer reliable service assurance, there is a panache for perfection as in the case of the product. And that is from the product definition to solution delivery.

And effective connection with the customer, even if the sponsors and clients are reluctant or if some of the core members of the client team or diffident about consultancy, they are

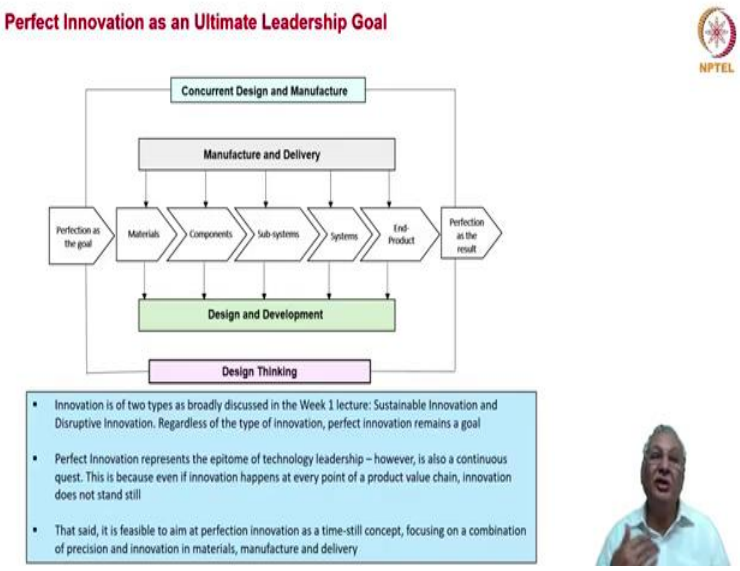
able to provide effective customer connectivity, because they have taken up a job. Again, in this case as well a blockbuster consultancy may not score 10 over 10 in all the parameters.

However, each blockbuster consultancy has got some core capability, like in strategic consulting, or in organization transformation, business transformation McKinsey shines, in respect of knowledge, outsourcing or in ERP consultations in establishing new efficiency and effectiveness paradigms Accenture could be the leader.

Ernst and Young has got a broad spectrum of a financial services that could be offered by them including diligent services. Engineers India limited is a company which is devoted to setting up oil refineries and other engineering projects. And, they have got core technological expertise in that area, you have certain core domains which can be expanded step by step as the consultancy takes route.

And leaders of consultancies have to win over skeptics with results, just as product leaders need to win over customers through the efficiency and effectiveness of their products.

(Refer Slide Time: 50:01)



So, if this is the case, what is the leadership goal, one of the very important leadership goal which is probably super ordinate or which every good leader waded to science and

technology must aspire for is perfect innovation. What is perfection? Ability to do the best based on the available science and technical inputs.

And, what is innovation? Ability to think of something which has not been there at all. So, you have one hand innovating something which has not been there, but also producing it in a perfect manner. So, that it has got the best of quality, best of functionality and provides best of experience in the hands of the customers.

So, if you have a value chain of the company or the product, starting with materials, components, subsystems, systems and finally, the end product. Perfection should be the goal in terms of tolerance, specifications, integrity, reliability, mean time between failure, durability and so on that is perfection, including the look and feel, the form factor etcetera and the result therefore, would be perfection.

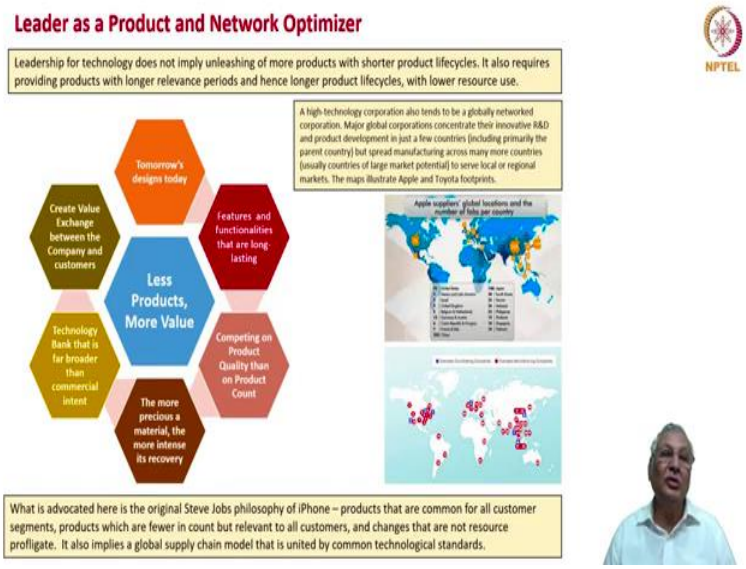
And what are the four schematic systems we have to be able to do that, one is concurrent design and manufacture, second is manufacture and delivery based on the concurrent design and manufacture. Third design thinking which will help a prudential design and development so, that each of these parts of the value chain or done in the best possible manner.

So, we have considered in week 1 that innovation is of two types sustainable innovation and disruptive innovation. Regardless of the type of innovation, perfect innovation remains a goal. Because, there is nothing like perfection, what was seen as perfection few years ago is no longer perfection is ordinary. Newer standards of perfection come into being every year. So, it is a kind of iterative goal which stays before the leaders all the time.

But, combining perfection and innovation as science and technologies available at that point of time, as managerial systems are available at that point of time is the ultimate challenge for a good leader.

And, it should be taken as a time still concept, if I am able to develop a product for 20-21 with the best possible levels of perfection and innovation, I have achieved my goal that should be the concept. It is a combination of precision as well as innovation in materials, manufacture, delivery, co-creation of experience with customers and so on.

(Refer Slide Time: 52:34)



So, if you look at leader, he is just not leader of science or technology, he is also an optimizer of the network of the product. You should be able to have less products in the system and generate more value for the customer, how do we do that? By bringing in tomorrow's designs today. You bring in features and functionalities that are long lasting, you should not throw away the product with just 3 months of use, you should be able to retain the product even for 3 years.

Because, it looks as fresh 3 years has as it is looking now. If, you have consumer surplus well that should be used on a different types of product, rather than just replace with the same product by another product. If you are constantly replacing one smart phone by the other smart phone every 6 months, you are not really improving your lifestyle.

If you are able to use your smart phone with equal proficiency and with equal usability even after 3 years with the same level of status and premium feel. But, you use your savings to have another type of device for example, a watch, a smart watch, or another health companion. Then, you are improving or widening your lifestyle and quality of life on different parameters, just substituting one product by the other over shorter spells of time is not good for either the society or the firm.

Therefore, you should be able to get features and functions in a product which are of long lasting nature. Then, you should compete on product quality rather than on product count, there is no point in segmenting the market so much and gaining some volumes.

You should have perfect quality for the product and therefore, occupy more of the market space.

And the another important factor is that the more precious a material, the more is intense should be the recovery. If cobalt is the precious material, which is going to be used in an electric battery or if several rare earths are being used in newer devices, smart devices. Then, you should have the ability to extract more of them and recycle them, that is one of the technological requirements of using less products and more value, and when we say less products, it also will be less materials.

And, you should also have a technology bank that is for broader than the commercial intent, you should have a technology bank which can develop many more products than what you are intending to put in the market or what the consumer needs, that only gives you the flexibility.

That is the R&D funnel should be pretty wide and pretty deep, even though you are manufacturing portfolio is a bit narrower. And, you should always create value exchange between company and the customers that is extremely important.

When, you look at the Apples suppliers' global locations and the number of hubs per country, you can see how the networking has taken place, similarly with Toyota. So, a high technology cooperation which is led by futuristic leaders tends to be a globally network cooperation, they concentrate their innovative R&D product development in a few countries.

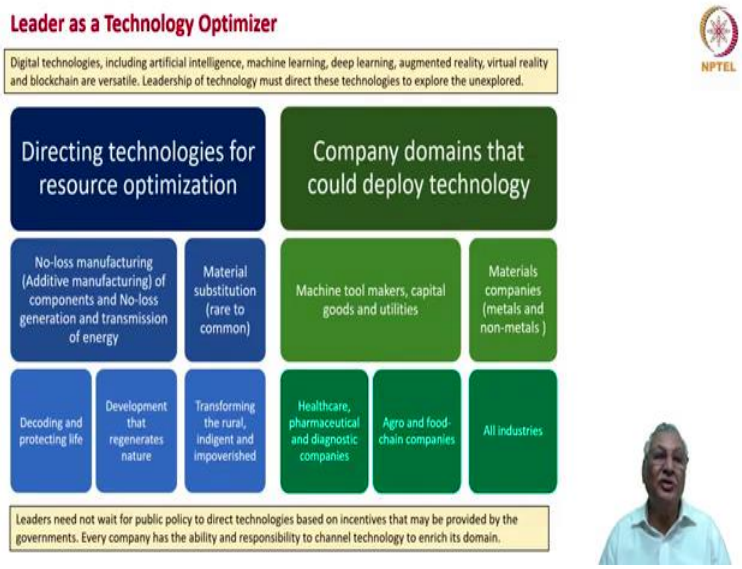
But, they have distributed manufacturing activities and also regionally spread out marketing network. So, you are able to balance or integrate, the local and regional markets both by design and manufacture on one hand and offering products on the other.

So, what is advocated here is the original Steve Jobs philosophy of iPhone. Products that are common for all segments, whether it was a managing director, or a person at the very beginning of the career or even a chauffeur, iPhone was a common product. There was no differentiation between an iPhone offered for the managing director and an iPhone offered for the driver. Yet nobody felt that it was in infra dig, or it was overdone to use an iPhone.

There was no premium loss, because the driver and the MD use the same kind of iPhone that is the excellent philosophy of Steve Jobs, that is ability to let the customer own the product regardless of the standardized design. Because, the features and functionalities, completely satisfied what the user wanted, not only that, in terms of the manufacturing, efficiency supply chain efficiency by having all the other features which we have discussed.

The entire value chain was optimized, and the revenues as well as profits or maximized. And, today Apple is looking at several ways of extracting the rare materials from the iPhones. So, that the planet is protected to whatever extent it can be protected, despite the increase, in the iPhones and other smart devices that are being produced and sold.

(Refer Slide Time: 57:23)



So, when leader has the role of the technology optimizers. What should they do? There must be two things which should be done; one, should understand where technologies can be used for resource optimization. One of the ways is to ensure no loss manufacturing, that is when you machine a rock forging into a finished component you lose lot of material.

Instead of that why not do 3D printing of the component directly with powder material to the exact specifications required. Similarly, energy when it is generated and distributed so, much loss takes place, can we have no loss generation transmission of energy. If such

directive technology is possible, machine tool makers and capital goods and utilities companies would have application of those technologies within their selves.

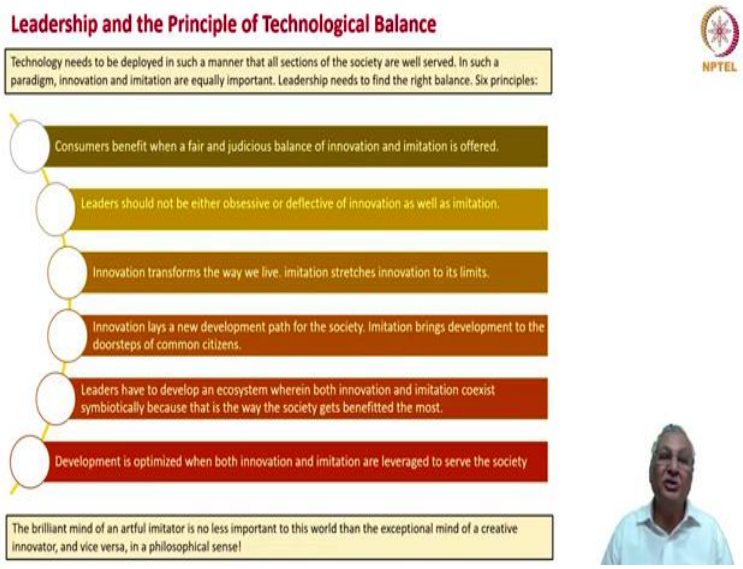
So, the company domains and technology domains get interrelated. Similarly, materials substitution from rare materials to common materials, then a whole lot of material companies' metals and non metals would benefit. Decoding and protecting life would support health care and pharmaceutical and diagnostic companies. Developments, that regenerate nature help agro and food chain companies.

Transforming the rural indigent and impoverished sections of our society, a whole spectrum of industries can participate. If, in the COVID situation, several fast moving consumer goods companies and several other companies survived in a reasonable fashion, it is because of the rural inter land.

It provided the necessary economic support through agriculture and other activities, and also the income generation. To use the products that are being manufactured in the urban areas and semi urban areas. So, leaders need not wait for public policy to say how technology must be used, to optimize the industrial system.

Leaders by themselves should plan ahead and use technologies, to develop appropriate solutions and product offerings for customers. Technology must be used as an instrument of public policy, even before the governments could use those instruments of public policy.

(Refer Slide Time: 59:33)



So, what is the connection between leadership and the principle of technological balance, we have been discussing so far. All sections of the society should benefit for that both innovation and imitation have to be equally handled, they are both equally important, the right balance has to be formed. There are 6 principles for having the right balance between innovation and imitation.

Fundamentally consumers benefit, when a fair and judicious balance of innovation and imitation is offered in the industrial workplace and also in the market place. Leaders should not be either obsessive or deflective of innovation as well as imitation. Some leaders tend to be all innovation oriented, some people tend to be all imitation oriented. Some leaders want to make only niche products with high profit potential, but low volume requirements.

Leader should not take any of those extreme viewpoints, they should openly embrace appropriate levels of innovation and appropriate levels of imitation so, that this pyramid structure which I mentioned that is three types of innovation, and three types of imitation or anchored around three points where the innovation and imitation could be used. So, that the firm gets the best out of science and technology deployment.

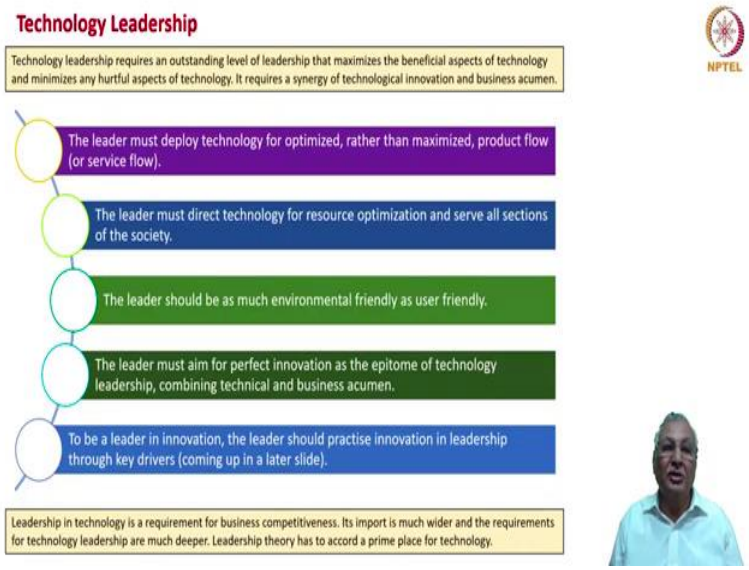
Because, innovation transforms the way we live, we should not say that we should always go by innovation. Finally, imitation stretches innovation to its limits, as I said innovation opens up an industry, but imitation brings the industry to the door steps of the masses, important. Innovation lays a new development path for the society whereas,

imitation brings development to the door steps of common citizens, bottom of the pyramid happens, because of imitation.

But, creative imitation increases that potentially even more and leaders have to develop an ecosystem, wherein both innovation and imitation can coexist symbiotically. So, because that is the way the society gets benefitted the most. And development is optimized, when both innovation and imitation are leveraged to serve society.

So, I would conclude this particular theme with a philosophical statement. The brilliant mind of an artful imitator is no less important to this world, than the exceptional mind of a creative innovator and vice versa in a philosophical sense. This principle, we need to keep in mind as we pursue technology and science, and also innovation and imitation as part of our leadership responsibilities.

(Refer Slide Time: 62:05)

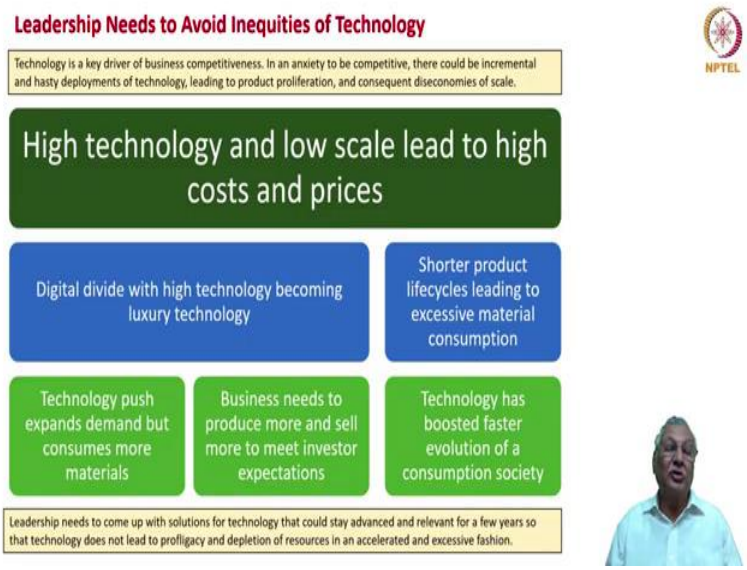


To be an effective technology leader, the leader must have an outstanding appreciation of the beneficial impact of technology and also the deleterious activities that could happen because of technology. For that, we should have an understanding of how technological innovation and business acumen could work together through a synergistic combination. So, the leader must deploy technology for optimized product flow or service flow, not necessarily for maximized product flow or service flow.

The leader must direct technology for resource optimization and serve all sections of the society. The leader should be as environmental friendly as user friendly. The leader must aim for perfect innovation as the epitome of technology leadership, combining technical and business acumen.

And to be a leader in innovation, the leader should practice innovation in leadership through key drivers, which will come up at a later stage. Leadership and technologies is extremely important for business competitiveness. Its import is much wider than requirements for technological leadership being deeper. And leadership theory has to accord lot of importance and provide a prime place for technology.

(Refer Slide Time: 63:17)



Primarily we should also avoid the inequities of technology, when you have high technology and low scale there will be high costs and prices, there will be digital divide. When, high technology is applied, let us say overly in urban areas, let say in education or work from home kind of office situations digital divide increases.

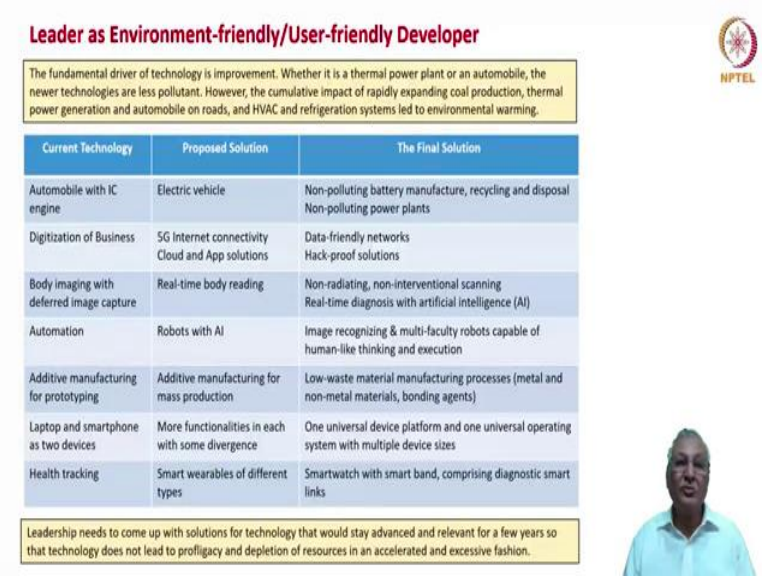
People who come from far off areas or people who do not possess laptops and computers, they are handicapped they are impoverished in this new digital world. So, high technology and low scale is not the solution, we should have high technology, but it should be available for the masses.

Similarly, having shorter product lifecycles just to keep the customer enthusiasm up and running is also not good, because it leads to excessive material consumption. You may through technology expand demand. But, beware it consumes more materials. Business needs to produce more and sell more in this paradigm to meet investor expectations.

And, also it will lead to a consumer oriented or materialistic consumption-oriented society which is also not good. So, leadership needs to come up with solutions, so that technology satisfies the consumers at all times, but also conserves on the resources that would be used for production of products or delivery of services.

Profligacy in the use of resources, depletion of resources in an accelerated and excessive fashion could result from technology. And leader should be open, objective and clinical about this aspect of technology, they should not use technology just as a tool to increase production or improve customer mindset. They should use technology not only for product development and service development, but also for preserving the natural resources as much as possible.

(Refer Slide Time: 65:08)



So, when you think of an environment friendly, user friendly developer, whether it is a thermal plant or an automobile the newer technologies tend to be less pollutant. But, the cumulative impact of rapidly expanding coal production, thermal power generation, automobiles on the roads, increase in HVAC and refrigeration systems lead to environmental warming.

If you compare Euro 6 emission norms with the Euro 1 emission norms, there is a huge difference in terms of the pollutants that are getting controlled. The pollutants today are just a fraction, when you use to have black smoke in the Euro 1 vehicles.

Today, you have clean air coming out of the Euro 6 vehicles or Bharat 6 vehicles provided proper fuel is being used. And the engine and vehicle are kept in a finely tuned condition. Now, that is an improvement, but the number of vehicles on the roads has been going up at such a phase that all this is not sufficient to control the climatic conditions for the benefit of the people.

So, we need an automobile with IC engine, no doubt, until electrical vehicle comes full hog, but you must see how the electric vehicle can be supported. Therefore, you need a non polluting battery manufacture, because making batteries and then discarding them. And using energy sources, using natural resources in production of batteries is not the solution. Therefore, you should have a non polluting battery manufacture, recycling and disposal.

Similarly, you should have non polluting power plants because battery charging requires, more power generation and the distribution and that should not be cause of newer levels of pollution. Therefore, you should also have nonpolluting power plants, that is the leadership thinking spectrum, that you must have. You are doing digitization of business you need 5 G internet connectivity, cloud and app solutions as the proposed solutions. For that you need data friendly networks and hack proof solutions.

Similarly, when you want to do body imaging with deferred image capture, which is the current technology to be changed to real time body reading. You require non radiating, non interventional scanning, because when you are scanning real time.

You cannot afford to keep the radiator, radiating part of the equipment focused on the body. Because, radiation load will be excessive and could be cancer causing. Therefore, you require non radiating, non interventional scanning with real time diagnosis with artificial intelligence so, that the NC 2 diagnosis can be extremely fast. And from today's automated technology when you go for robots with artificial intelligence, you should have the image recognizing facility, multi-faculty facility for the robots. And you should have human like thinking and execution.

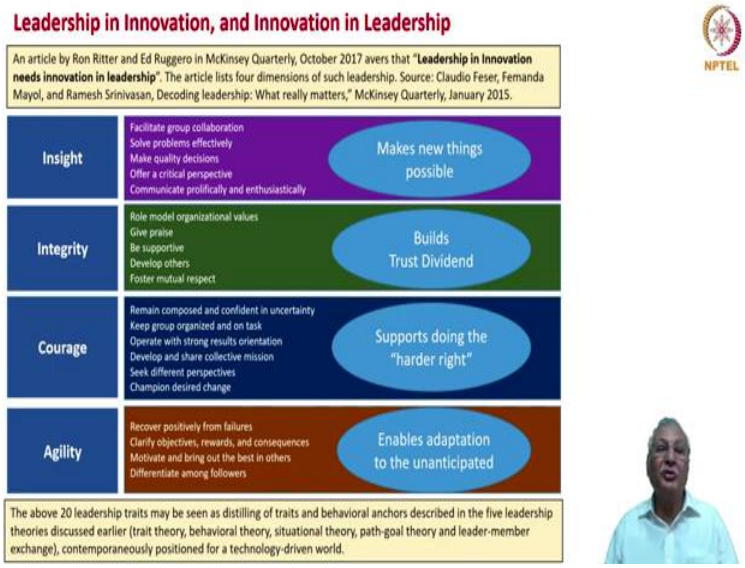
When you think of additive manufacture, it is now use only for prototyping, how can you make it for mass production that is the proposed solution. Therefore, you should have low waste material manufacturing processes providing materials which can glue themselves to each other, with appropriate bonding agents to provide high strength additive manufactured components.

Laptop and smart phone are two devices, you should have convergence at some point of time with one universal device platform and one universal operative system, sizes only may differ. But, the entire hardware and software could be the scaled up or scale down version of the same user friendly and powerful operating system with hardware.

Health tracking, smart wearables of different types, but you could have a smart watch which does certain smart watch functionalities and a smart band which could do certain other things. So, the entire system of smart watch and smart band could be made a very productive, efficient health companion for beyond what is being envisaged at this point of time.

Therefore, leadership needs to come up with solution for technology that would stay advanced and relevant not for this year or next year, but for a few years. So, that technology does not lead to profligacy and depletion of resources in an accelerated and excessive fashion.

(Refer Slide Time: 69:19)

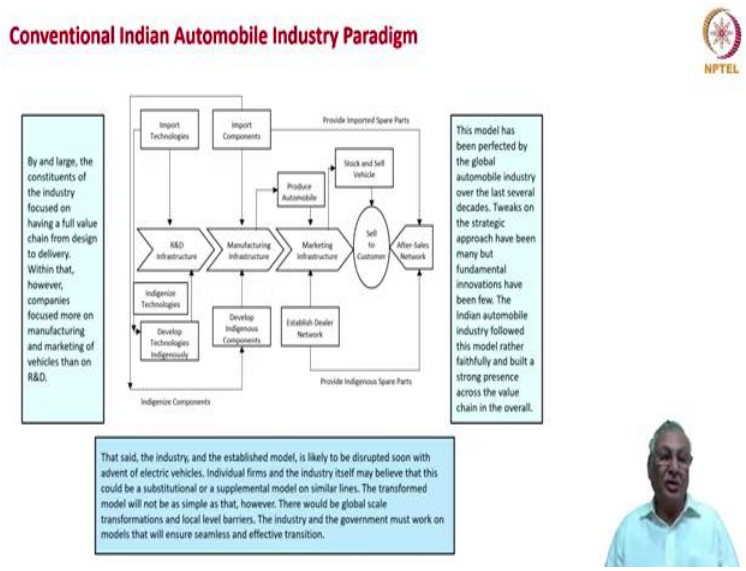


So, if you want to be a leader in innovation, you also need to have innovation in leadership. McKinsey in one of its articles has taught about four areas, where there could be innovation in leadership, one insight, second integrity, third is courage and fourth is agility. Insight is making new things possible, that is the innovation part of the whole organizational exercise.

Then integrity, that is a way of doing products, a way of providing services that builds trust dividend. Courage, which is supporting, doing the harder right, that is right things are always harder to do. And therefore, you should have courage as a leader to support people do the harder right and agility, ability to adapt to the unanticipated that is extremely important.

And these are the more detailed explanators for these clusters. And, if you see these things probably you can relate these things to some of the traits and the behavioral factors, which we have discussed in the previous leadership theories. But, they have been suitably modified for today's science and technology driven business situation.

(Refer Slide Time: 70:29)



I would like to conclude this leadership discussion with reference to technology leadership, with an example of the transformative industry paradigm. Let us look at the conventional Indian automate mobile industry paradigm. Today, we have R&D infrastructure which produces IC engines and related components through a

manufacturing infrastructure. And, they are developed and sold through dealers through customers.

There is an importation of components depending upon the level of technology. And a huge number of components are actually made in India itself, we have after sales network which is operated through the established dealer network. And, there is always the emphasis and indigenizing the imported components. And also providing spare parts as a parallel solution, by and large the entire industry is focused on a full value chain from design to delivery.

And some companies have focused more on manufacturing and marketing whereas, some companies have focused more on R&D manufacturing. And very few companies have focused on the entire value chain, some companies, which are subsidiary of the foreign companies have chosen to import technologies and CKD kits; whereas, some other companies such as Hyundai decided to indigenize those as well.

This model of design to delivery along with the dealers and vendors through a judicious mix of outsourced and in house production has been optimized and perfected, by the global automobile industry over the last several decades. There could be tweaks in the strategic approach between different companies, but the overall the theme and the nature of the drive of innovation remains the same.

Model changes every couple of years and improvements to fuel economy emission levels every few years, meeting the public policy requirements. These are the standard practices that the automobile industry adopts, that said the industry and more particularly established model is likely to be disrupted soon, with the advent of electric vehicles and in the developed world with the additional advent of autonomous automobiles.

Individual firms and industry itself may believe that it could be a substitutional or a supplement model on similar lines, that is I have this model, I will also have the electric vehicle model as a niche portfolio. Some people may say that the job could be simplified by removing the IC engine and putting an electric power.

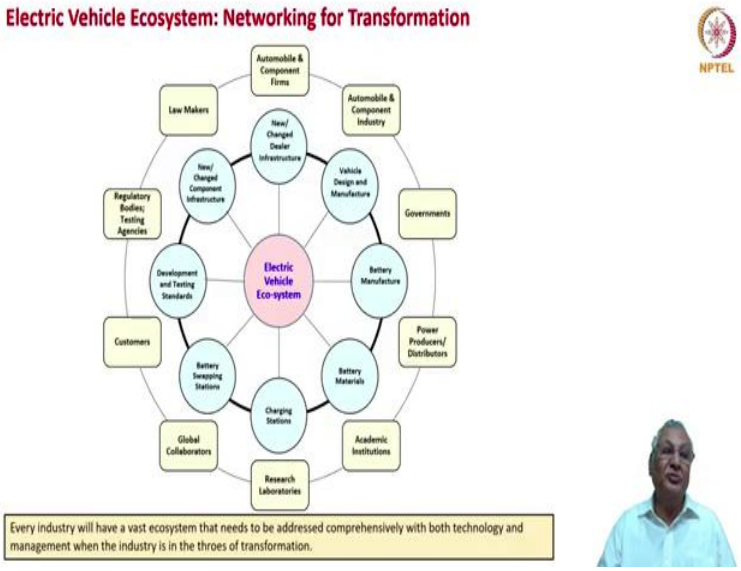
And making only those minimally required changes that are required to make it going as an electric vehicle, but it is not as simple as that. Because, there would be global scale

transformation in this electrification drive, there would also be local level barriers, there would silos and there would be also vested interest.

The industry and the government must work on models that will ensure a seamless and effective transformation. Because, it is like no other transformation, it is not like substituting one type of gear box with another type of gear box, or one type of engine with another type of engine. Or one type of material with another type of material, it is completely new industrial system that is going to be brought.

And the nature of the industrial system is so, comprehensive that it cannot also be brought in within just 1 day or 1 year, it requires a phase in of a new system and phase out of the new system. And, it is also not possible for a single end product manufacture to develop an electric vehicle; it requires a score of ecosystem entities that need to be collaborating on this.

(Refer Slide Time: 73:59)



This slide for example, focuses on the electric vehicle ecosystem. You require from the automobile and component firms to the automobile and component industry itself. The governments, the power producers, distributors, academic institutions, research laboratories, global collaborators, customers, regulatory bodies, testing agencies, law makers to collaborate.

So, that an electric vehicle is brought out, it is homologated, it is tested its safety and durability is proven and finally, is made available for the consumer. With the same level of confidence as an automobile, which is tried and tested for decades is being offered today, that is the kind of difference which is there that is on the cards. And to be able to do that, several processes have to change, the dealer ecosystem has to change, new type of dealer infrastructure has to come.

The processes of vehicle design and manufacture change. The guys you have to deal with are no longer the same as the guys with whom you have been dealing with in terms of new component development. Battery manufacture becomes an extremely important aspect of electric vehicle development and to be able to manufacture batteries, you need a new wave of battery materials.

Then, you need charging stations, again new technologies and cooperation with the power producers and power distributors. You require battery swapping stations in one type of solution for the electrification. Then, you have to develop a new testing standards, new quality standards for electric vehicles including crash methodologies.

And, also understanding the total lifecycle carbon neutrality of electric vehicle manufacture from the time the components are manufactured to the time the entire vehicle is disposed off, which means a huge canvas of work that needs to be done covering all these stakeholders.

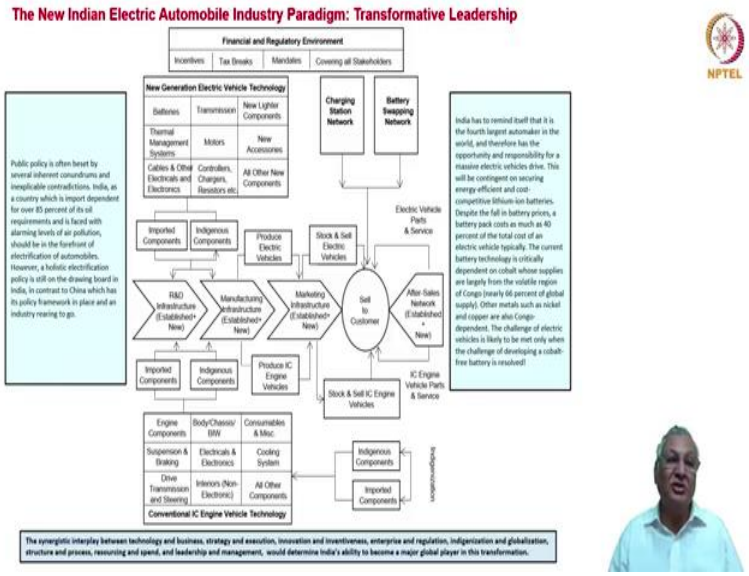
It also means, that the entire component infrastructure industry, which is there today like you may not, you won't require a crankshaft, you don't require a camshaft, you do not require an engine at all and the gear box will be super seated by a power train in system which is suited for electrical.

And a whole new breed of sensors will be required, a whole new breed of chargers and motors would be required, the electric systems will change, body materials may even move from more steel to aluminum to reduce the weight.

The way the engine is positioned, it will require different types of suspension systems. Everything related to the car, commercial vehicle or the utility vehicle would completely change; that means, that you are rediscovering yourself, from an industrial point of view. When that is the change that is going to come, imagine how the automobile industry

which is facing in the electric industry. And also facing out the IC engine based industry would look like, this how it would look like.

(Refer Slide Time: 76:57)



It simply doubles itself, you have the existing infrastructure and you are going to have the new generation electric vehicle technology. R&D infrastructure has to take care of both the established and new, manufacturing infrastructure also has to take care of both the established and new and so, does marketing infrastructure. You should have the ability to sell directly to the customer, if necessary, because, these are the newer digitally savvy products that the customer may appreciate directly.

The new generation electric vehicle technology, we will have a high preponderance of imported components potentially, batteries, transmission, new lighter components. Thermal management systems, motors, accessories, whole new series of a cables, controllers, chargers, resistors all other new components. Then, you have the supplement of charging station network, battery swapping network.

And the financial regulatory system which automatically operates today, suddenly becomes again totally new financial system or new regulatory system. You require incentives, you need tax breaks, you need mandates, these have to cover all the stakeholders. And there would need to be new systems and procedures to check the eligibility and also distribute those incentives.

At the other end, you still have to run your existing infrastructure, because millions of automobiles cannot be electrified in just one go, in one financially year. So, the existing automobile industry would also continue to be operating which means, what if you have six plants, probably at some point of time you require at least four more plants.

To meet the requirements of about the new infrastructure of electric vehicles, as well as the existing established infrastructure that is the challenge. And, public policies often beset by several inherent conundrums and inexplicable contradictions. With over 85 percent dependence on imported oil, India should be amongst the first countries to welcome electric vehicle development and it should be in the forefront of that.

Yet the policy on electric vehicle development is not at forthcoming with vigor and enthusiasm either from the automobile manufacturers, or from the government or from the industry associations or from all the stakeholders together; that means, that the level of preparedness with reference to the kind of transformation that is required is not there.

However, we have to remind ourselves that we are the fourth largest automobile manufacturers. We are the fourth largest automaker in the world. Therefore, we have the opportunity and also the responsibility for a massive electric vehicles drive, it will be contingent on several of these new age components from batteries to the new accessories being available. Battery prices are bound to come down, but still that must be the most important number in the overall cost of the electric vehicle.

Not only that the batteries will be made with materials from hardly controlled regions such as Congo for example, and having access to those materials itself is a challenge. When, the challenging aspect of developing a cobalt free battery is resolved.

Therefore, while we think that electric vehicle is available as a solution, this solution is probably is going to elude unless you find a solution for the real, non polluting, safe and energy dense and energy powerful battery, with long range that is the requirement, which means that our emphasis should be more on the batteries and related components than on the electric vehicle per say.

The pull effect could be there, but the push effect of developing a brand new electric vehicle component and other ecosystems is extremely important. These are the kinds of

transformational challenges leader's face, when they are in the industries which are likely to be subject to major transformations.

To be able to do that, the leaders have to have lot of capability, to get synergy out of number of factors there is going to be synergistic interplay between technology and business, strategy and execution, innovation and inventiveness, enterprise and regulation, indigenization and globalization, structure and process, resourcing and spend, leadership and management to be able to achieve these kinds of industry transformations.

So, my submission to you is that we should not look at leadership as just as simple domain, or a simple responsibility which involves managing people. If you manage few people you are a manager, if you manage an organization you are a leader. No, that is a very simplistic view of leadership life. Leadership life involves facing multiple factors, multiple stakeholders and taking charge of the situation.

We have discussed at the beginning of this lecture, five factors or five forces, which the leader must need to manage, of which technology has been discussed in detail. And to be able to achieve an industrial transformation on the basis of technology, I said that we require all of these things to be in synergistic interplay and that is the leadership responsibility and that is a leadership opportunity.

In the other lectures, we will talk about the other four aspects of sustainability in leadership development, sustainability in making leadership work and ensuring sustainable growth for companies that would be the topic for our forthcoming lectures this week.

Thank you.