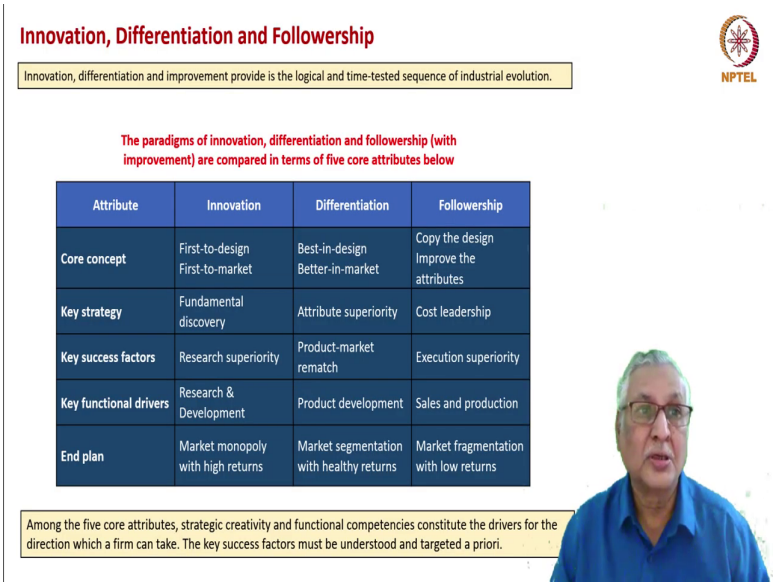
Business Development From Start to Scale
Prof. C Bhaktavatsala Rao
Department of Management Studies
Indian Institute of Technology, Madras

Week - 11
Strategies for Markets and Industries
Lecture - 52
Growth Examples

(Refer Slide Time: 00:29)



Attribute	Innovation	Differentiation	Followership
Core concept	First-to-design First-to-market	Best-in-design Better-in-market	Copy the design Improve the attributes
Key strategy	Fundamental discovery	Attribute superiority	Cost leadership
Key success factors	Research superiority	Product-market rematch	Execution superiority
Key functional drivers	Research & Development	Product development	Sales and production
End plan	Market monopoly with high returns	Market segmentation with healthy returns	Market fragmentation with low returns

Hi friends, welcome to the NPTEL course, Business Development from Start to Scale. We are in week 11 with the three more Strategies for Markets and Industries. In this lecture, the 52nd in the series, we cover the topic of Growth Examples. We have considered in earlier lectures three important technological strategies, innovation, differentiation and followership.

We also understood through our discussions earlier that technology is the prime developer of new industries. These three paradigms are compared below in respect of certain key attributes. What is the core concept in respect of innovation? It is being first to design and being first to market.

Differentiation aims at being best in design and better in market. Followership looks at copying the design, but improving the attributes. The key strategy of innovation is fundamental discovery. That of differentiation attribute superiority, and in respect of followership, it is cost leadership.

The key success factor for innovation is research superiority. For differentiation, it is product and market rematch. And for followership, it has to be execution superiority. The key fundamental functional drivers for innovation relate to research and development as a discipline, as a domain. For differentiation, it is development of products. And for followership, it is sales and production.

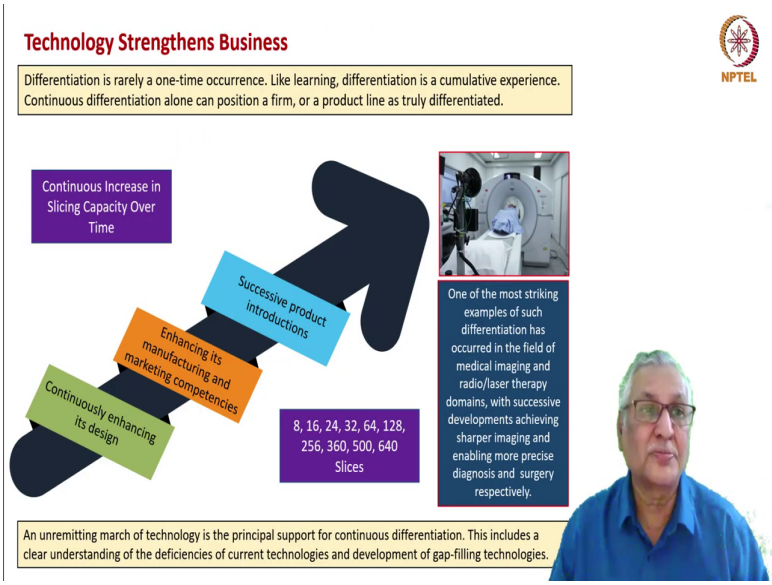
The end plan or the end game, as you may call it, in respect of innovation, is market monopoly with high returns. For differentiation, it is market segmentation with healthy returns. And for followership, it is market fragmentation with low returns. From this itself, you can understand how industries get formed.

Innovation provides the basic nucleus based on which a firm develops itself to a near-monopoly state and looking at the success enjoyed by the innovator firms, differentiated firms coming to play. They do better than the innovator in respect of certain areas and they are on par. In respect of certain other areas and possibly they could also be inferior in respect of certain other aspects compared to innovation. Yet, they expand the market. They become powerful new clients by themselves.

Once the patent monopoly is over, followership takes over and the industry expands beyond leaps and bounds. Among the five core attributes, strategic creativity and functional competencies constitutes the key drivers for the direction which a firm can take. The key

success factors must be understood and targeted a priori based on the technology strategy that is being followed.

(Refer Slide Time: 03:07)



Technology strengthens business. From this slide onwards, I will provide you with several examples how industries have been reinforced. New industries have been created based on technological business and managerial innovation. Differentiation is rarely a one-time occurrence. Like learning, differentiation is a cumulative experience. Continuous differentiation alone can position a firm or a product line as truly differentiated.

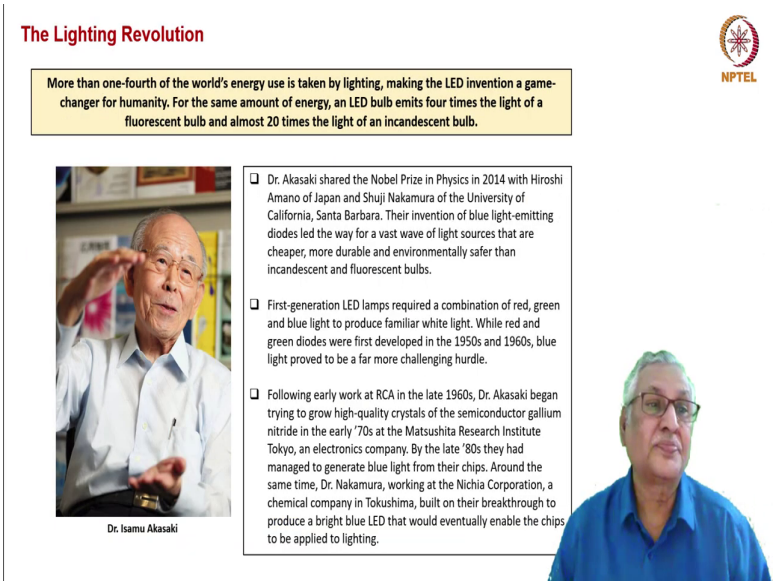
Let us look at the imaging equipment which are used in hospital settings. This has been one of the most striking examples of differentiation. That has occurred in the field of medical imaging and radial laser therapy domains with successive developments achieving sharper imaging and enabling more precise diagnosis and surgery respectively. The imaging

equipment started with 8 slices moved to 16, then to 24, 32, 64, 128, 256, 360, 500 and now 640 slices a CT scans are commonplace.

So, there has been a continuous increase in slicing capacity over time, which has enabled medical diagnostics take an important step ahead in terms of understanding the disease patterns. An unremitting march of technology is the principle support for continuous differentiation.

That happens based on continuous enhancements in designs, continuous enhancements in the manufacturing and marketing competencies and successive product introductions. A clear understanding of the deficiencies of the current technologies and development of gap bridging technologies is part of the technological endeavour for any company.

(Refer Slide Time: 04:57)



Let us look at the lighting revolution. More than one fourth of the world's energy used is taken by lighting and this makes the LED invention a game changer for humanity. For the same amount of energy an LED bulb emits 4 times the light of a fluorescent bulb and almost 20 times the light of an incandescent bulb. This research was carried out in the universities.

Doctor Akasaki shared the Nobel Prize in Physics in 2014 with Hiroshi Amano-san of Japan and Shuji Nakamura-san of the University of California, Santa Barbara. Their invention of blue light emitting diodes led the way for a vast way of light sources that are cheaper, more durable and environmentally safer; lighting devices than incandescent and fluorescent bulbs.

The first generation LED lamps required a combination of red, green and blue light to produce the familiar white light. While red and green diodes were first developed in the 1950s and 1960s, blue light proved to be a far more challenging hurdle. Following the early work at RCA in the late 1960s, Doctor Akasaki-san began trying to grow high-quality crystals of the semiconductor gallium nitrite in the early 1970s at the Matsushita Research Institute Tokyo, an electronics company.

By the late 80s, they had managed to generate blue light from their chips. Around the same time, Doctor Nakamura-san working at the Nichia Corporation, a chemical company in Tokushima, built on their breakthrough to produce a bright-blue LED that would eventually enable the chips to be applied to lighting. Therefore, the universities provided, along with research centers, a great breakthrough for the humanity in terms of energy, generation and energy usage.

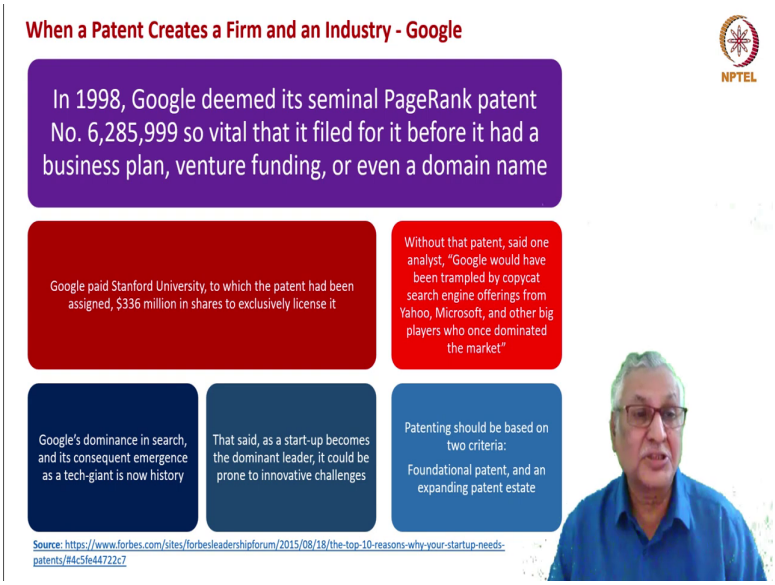
(Refer Slide Time: 06:52)

Let us consider strategic improvement as one of the things which makes a firm take root. Improvement considers the pioneer success as a directional trend rather than as a strategic template or a winning formula. Let us look at the Indian industrial scene, particularly the automobile industry. The first-ever introduction of small car by Maruti Suzuki in the 1980s has been a pioneers action in an industry dominated by the highly dated designs of the 1940s.

Introduction of a tall by small car Santro by Hyundai in the 1990s, a good many years thereafter, has been an example of strategic improvement. It is not total differentiation, however. Forms that are seeking to follow competitive improvement must spend considerable time analyzing the product market space and the factors influencing evolution of the industry. And this is as opposed to adopting a quick fix solution of replicating the pioneer strategy.

The initial triggers for improvement tend to be the same as the drivers for followership, namely, market space and pioneer success. However, the drivers for strategic improvement are notably different. The difference between 800 CC Suzuki car and the tall boy small car are evident for you to see.

(Refer Slide Time: 08:16)



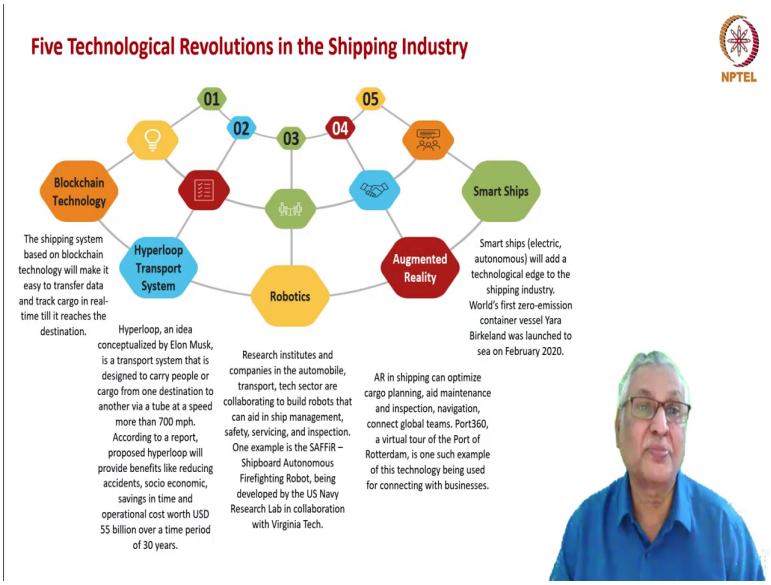
There are occasions when a single patent can create a firm and even an industry. The case of Google is interesting in this respect. In 1998, Google deemed its seminal page tag patent number 6285999 so, vital that it filed for the patent even before it had a business plan, venture funding or even a domain name.

Google paid Stanford University, to which the patent had been assigned 336 dollar millions in shares to exclusively license it. Without that patent set one analyst, Google would have been

trampled by copycat search engine offerings from Yahoo, Microsoft and other big players who once dominated the market.

Google's dominance in search and its consequent emergence as a tech-giant is now history. That said, as a start-up becomes the dominant leader, it could be prone to innovative challenges. Patenting, which builds firms and industries should be based on two criteria, a foundational patent, and an expanding patent estate.

(Refer Slide Time: 09:20)



Another example - Five technological revolutions are going to sweep the shipping industry. Everybody focuses on the road transportation industry, but people are not aware the kind of changes that are going to take place in the maritime industry. Blockchain technology is going to enable extremely accurate and speedy data transfer and cargo tracking mechanisms in real time.

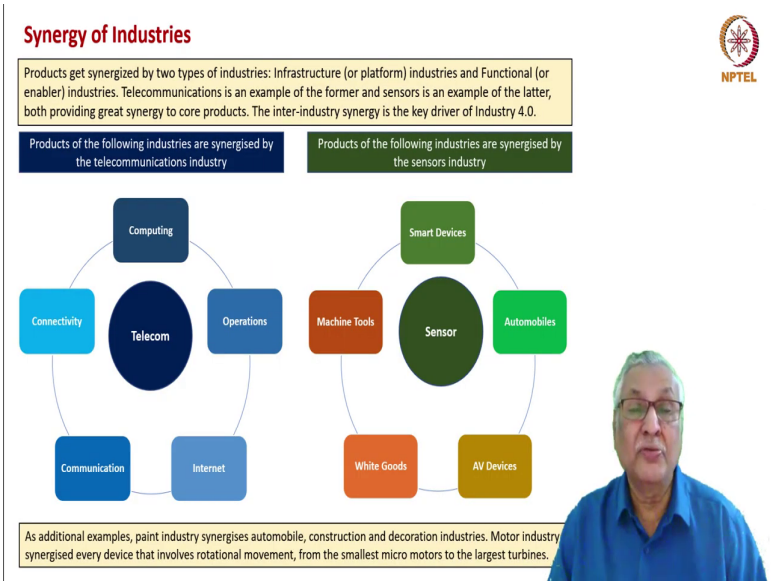
Hyperloop transport system, an idea conceptualized by Elon Musk could be utilized for underversion transportation. Robotics, which are applied in automobile and transportation sector could be utilized in the ship management, safety, servicing and inspection areas.

Already we have a shipboard autonomous firefighting robot that is getting developed by the US Navy Research Lab in collaboration with Virginia Tech. Augmented reality could be another area where there would be strides in shipping. Augmented reality can optimize cargo planning.

It can help maintenance and inspection take place appropriately. It could fast track navigation and connect global teams. Port 360, a virtual tour of the port of Rotterdam is one such example of this technology being used. And ultimately, there would be several smart ship designs that would be on the anvil.

Electric autonomous and hydrogen based smart ships will add a technological edge to the shipping industry. The world's first zero emission container, vessel, Yara Birkeland was launched to sea on February 2020. Even our own Cochin shipyard is looking at electric ferries to be deployed in its campuses.

(Refer Slide Time: 11:06)



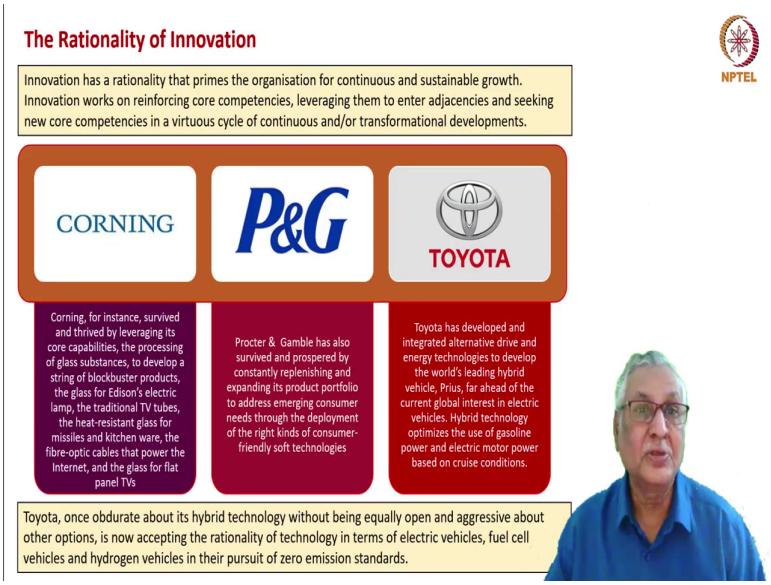
When we see industrial developments of this kind, we have to analyze how this energy comes in for these new industries to get established. Products get synergised by two types of industries. Infrastructure or platform industries and functional or enabler industries. Telecommunication is an example of the platform industry. And sensors is an example of the functional industry.

Both provide great synergy to core products. The inter-industry synergy is the key driver of Industry 4.0. Products of the following industries are synergised by the telecommunication industry, computing, operations, internet, communication and connectivity.

Products of the following industries are synergised by the sensors industry. Smart devices, automobiles, audio visual devices, white goods, machine tools as additional examples, we have paint industry that synergizes automobile construction and decoration industries. We

have motor industry that synergizes every device that involves rotational movement, from the smallest micro motors to the largest turbines.

(Refer Slide Time: 12:19)



Innovation must have rationality. Innovation must have a rationality that primes the organization for continuous and sustainable growth. Innovation works on reinforcing core competencies, leveraging them to enter adjacencies and seeking new core competencies in a virtuous cycle of continuous and or transformational developments. Let us take the example of Corning.

Corning survived and thrived by leveraging its core capabilities, the processing of glass substances to develop a string of blockbuster products, the Glass for Edison's electric lamp, the traditional TV tubes, the heat resistant, glass for missiles and kitchenware, the fiber optic

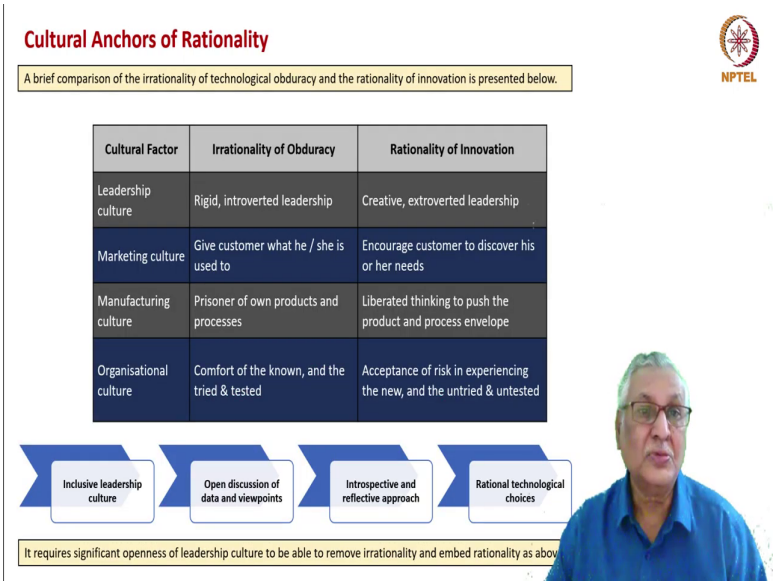
cables that power the internet and the glass for flat panel TVs. Procter and gamble is a consumer giant.

This company also has survived and prospered by constantly replenishing and expanding its product portfolio to address emerging consumer needs through the deployment of the right kinds of consumer-friendly soft technologies. Toyota is the global automobile giant. Toyota has developed and integrated alternative drive and energy technologies from time to time. To develop the world's leading cars and its stride.

Couple of decades ago has been in terms of developing the world's first hybrid vehicle on a commercial scale called Prius and it was far ahead of the current global interest in electric vehicles or train vehicles. Hybrid technology optimizes the use of gasoline power and electric motor power based on cruise emissions.

Toyota was once obdurate about its hybrid technology without being equally open and aggressive about other options. However, the company is now adopting the rationality of technology in terms of a whole range of clean energy vehicles, electric vehicles, fuel cell vehicles and hydrogen vehicles for the pursuit of zero emission standards.

(Refer Slide Time: 14:22)



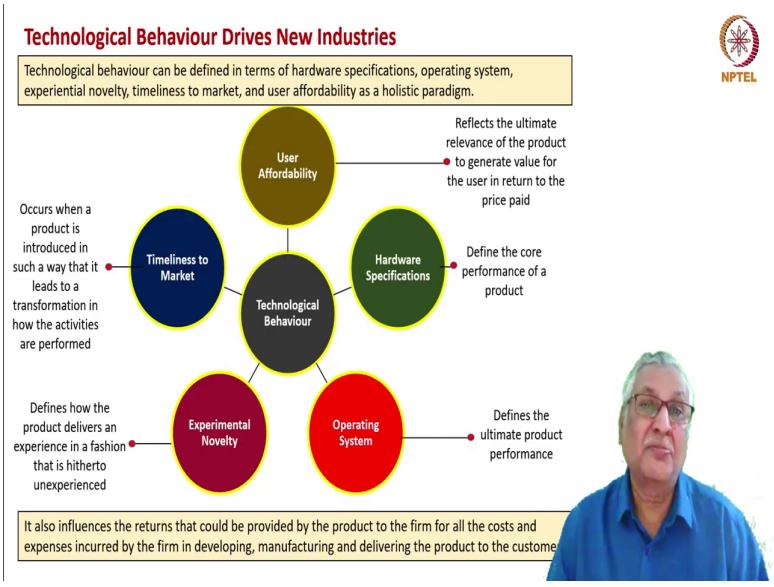
What are the cultural anchors for rationality? Let us look at the irrationality of technological obduracy and the rationality of innovation. It is the rationality of innovation that creates new industries while it is the irrationality of obduracy that makes industries wither away and eventually collapse. There are four important factors. Leadership culture leads to irrationality of obduracy if the leadership is rigid and interpreted.

On the other hand, creative and extroverted leadership leads to rationality of innovation. If the marketing culture is to give what the customer is used to that leads to obduracy. But instead, if the company thinks of encouraging the customer to discover his or her needs, then it would lead to rationality of innovation, the design thinking principle. If the manufacturing culture becomes a prisoner of its own products and processes, it will lead to irrationality of obduracy.

On the other hand, if innovation liberates the thinking to push the product and process envelope, it will be rational for any company to follow. If the organizational culture lies in the comfort of the known and the tried and tested, technological obduracy will be perpetuated in such companies. On the other hand, if companies accept risk in experiencing the new, the untried and the untested, there would be rationality for innovation in such organizations.

So, inclusive leadership culture, open discussion of data and viewpoints, introspective and reflective approach and rational technological choices are one virtual sequence. It requires significant openness of leadership culture to be able to remove irrationality and embed rationality in an organization's psyche as above.

(Refer Slide Time: 16:24)



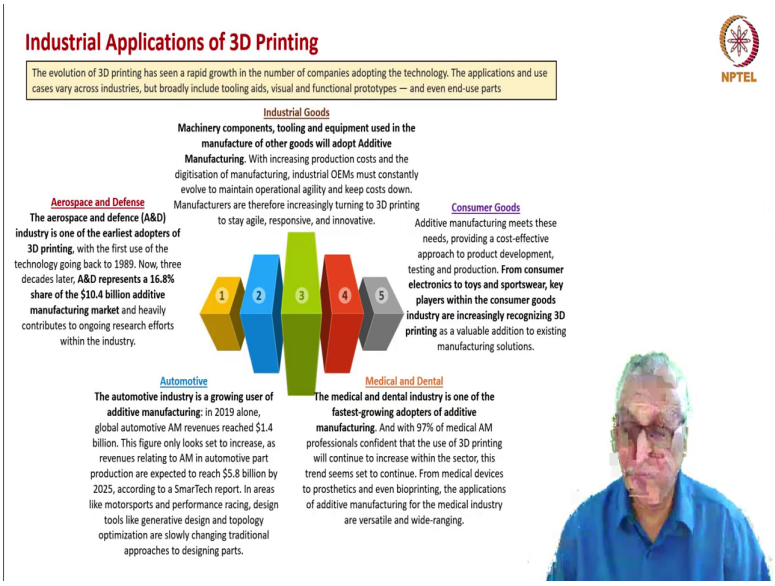
Technological behaviour drives the creation of new industries, just as individuals have their behavior, just as organizations have organizational behaviour, technologically oriented

activities have their own technological behaviour. A technology oriented company must display positive technological behaviour. And this technological behaviour is expressed in terms of five aspects. The first is the user affordability.

Reflects the ultimate relevance of the product to generate value for the user in return for the price that is being paid. Hardware specifications define the core performance of the product. The operating system defines the ultimate product performance and the customer experience with the device or the equipment. The experimental novelty defines how the product delivers an experience in a fashion that is hitherto unexperienced.

The timeliness to market as a driver occurs when a product is introduced in such a way that it leads to a transformation in how the activities are performed. Together, all of these constitute the technological behavior of a firm. This also influences the returns that could be provided by the product to the firm. For all the costs and expenses incurred by the firm in developing manufacturing and delivering the product to the customer.

(Refer Slide Time: 17:50)



Let us look at another important aspect, the 3D printing. It is also called additive manufacturing. Instead of reviewing materials from (Refer Time: 18:02) or raw castings, this assumes that the entire material can be bonded together into the part straight from the 3D modeling to becoming a part. It is a revolutionary. The evolution of 3D printing has seen a rapid growth in the number of companies adopting the technology.

The applications and use cases vary across industries, but broadly include a whole range of tooling aids, visual and functional prototypes and even end-use parts of it. In the industrial goods sector, we have missionary components; tooling and equipment used in the manufacture of other goods, being open to adopting adopt additive manufacturing.

In the aerospace and defense sector, additive manufacturing has been one of the earliest progress. This industry has been the earliest adopter of 3D printing with the first use of the

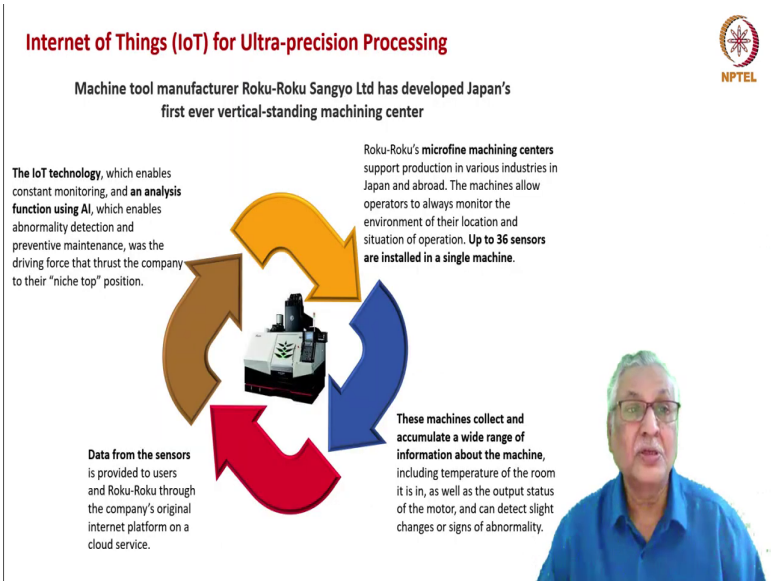
technology going back to 1989. Now, 3 decades later, A and D represents a 17 percent share of the 10.4 billion dollar additive manufacturing market and this is going to only increase as the industry tries for light weighting, flexible manufacturing and high strength.

The automotive industry is also a growing user of additive manufacturing. It is expected that in areas like motorsports and performance racing, as well as in areas of rapid prototyping additive manufacturing will come into play in a big way. The medical and dental industry is also one of the fastest growing adopters of additive manufacturing.

The use of 3D printing will continue to increase within the sector and new implants, new support systems for the human body will be made available through the 3D printing approach. Consumer goods will be the next horizon for additive manufacturing. From consumer electronics to toys and sportswear, three players within the consumer goods industry are increasingly recognizing 3D printing.

So, the entire manufacturing segment of an economy is likely to be radically transformed by the adoption of additive manufacturing, saving huge amounts of material and energy besides time.

(Refer Slide Time: 20:25)



Internet of Things is going to radically transform how machine tools work. Machine tool manufacturer Roku Roku Sangyo of Japan has developed Japan's first-ever vertical standing machining center. The IoT technology which enables constant monitoring and an analysis function using artificial intelligence which enables abnormality detection and preventive maintenance is the core of this machining center.

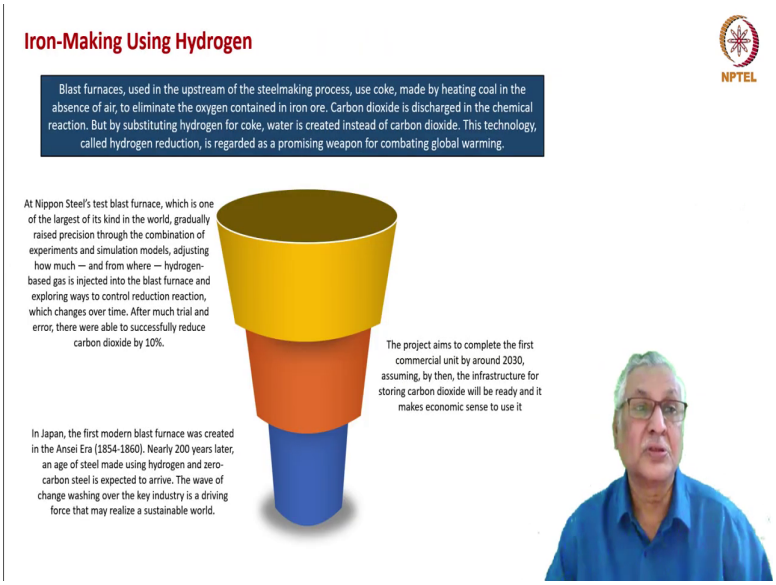
Roku Roku's microfine machining centers support production in various industries in Japan and abroad. The machines allow operators to continuously monitor the environment of their location and situation of operation. Up to 36 sensors are installed in a single machine and the number will only go up.

These machines collect and accumulate a wide range of information about the machine based on the data from these sensors and that gets entangled with the company's original internet

platform on a cloud service. So, every parameter that you can conceive of including the temperature of the room, the output status, the slightest changes in the tolerances, signs of abnormality can be located, can be discovered, can be defined and can be used to remediate the machining process.

This is going to transform normal machining into ultra precision processing.

(Refer Slide Time: 21:51)

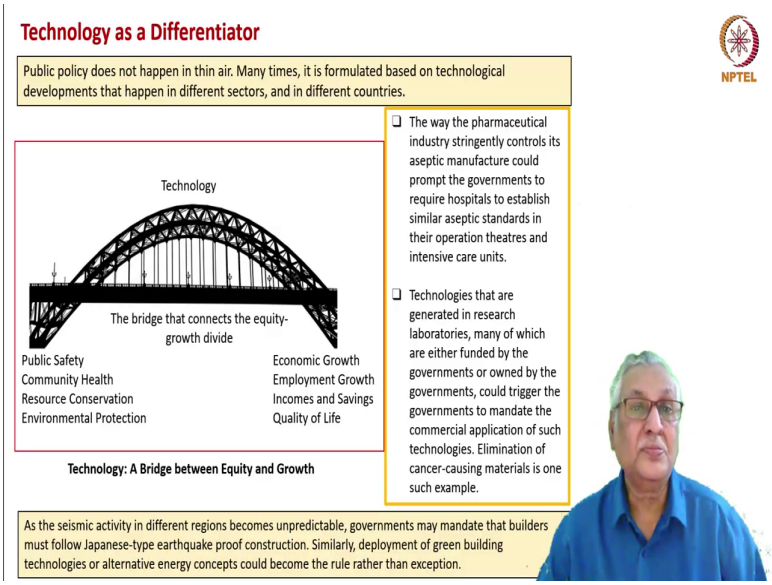


Iron is going to be made in future using hydrogen. Blast furnaces used in the upstream of the steel making process use coke made by heating coal in the absence of air to eliminate the oxygen contained in iron ore. Carbon dioxide is discharged in the chemical reaction, but by substituting hydrogen for coke, water is created instead of carbon dioxide. This technology called hydrogen reduction is regarded as a promising weapon for combating global warming and contributing to decarbonization.

Nippon steel is having a test blast furnace, which is one of the largest of its kind in the world where this technology is getting deployed. After much trial and error, they were able to successfully reduce carbon dioxide by 10 percent, but the goal is to eliminate completely if possible.

The first modern blast furnace was created in 1854 in Japan, nearly 200 years later. An age of steel made using hydrogen and zero carbon steel is expected to arrive. And that is the path of progress using technology. This project aims to complete the first commercial unit by around 2030. And by that of hopefully the infrastructure for so, storing carbon dioxide and hydrogen will be ready completely and it would make atomic sense to use it.

(Refer Slide Time: 23:14)



Technology is a great differentiator. Public policy uses technology to differentiate the future from the present. Public policy does not happen in thin air. Many times it is formulated based

on technological developments that happen in different sectors and in different countries. Technology is the bridge that connects the equity growth divide.

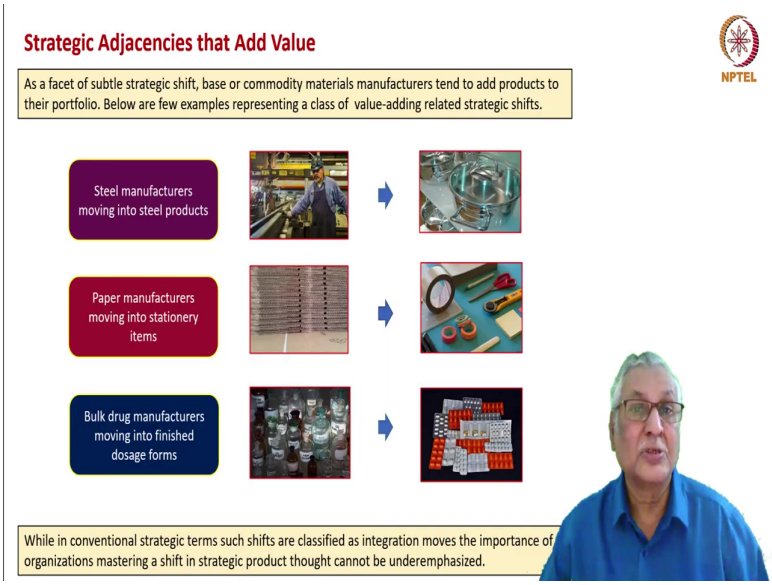
What is the equity? Public safety, community health, resource conservation and environmental protection and what is growth? Economic growth, employment growth, income savings, quality of life. All of these mean higher consumption and higher exploitation of natural resources. Whereas environmental considerations require that we should have pause in the growth if not the growth.

Technology is a bridge between equity and growth. The way the pharmaceutical industry stringently controls its aseptic manufacture could prompt the governments to require hospitals to, establish similar aseptic standards in their operational theatres and in their intensive care units.

Technologies that are generated in research laboratories, many of which are either funded by the governments or owned by the governments could trigger the governments to mandate the commercial application of such technologies. Elimination of cancer causing materials is one such example.

As this seismic activity in different regions becomes unpredictable, governments may mandate that builders must follow Japanese type earthquake-proof construction. Similarly, deployment of green-building technologies or alternative energy concepts could become the rule rather than exception.

(Refer Slide Time: 24:53)



Many times strategic adjacencies is add value to your business and create a new industry. As a facet of subtle strategic shift, the base or commodity materials, manufacturers tend to add products to their portfolio. Below are a few examples representing a class of value adding related strategic shifts. Steel manufacturers moving into steel products, paper manufacturers moving into stationery items, bulk drug manufacturers moving into finished dosage forms.

While in conventional strategic terms, such shifts are classified as integration moves. The importance of organizations mastering a shift in strategic product thought cannot be overemphasized.

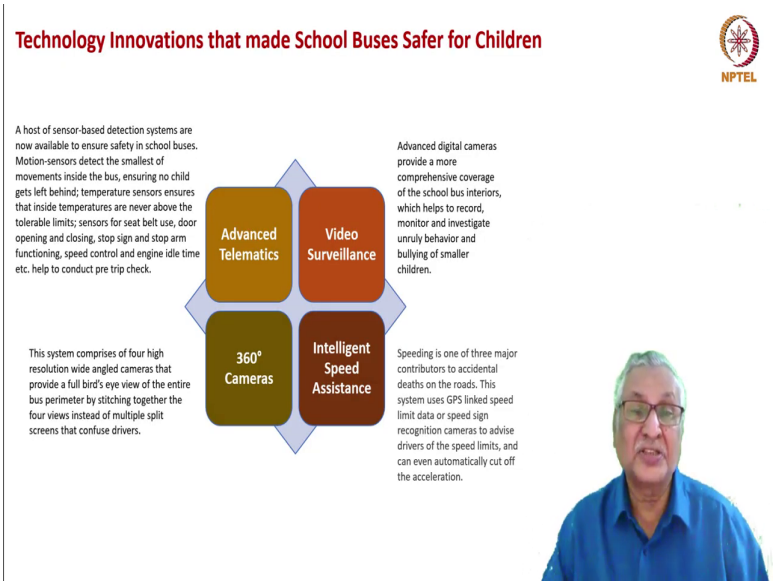
(Refer Slide Time: 25:42)

Sweeping shifts also take place. As companies take more remarkable strategic shifts in steps, product lines get added and this changes the business mix over time. In some cases, this also transforms companies into conglomerates. Wipro which started in 1945 as a vegetable oil company with 100 percent of its revenues from oils and soaps, is today, a software giant with over 80 percent of revenues accruing from software services. But the company is still dealing in soaps, oils and other consumer products.

It has recently made an acquisition of a Kerala-based FMCC company in the foods and nutrition area to further strengthen its FMCC food print. Reliance industries started as a small textile mill in 1975. Today, it is an energy including green energy, telecommunications and retail conglomerate with continued presence in textiles. Reliance Industries continue touch with textiles has prompted the company to acquire Alok Industries under the IBC processes.

Many conglomerates are, in fact, a result of a series of strategic shifts that are executed over time. It is difficult to draw a clear line between conglomeration through a targeted diversification strategy vis-a-vis what happens through multiple strategic shifts that take place over time periods.

(Refer Slide Time: 27:09)



Let us take the example of school buses. It is considered one of those products of an automobile industry, particularly the bus industry. However, four things are going to completely differentiate a new school bus of contemporary era. Advanced telematics, video surveillance, 360 degree cameras and intelligent speed assistance are going to make school buses safer for children.

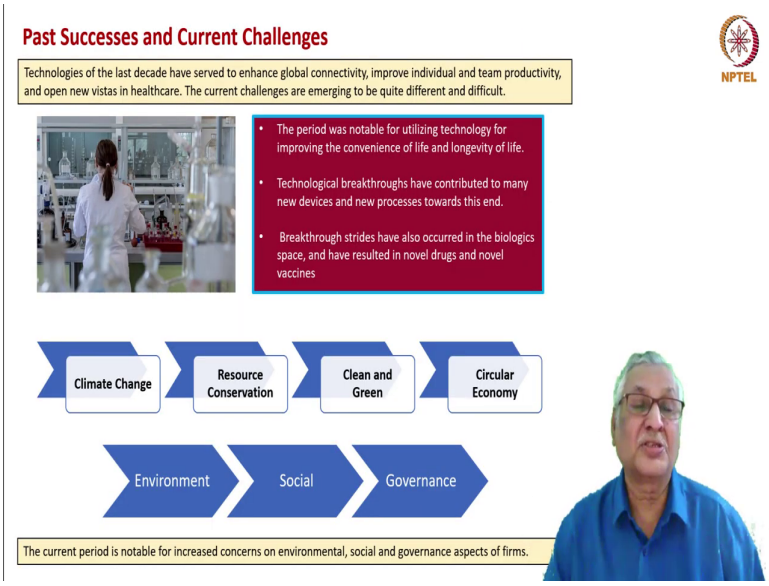
A host of sensor based detection systems are now available to ensure safety in school buses. Motion sensors will detect the smallest of movements inside the bus ensuring that no child

gets left behind ever. Temperature sensors will ensure that inside temperatures are never above the tolerable limits.

Sensors for seat belt use, door opening and closing, stop sign and stop arm functioning, speed control and engine idle time etcetera help to conduct pre-trip check. The 360 degree camera system comprises of four high resolution wide-angle cameras that provide a full bird's eye view of the entire bus parameter by stitching together the four views instead of multiple split screens that confuse drivers.

Advanced digital cameras provide a more comprehensive of the school bus interiors which helps to record, monitor and investigate unruly behavior and bullying of smaller children. Intelligent speed assistance is in terms of controlling the speeding. Speeding is one of the three major contributors to accidental deaths on the roads. This system uses GPS linked speed limit data or speeds and recognition cameras to advise drivers of the speed limits and can even automatically cut off the acceleration.

(Refer Slide Time: 28:55)



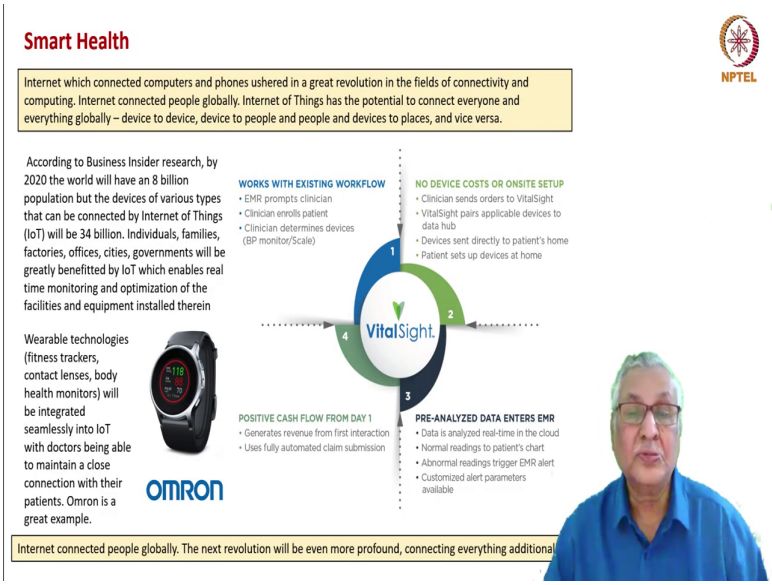
Past successes and current challenges technologies of the last decade have served to enhance global connectivity, improve individual and team productivity and open new vistas in healthcare. The current challenges are emerging to be quite different and difficult.

The period was notable for utilizing technology for improving the convenience of life and longevity of life. Technological breakthroughs have contributed to many new devices and new processes towards this end. Breakthrough strides have also occurred in the biologic space and have resulted in novel drugs and novel vaccines.

But for the future, climate change, resource conservation, clean and green and circular economy are the four new drivers. Environment, empathy, social responsibility and corporate

governance would induce companies to look at their businesses in different way. The current period is notable for increased concerns on these lines.

(Refer Slide Time: 29:55)



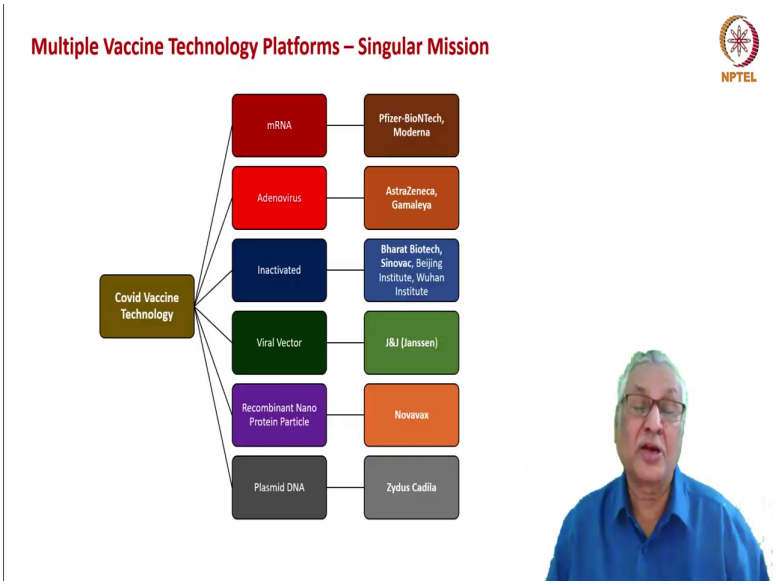
Let us look at smart health. Internet which connected computers and phones ushered in a great revolution in the fields of connectivity and computing. Internet connected people globally. Internet of Things has the potential to connect everyone and everything globally - device to device, device to people and people and devices to places and vice versa.

Omron has come up with a great wearable technology and that would seamlessly utilize IoT. So, that the doctors are able to maintain a close connection with their patients. It has a product called VitalSight which was with the existing workflow. The EMR prompts clinician, clinician enrolls patient. Clinician determines devices, the devices that are to be used. There are no device costs are on site setup.

The clinician sends orders to VitalSight. VitalSight pairs applicable devices to the data hub. The device are sent directly to the patient's home and patients set up devices at home. It will ensure positive cash flow from day 1, generates revenue from the first interaction, uses fully automated claims submission. Pre-analyze data enters EMR. Data is unless real time in the cloud. Normal readings to patients chart. Abnormal readings trigger EMR alert, customized alert parameters are made available.

The 8 billion population of the world will have devices of various types that can be connected by Internet of Things and that could be several billions over the population. And this is one example of how Internet is going to transform the healthcare. Internet connected people globally. The next evaluation will be even more profound connecting everything additionally.

(Refer Slide Time: 31:49)

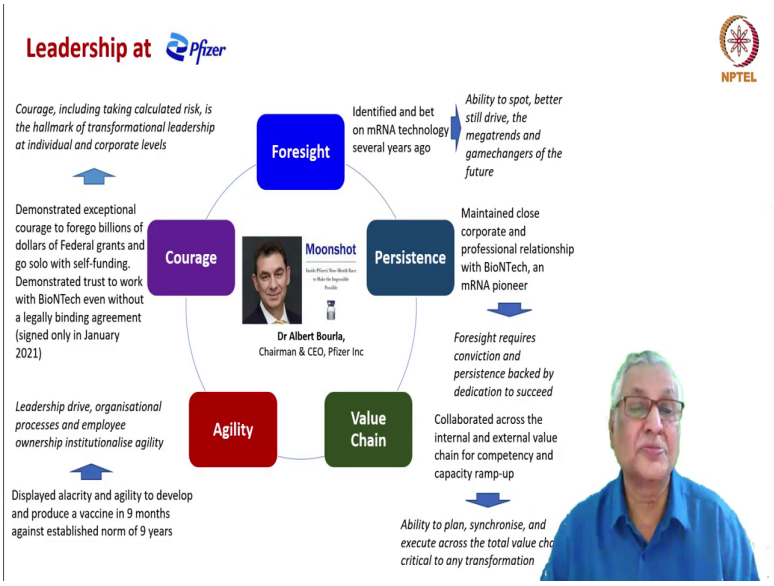


Let us look at what has happened on the vaccine front. When COVID-19 came on the scene, the entire scientific community responded with alacrity and the governments have also responded with emergency attention to support vaccine development. We had several alternative vaccine technology platforms, but the mission was singular.

The latest one that was put into action was mRNA technology, which had Pfizer and BioNTech collaborating and moderna pursuit on its own. The established adenovirus technology was the AstroZeneca. Bharat biotech, Sinovac, Beijing Institute and Wuhan Institute used inactivated virus technology.

J and J resorted to Viral Vector technology. Novavax looked at recombinant nano-protein particle and Zydus-Cadila looked at plasmid DNA. Whatever be the roots that are taken? Every company, so, hard to develop a vaccine, which usually takes 10 to 12 years to develop in just 10 to 12 months that has been the speed of development; of course, for that, emergency funding was provided by the various governments.

(Refer Slide Time: 33:03)



And this was possible because of leadership at Pfizer as an example. Dr. Albert Buorla, chairman CEO of Pfizer Inc, has been responsible for this leadership model for transforming the human health care situation in the face of such a dangerous pandemic. The company had the foresight to identify and bet on mRNA technology several years ago.

Therefore, the foresight, which is the ability to spot better still drive the megatrends and gamechangers of the future is one of the essential aspects of leadership. Second, persistence maintained close corporate and professional relationship with BioNTech an mRNA pioneer. So, foresight requires persistence. It requires conviction, backed by dedication to succeed.

Then the value chain collaborated across the internal and external value chain for competency and capacity ramp up, particularly in terms of cold chain transportation. Ability to plan, synchronize and execute across the total value chain is critical to any transformation. Agility -

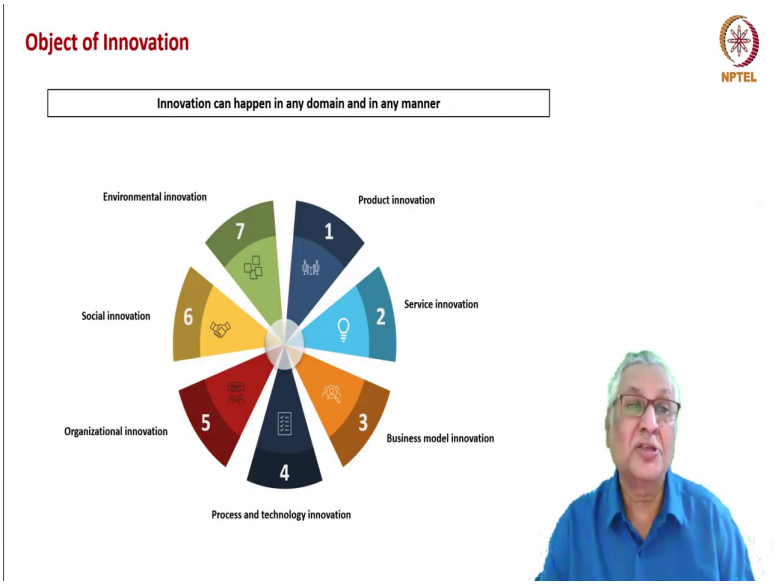
displayed alacrity and agility to develop and produce a vaccine in 9 months against the established norm of 9 years.

Leadership drive, organizational processes and employee ownership institutionalise agility. And finally, courage - the company demonstrated exceptional courage to forego billions of dollars of federal grants and go solo with self funding. Demonstrated trust to work with BioNTech even without a legally binding agreement; it was signed only in January 2021 after the vaccine was already into commercial approval.

Courage including taking calculated risk is the hallmark of transformational leadership at individual and the corporate levels. Foresight, persistence, value chain, agility and courage or the demonstrators of higher order leadership and higher order leadership is required to create new business lines and new industries.

The vaccine for COVID-19 is not just one vaccine. It is indeed a special vaccine that informed us how scientific equipment coupled with human dissolve could do something which is transformational for the humanity and in this Pfizer acted with the highest level of leadership.

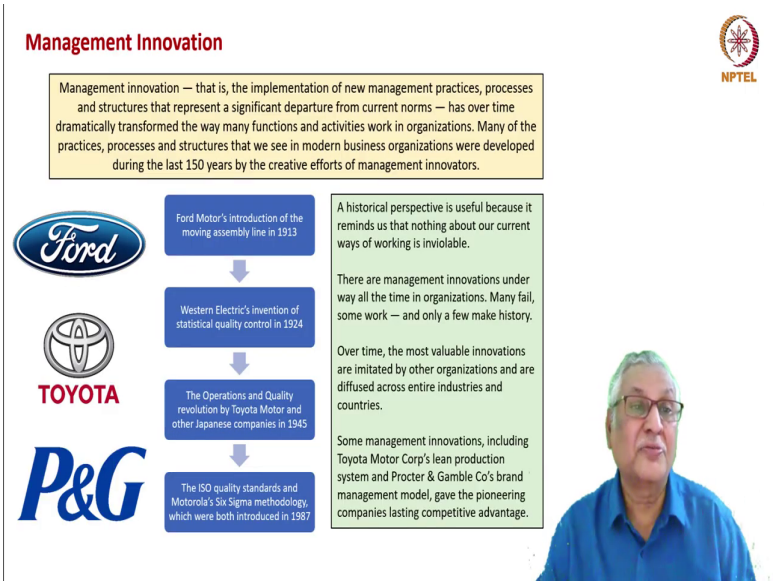
(Refer Slide Time: 35:40)



What are the objects of innovation? Innovation can happen in any domain and in any manner. There are seven important aspects of any innovation and innovation is required to create growth industries. Product innovation, service innovation, business model innovation, process and technology innovation, organizational innovation, social innovation and environmental innovation.

I am happy that as part of this course we have been able to touch upon many aspects of innovation including product innovation, service innovation, business model innovation and other aspects of innovation that I have mentioned just now.

(Refer Slide Time: 36:20)



Management innovation is also an important aspect. That is the implementation of new management practices, processes and structures that represent a significant departure from the known norms. This has worked and dramatically transformed the way many functions and activities work in organizations.

Many of the practices, processes and structures that we see in modern organizations were probably developed during the last 150 years progressively by the creative efforts of management innovators. However, each of these has been made sharper and more focused and more contemporary to the times.

Ford Motors introduction of the moving assembly line in 1913 was path breaking standardization. Western Electric's invention of statistical quality control in 1924 was game changer for quality assurance. The operations and quality revolutions by Toyota Motor and

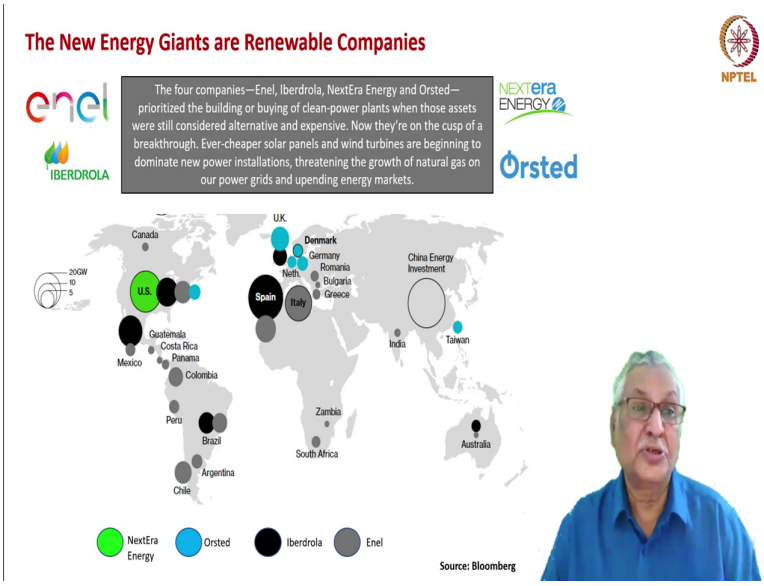
other Japanese companies in 1945 not only upgraded Japanese automobile manufacturing practice, but gifted at an entirely novel and effective manufacturing system to the entire world.

The ISO quality standards and Motorola 6-sigma technology which were both introduced in 1987 have informed us that it is possible to aim for the lowest level of deviation from the standard which you would like to have. A historical perspective in all these aspects of management innovation is useful because it reminds us that nothing about our current ways of working is inviolable.

There are management innovations underway all the time in organizations many fail some work, but only a few make history. Over time the most valuable innovations are imitated by other organizations and are diffused across entire industries and countries. So, management innovation is typically for the good of the entire industry and the economies in general.

As I said some management innovations including Toyota Motor Corps, lean production system and Procter and Gamble Companies brand management model gave the pioneering companies lasting competitive advantage. So, management innovation is also as important as technological innovation. Good management innovation recognizes the importance of technological innovation and good technological innovation understands the importance of commercialization of technologies for the human good.

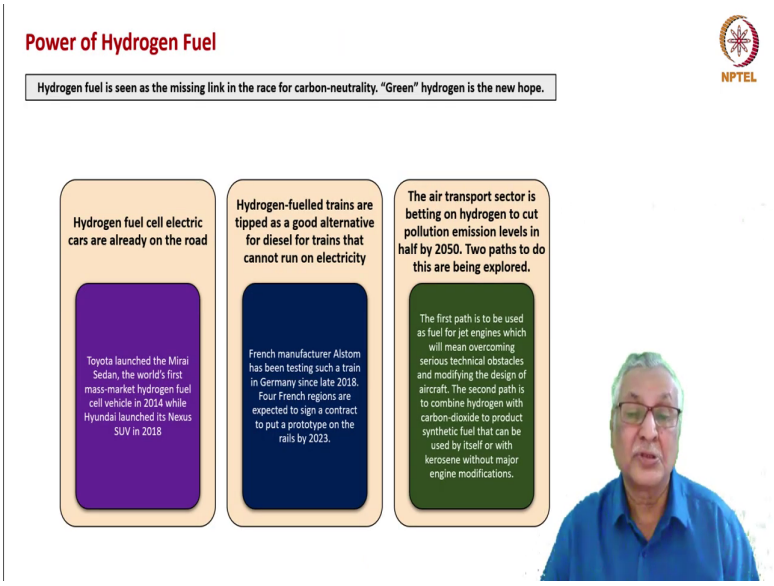
(Refer Slide Time: 38:56)



Today the new energy giants are renewable companies not the Shell or British Petroleum of the past era. The four companies in the renewable energy space Enel, Iberdrola NextEra Energy and Orsted - prioritized the building and buying of clean power plants when those assets were still considered alternative and expensive. Now, they are on the cusp of a breakthrough.

Ever cheaper solar panels and wind turbines are beginning to dominate new power installations threatening the growth of natural gas on our power grids and upending energy markets. So, the entire energy sea is undergoing a significant transformation and of course, the existing energy measures are also jumping into the renewables energy bandwagon.

(Refer Slide Time: 39:43)



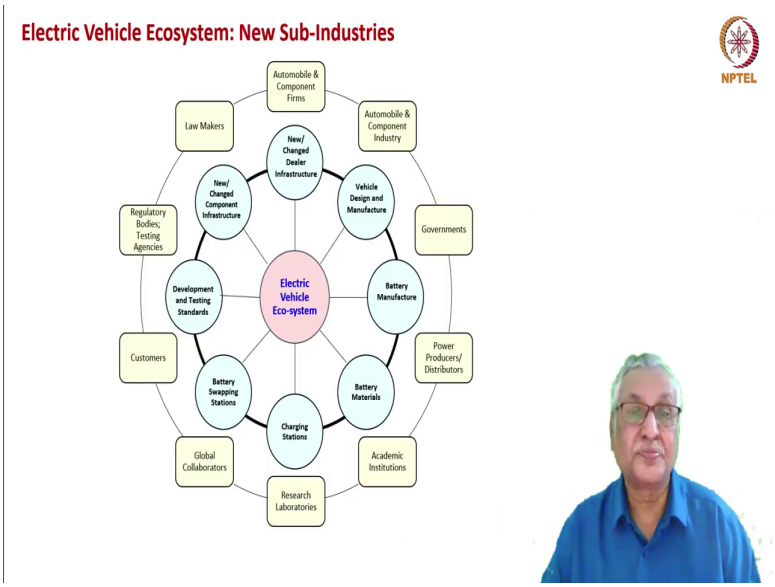
We cannot think about clean energy without discussing the power of hydrogen fuel. Hydrogen fuel was long seen as the missing link in the race for carbon neutrality. However, today green hydrogen is the new hope. Hydrogen fuel cell electric cars are already on the road. Toyota launched the Mirai Sedan the world's first mass market hydrogen fuel cell vehicle in 2014 while Hyundai launched its Nexus SUV in 2018. But this technology is getting perfected and the prices are being brought down.

Hydrogen fuelled trains are tipped as a good alternative for diesel for trains that cannot run on electricity. And even when electricity is being used hydrogen fuel trains could supplement a reduced use of electric power. French manufacturer Alstom has been testing such a train in Germany since the late 2018. Four French regions are expected to sign a contract to put a prototype on the rails by 2023.

The air transport sector 2 is betting on hydrogen to cut down if pollution emission levels in half by 2050. Two paths to do this are being explored. The first path is to be used as fuel for jet engines which will mean overcoming serious technical obstacles and modifying the design of the aircraft.

The second path is to combine hydrogen with carbon dioxide to produce synthetic fuel that can be used by itself or with kerosene without major engine modifications. So, lots of things are happening with hydrogen as the base.

(Refer Slide Time: 41:19)



Then we have all around us and all before us the new electric vehicle ecosystem. A host of news of industries are going to be generated because of the electric vehicle ecosystem. We are

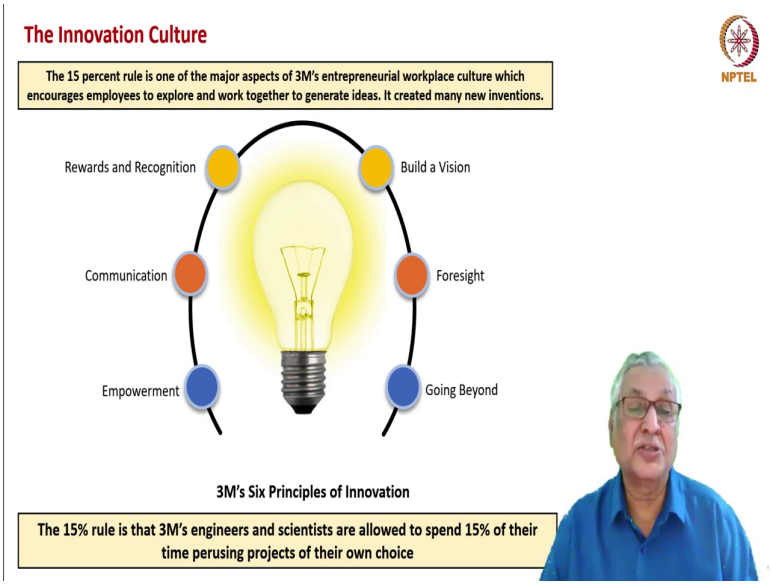
going to have new electric vehicles of course, at the core that will comprise the automobile and component firms. A new automobile and component industry will take shape.

The governments will plunge into electric vehicle support systems. Power producers and distributors will gear up to support the electric charging infrastructure. Academic institutions, research laboratories and global collaborators will work together to ensure several solutions for the creation of a new electric vehicle system.

Customers will be looking at the electric vehicles with expectation. Regular electric bodies and testing agencies will be developing new homologation systems while lawmakers will be grappling with any challenges that could arise with the electric vehicle system.

But at the core is the transformation that is going to happen. The new changed component infrastructure, the development and testing of standards, battery swapping stations, charging stations, battery materials, battery manufacturer, vehicle design and manufacturer, new and change dealer infrastructure would all be a part of a new electric vehicle ecosystem that will generate new industries and sub industries.

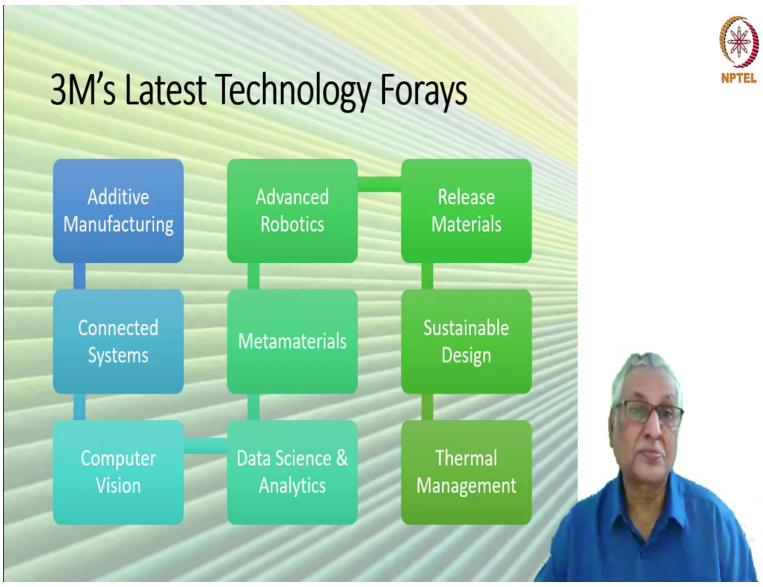
(Refer Slide Time: 42:49)



Then the innovation culture - Every company should dictate to its people that its time should be adequately spent on innovation. One of the most innovative companies in the world, 3M has a 15 percent rule. It is one of the major aspects of 3M's entrepreneurial workplace culture and this encourages employees to explore and work together to generate ideas. And this approach has created many new inventions.

The 15 percent rule is that 3M's engineers and scientists are allowed to spend 15 percent of their time perusing pursuing projects of their own choice and this has created several innovations at 3M. In addition to this, 3M follows six principles of innovation, empowerment of people, communication across division's rewards and recognition, going beyond the current, having foresight and building a vision.

(Refer Slide Time: 43:50)



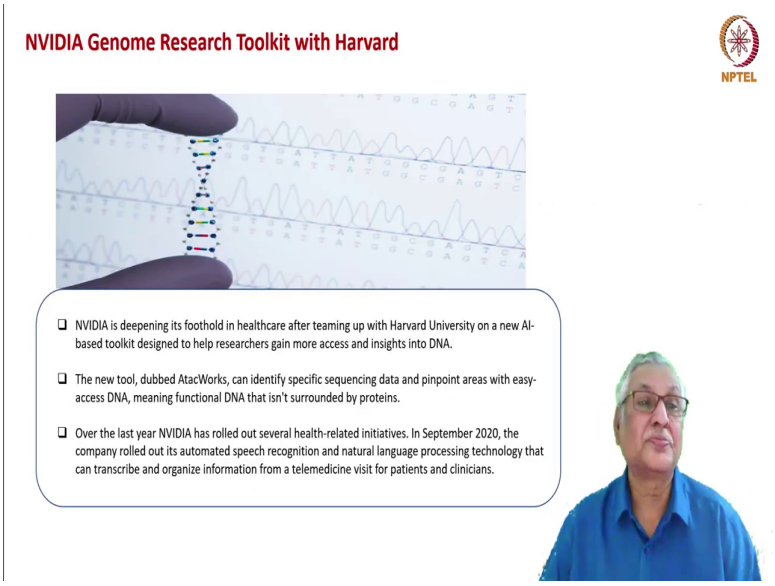
3M's latest technology forays are - additive manufacturing, connected systems, computer vision, data science and analytics, meta materials, advanced robotics, release materials, sustainable design and thermal management. The way it is moving ahead, it may be even redefining the periodic table of elements with new discoveries.

(Refer Slide Time: 44:15)

DuPont is another company which has excelled itself in materials and related technologies. It has three transformative technologies, electronics convergence that is emerging technologies for miniaturization and speed, increasing power density and frequency, advanced packaging for high-performance devices, all of these for electronics convergence.

Then it works on digital acceleration, artificial intelligence and machine learning, big data and predictive analysis, smart technologies and connected devices. It also has multi-material system integration; for safer, more valuable, more reliable and higher performing products, advancing hybrid and electric vehicle technology and application specific expertise in material selection. That is DuPont for you.

(Refer Slide Time: 45:02)



NVIDIA, as we know, is a computer chip manufacturer, particularly for gaming devices. Its status in radically transforming the mobile and gaming devices is very well-known. Now, it is into Genome Research. It is developing a research toolkit for genomics with harvard. It is going to deepen its foothold in healthcare based on a new artificial intelligence-based toolkit which will help researchers gain more access and insights into human DNA.

This new tool dubbed AtacWorks, can identify specific sequencing data and pinpoint areas with easy access DNA, meaning functional DNA that is in surrounded by proteins. Over the last year, NVIDIA has rolled out several health-related initiatives. In September 2020, the company rolled out its automated speech-recognition system and natural language processing technology that can transcribe and organize information from a tele telemedicine, visit for patients and clinicians.

(Refer Slide Time: 46:06)

Then we have Bose. Boses growth is founded on acoustic purity. But it has lessons which are commonsensical as also highly technological. Let us look at noise-cancelling headphones were not about cancelling noise. Bose wanted to improve the sound quality and tonal balance of a set of headphones. Only after developing the technology did Bose scientists realize that their real aims were off target and that the right goal was noise reduction. Often a secondary artifact of the invention matters most in the end.

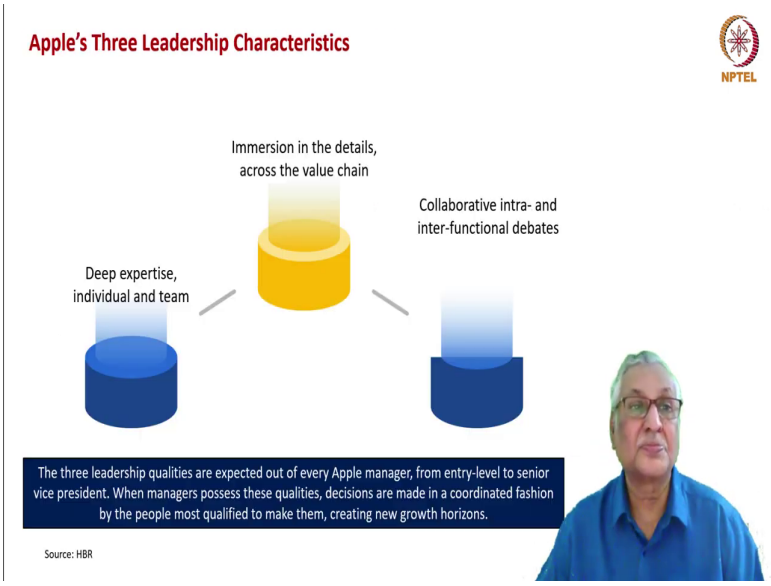
The 2nd aspect of Bose was listening to customers. Bose discovered the chief benefit of the noise-cancelling technology when they took the product around the country to military installations, such as an air force base and an armored personal carrier in pursuit of government contracts.

Product selection can be instinctive too. That is a 3rd lesson. Dr. Bose would abandon research projects that would not work. Bose believed that there is an element of instinct involved in the scouting of paths that are taken during the discovery process. The 4th is to conduct pure research. Innovations are fragile. The system is wired against them and they often fail. Having structure around pure research can give innovations a greenhouse in which they could grow to a level of maturity.

And 5thly, believing the customers. Bose always believed in putting the invention into the hands of the consumers as early as possible as the customers are best placed to say whether it is good or bad about it and what is good or bad about it. 6thly, marketing must support inventions. Bose learned that it is critically important to have the technology supported by the marketing site. Commercialization of its noise-cancelling headphone technology was a great example.

And 7thly, it is not always technology innovation that makes a technology product successful. The total product includes much more than the item on the shelf. It includes connections, online, social sanctions, packaging, distribution, etcetera. Another blockbuster of Bose, that is the Bose wave music system, had great technology, but its success was limited until the innovations around distribution came into play and made it a widely accepted product across customer segments.

(Refer Slide Time: 48:29)



Leadership is extremely important in driving technological growth, technological development and technological leadership. New industries are created only through leadership that appreciate technology that expresses technology and that executes on technology. In Apple, there are three important leadership characteristics that are expected of every individual, more so, a manager and a leader.

Deep expertise, both individual and team, immersion in the details across the value chain; collaborative intra and inter functional debates. The three leadership qualities are expected out of every Apple manager from entry level to senior vice president. When managers possess these qualities, decisions are made in a coordinated fashion by the people most qualified to make them creating new growth horizons and that is Apple for you.

And this has been optimized and also institutionalized by none other than the visionary technologies at the helm of Apple that is Steve Jobs.

(Refer Slide Time: 49:37)

I would like to conclude this lecture on establishment and creation of new industries by talking about futurism. Futurism is the differentiator for companies and industries, which are set to grow on novel paths. Competitiveness of a business accrues from superior faculties. Imagination is one of the critical faculties. Innovation and differentiation are the characteristics of a futuristic developmental approach.

There are five core faculties for designers and developers in firms which are committed to differentiation as a strategy. First, learning from the past as well as the present; two, adoption

of methods of sharp observation; timing the future developments; sophisticated sensing mechanisms and imagining the use of ordinary to deliver the extraordinary.

There have been books written by extraordinary authors related to futurism; The Beginning of Infinity, The Future of The Mind, Mobilized and The Next 100 Years or some of the books by the authors of repute in futurism. Futurism needs to be a strong cultural facet of organizations committed to a technology-driven competitive strategy of innovation and differentiation.

Futurism creates new growth industries and lack of futurism makes industries stagnant. It makes industries get fragmented and ultimately unviable. So, futurism is the key to generate new technologies, new firms and new industries leading to all-round growth for the humanity.

Thank you. I hope you enjoyed this lecture. I hope to see you in the next lecture.