Entrepreneurship
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Lecture: 25
Technological Innovation and Entrepreneurship

Hi Friends, Welcome to the course on entrepreneurship. In this module, we will continue our focus on technological innovation and the linkages it has with entrepreneurship.

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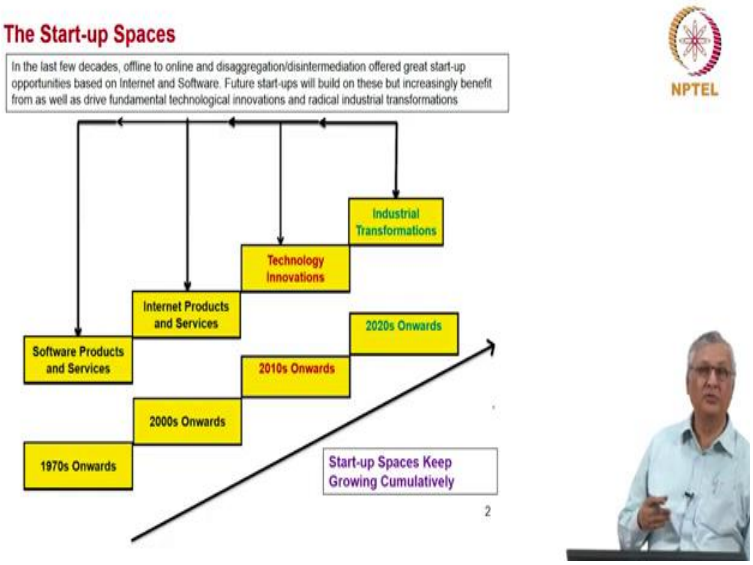

We discussed earlier the nature of technological innovation and what does innovation mean what kinds of innovation exists and how different types of innovations help in different types of industrial developments and we also discussed the multiple role startups can play using technology for business development. Now, in this module, we will look at certain priorities of technological development and how things would go but if we take a quick review of what has been happening in this startup space. From the 1970 onwards till now and also take a peek at what could happen in the future.

We could say that this could be divided into a few time spans in the first time span which started from 1970's software products and services became a new technological development or it is not necessarily an innovation. Much of the innovation occurred in the hardware but operating systems came into their own and then operating systems helped bring the computing to the hands of people first in terms of desktops and then in terms of laptops and that has led to a big

difference in the way businesses are managed in the way in which data is analyzed and the way in which efficiencies are achieved in business processes. Then from late 1990's to be exact and from 2000's onwards, we have internet connectivity making a remarkable difference as to how global business is conducted and internet products and services have led to a huge revolution in terms of shifting multiple offline activities to online activities. Along with that, we have had several innovations, which were based on disintermediation and aggregation of demand creating new digital bridges between demand seeker and then supply providers.

So, that was the origin of various companies, which we see in the e-commerce space and with mobile devices coming into play then the mobile commerce also took on. Therefore, a whole new generation of startups have emerged and several of them became unicorns as we looked at in the previous sessions and they have started offering several internet products and services from 2010 onwards. We are having a new set of fundamental technological evolutions that have been happening and they have been happening in terms of newer sensor technologies neural networks different ways of powering automobiles then how to generate electricity from natural resources.

So, this time we are having more fundamental technological innovations that have been happening and these are all likely to network with each other and also drive industrial transformations, as we look at 2020' onwards. So, when this kind of change happens it is not that the changes that have taken place in the 1970's or 2000's will move away that the changes of 2010's and 2020's will supersede them, rather they coexist and rather they would make the earlier developments even more powerful. For example, if artificial intelligence and machine learning are the newer technologies that are happening in the digital space they are going to enhance the way in which software services are going to be deployed in the industry or in the services sector. And therefore, I would say that startups have got role probably a much larger role in several of the domains that have been there and growing in the past and are presently growing but also would grow substantially in the future as well.

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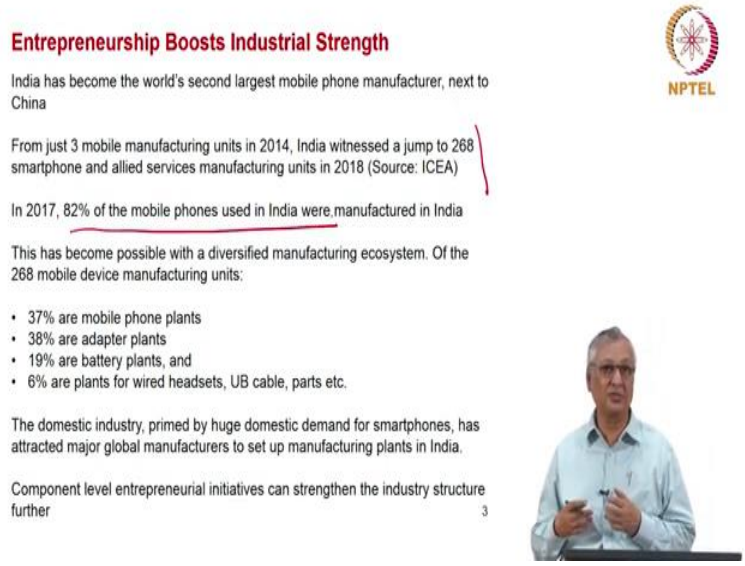

So, the future looks much better than ever for startups. Now when this kind of startups happens it boosts industrial strengths. If you recall maybe about 10 years ago, India did not have any mobile manufacturing network. All the mobiles, particularly the smart mobile's that being used while being imported from outside the country. But today, from just three mobile manufacturing units in 2014, India has witnessed a 268 company manufacturing base which is significant increase. In 2017, 82% of the mobile phones used in India were being manufactured in India, how has this become possible? This has become possible because the diversification of manufacturing ecosystem. Several entrepreneurial companies have come in to take small parts of mobile phone ecosystem which are very critical for example, charge it was a critical important part of the ecosystem then batteries were very important and we needed the headsets and then the basic mobile manufacturing plants themselves have come up. So 37% of this 268 new companies or mobile plants 38% of adapter plants 19% of battery plants and 6% of for other accessories. Therefore, there is a huge change in the mobile manufacturing infrastructure and possibly after China India is poised to be the second largest mobile manufacturing destination in the world. And this is primed by the huge domestic demand for mobile phones. What it means is that when entrepreneurship and startup activities occur at component level they together strengthen the product ecosystem and therefore they also strengthen the business ecosystem leading to larger economic strength in the country.

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We discussed in the previous sessions about non-linearity in technologies, the way in which technologies are being delivered and the business models that are occurring. This non-linearity is giving rise and hope for a newer set of startups. Now, when we look at non-linearity and linearity tends to be simple but non-linearity also could be a bit simple. When we talked about non-linearity, we said that it is a phenomenon of inexplicability on unpredictability as to how things occur. But, when we talk about simple non-linearity, we say that yes, things have had occurred but then things will occur in a related way but not exactly the same way this can be kind of compared with what I said earlier that there is an innovator and there is also a differentiator. Differentiator takes on the path made by the innovator but he does not exactly mimic the innovator he tries to differentiate himself.

Similarly, when we look at simple non-linearity, we will talk about somebody taking on the path of the pioneer but then improving upon it substantially. So, when we look at email, we have email that is now much stronger much more robust and much more agile and it is also becoming more intelligent than ever. So, if outlook was one phase of such improvement today we have AI powered email that has come in. Similarly, Twitter was another way of messaging, but it came with the brevity as its core competence or core appeal. Then WhatsApp came as a channel for transmitting all kinds of media from text messages to media messages or video messages and it came with the additional strength that it was fully encrypted.

Then came Instagram as a complete photo sharing application which is very focused on telling a story through photographs and commentaries and then also offering the capability to post edit and develop high resolution photographs which give you a feel of being there in this system. And tomorrow, probably AR,VR will be so common place that newer generations of this kind of systems and the procedures would come into play. So, all these are opportunities for startups. So, straight linearity as we discussed in one of the earliest sessions is a fertile ground for regular entrepreneurship, where a simple non-linearity is a fertile ground for startups.

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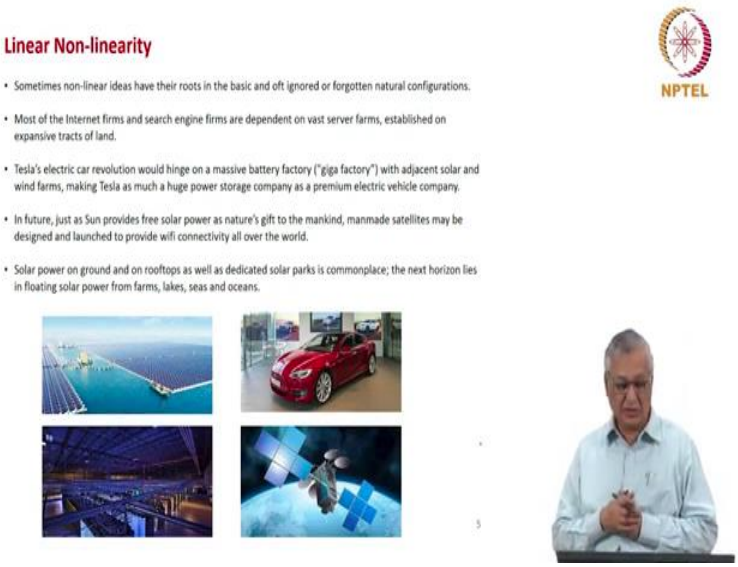

Then we also have linear non-linearity, what do I mean by that, what I mean is that nonlinear ideas can also have their roots in very basic and oft ignored or forgotten natural configurations. Now for example, we have internet forms, battery forms, server forms these are all set up in vast areas of land it was like warehousing of the established brick-and-mortar industry. Therefore, land is the basic asset which is being used in this kind of endeavors and newer types of Giga factories are developed as far as the electric kettles are concerned to ensure that they required battery manufacturing capacity is provided.

Similarly, Sun provides a lot of energy, which can be used for solar purposes. But that can be combined with the way in which we put the solar panels on. They could be put on the ground or could be put on the lakes, oceans, sea fronts. And that would help combine two of the basic natural parameters into a linear system. Similarly, we will find soon different kinds of materials

which will add solar strength solar power strength to our conventional buildings and even cars could be solar clattered cars. So, there is a non-linearity but that non-linearity can be described in terms of linear development of technology that has been happening. So, we have simpler non-linearity and also a linear non-linearity. All of these things are tremendous opportunities for startups to think of innovative ways in which they can use their innovative capabilities to develop new businesses.

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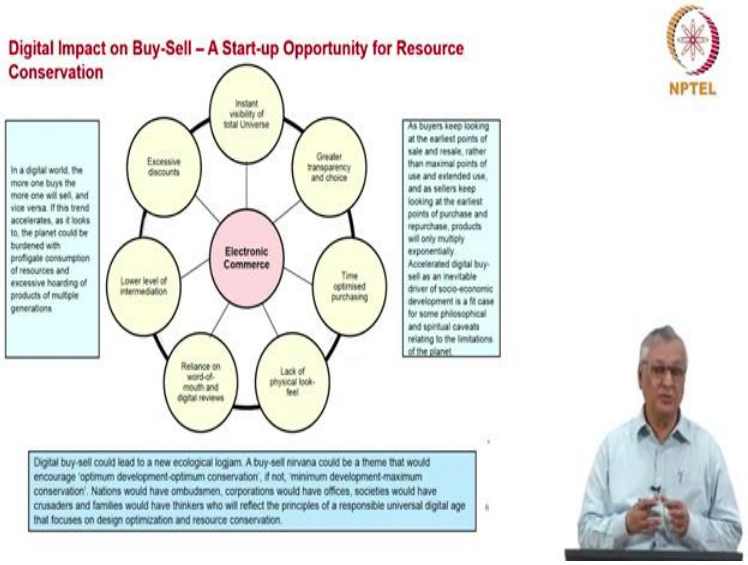

Now when we look at a digital impact digital impact, digital impact has been going one way. Digital impact has been increasing these transactions that happen on the by cell form. So, if you look at the kind of billions of transactions that have occurred in great Indian festival season of Amazon or Flipkart, you will see that the number of transactions have gone up several fold. And with the exchange platform being available, now you it is very easy for a person to exchange his product to another product. What this means is that the number of times a product is turned over has increased. The number of new products that are being produced and sold has increased.

Therefore, there is that much pressure on the earth's resources. Because, as we discussed in the earlier session, we cannot have a situation, where that is continuous and rapid growth in all the aspects of production and that will expect that the earth will be able to accommodate all of these things both in terms of the new products as well as the discarded or scrapped products. So, how does, how do you manage this total ecosystem of increased growth and increased consumption

with the need to conserve as resources. So, how do we develop a circular economy, where in we have as a goal zero waste, we have as a goal complete recycling of whatever is being produced and used and as a goal we have a way in which we will produce less consume less but will sustain ourselves better.

So, this is again a great opportunity for startups to think, how do you do that and the way we think could be in terms of much better or much lower material usage. It could be in terms of much better and much higher levels of material extraction, re-extraction and reuse. And it could be much better way of signaling, when to actually you discard a product and move on to another product. So, how do you clearly define the lifecycle of a product in the hands of the first purchaser in the hands of the second purchaser and then adopt different algorithms to say how do we really make inter-product or intra-product transfers very effective and useful for the earth as a whole. So, on one side, we have digital technology enhancing the by cell transactions therefore priming the consumption based production economy that is one aspect of startup scenario. But, there is also another aspect of startup scenario, which talks about conserving resources in this kind of burgeoning digital economy scenario.

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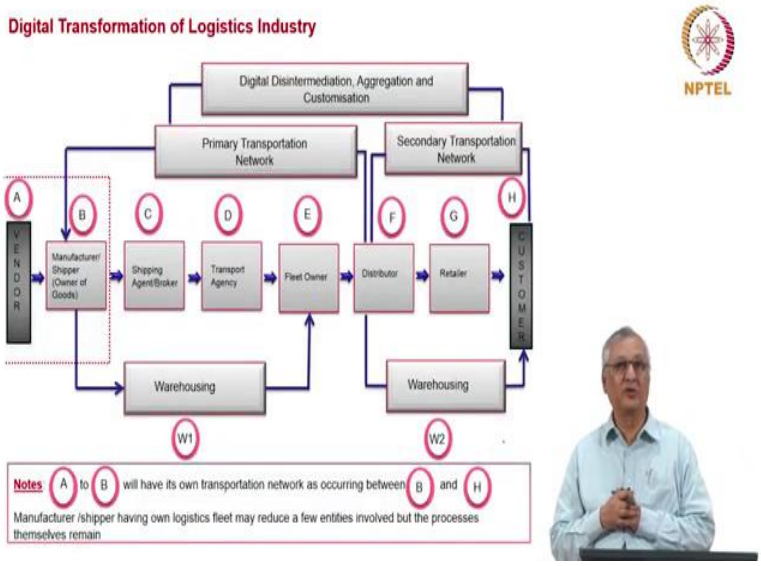

Now, how does this digital transformation of large industry happen? So, we can take an example of the logistic industry. If you look at the logistics industry, you will find that typically a manufacturer or a shipper in this case we see him or her as B. The manufacturer or shipper of the

goods is the owner of goods and the owner produces the goods, through components taken from several vendors which is A. But, from B the product has to reach H, The customer. And when the product moves from B to H, we will have a number of agencies who are having a role in how this product is transmitted. Because, typically you are transmitting a product, you will have a shipping agent or a broker, whom you contact for getting the proper truck and then the truck is sourced from a fleet owner and the fleet owners sends the product to the distributor. Therefore, from the manufacturer B to the distributor F. We have the primary transportation network that is it finds a new home.

If the produced product has been sitting in the warehouse of the manufacturer it is moved into the distributors warehouse and that is when a new house comes up. But then that is not the end of the sale the distributor has to sell to the retailer and the retailer has to sell to the customer. So, you have the secondary transportation network from F to H.

So, what you have here, here are two types of movement. The primary transportation movement and the secondary transportation moment and each backed by one type of warehousing in the primary sector and another type of warehouse and in this secondary sector. But the point here is that this entire industry at least in India is completely organized or disorganized in the individual truck owner segment by enlarge. And also, there was no way in which these demand patterns these supplier patterns could be coordinated except in terms of large companies and regular moments. So, there was a great opportunity to aggregate, converge the demand and supply notes and make sure that the products move with the utmost efficiency. Thus came this idea of digital disintermediation aggregation and customization which sits over the primary transportation network and the secondary transportation network and make sure that the logistics is efficient.

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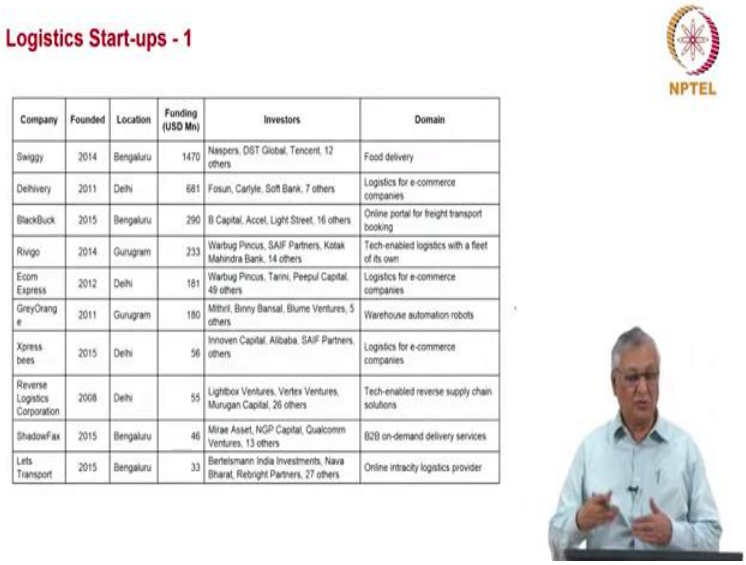

Company	Founded	Location	Funding (USD Mn)	Investors	Domain
Swiggy	2014	Bengaluru	1470	Naspers, DST Global, Tencent, 12 others	Food delivery
Delhivery	2011	Delhi	681	Fosun, Carlyle, Soft Bank, 7 others	Logistics for e-commerce companies
BlackBuck	2015	Bengaluru	290	B Capital, Accel, Light Street, 16 others	Online portal for freight transport booking
Rivigo	2014	Gurugram	233	Warbug Pincus, SAIF Partners, Kotak Mahindra Bank, 14 others	Tech-enabled logistics with a fleet of its own
Ecom Express	2012	Delhi	181	Warbug Pincus, Tarini, Peepul Capital, 49 others	Logistics for e-commerce companies
GreyOrange	2011	Gurugram	180	Mithril, Binny Bansal, Blume Ventures, 5 others	Warehouse automation robots
Xpress bees	2015	Delhi	56	Innoven Capital, Alibaba, SAIF Partners, others	Logistics for e-commerce companies
Reverse Logistics Corporation	2008	Delhi	55	Lightbox Ventures, Vertex Ventures, Murugan Capital, 26 others	Tech-enabled reverse supply chain solutions
ShadowFax	2015	Bengaluru	46	Mirae Asset, NGP Capital, Qualcomm Ventures, 13 others	B2B on-demand delivery services
Lets Transport	2015	Bengaluru	33	Bertelsmann India Investments, Nava Bharat, Rebright Partners, 27 others	Online intracity logistics provider

So as a result of digital companies entering this logistic space, we are seeing a whole set of new wave of logistic startups, which are having a significant amount of funding let us say from 1.5 billion dollars which a food delivery company like Swiggy has had.

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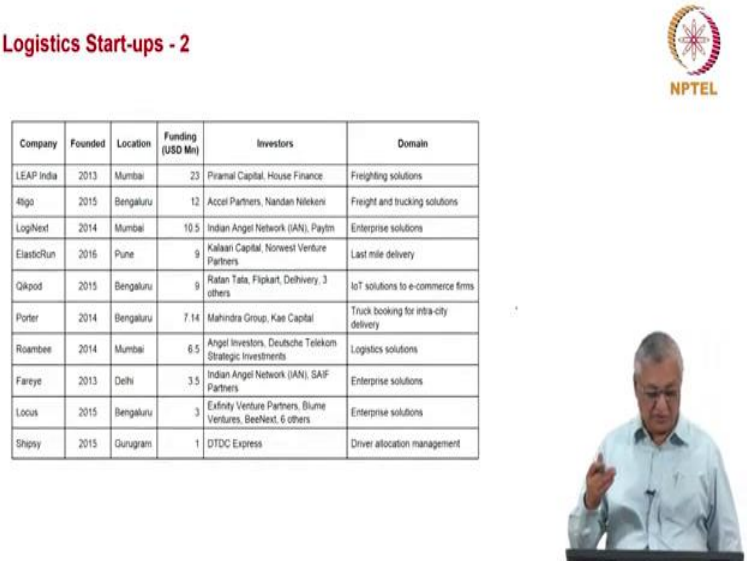

Company	Founded	Location	Funding (USD Mn)	Investors	Domain
LEAP India	2013	Mumbai	23	Piramal Capital, House Finance	Freighting solutions
4tigo	2015	Bengaluru	12	Accel Partners, Nandan Nilekeni	Freight and trucking solutions
LogiNext	2014	Mumbai	10.5	Indian Angel Network (IAN), Paytm	Enterprise solutions
ElasticRun	2016	Pune	9	Kalaari Capital, Norwest Venture Partners	Last mile delivery
Qikpod	2015	Bengaluru	9	Ratan Tata, Flipkart, Delhivery, 3 others	IoT solutions to e-commerce firms
Porter	2014	Bengaluru	7.14	Mahindra Group, Kae Capital	Truck booking for intra-city delivery
Roambee	2014	Mumbai	6.5	Angel Investors, Deutsche Telekom Strategic Investments	Logistics solutions
Fareye	2013	Delhi	3.5	Indian Angel Network (IAN), SAIF Partners	Enterprise solutions
Locus	2015	Bengaluru	3	Exfinity Venture Partners, Blume Ventures, BeeNext, 6 others	Enterprise solutions
Shipsy	2015	Gurugram	1	DTDC Express	Driver allocation management

And to much smaller ranges, as we have in DTDC Express funded, Shipsy, driver allocation management company. And many of them are straight freight delivery companies but some are also monitoring companies, some are also emergency backup companies, some are focused on first mail delivery, some are focused on last mile delivery. And there is some kind of pan-Indian

focus in some companies and in some companies, it is a global focus. So, when we look at digital disintermediation it has led to several companies which are entering the space and helping this whole sector organize itself better.

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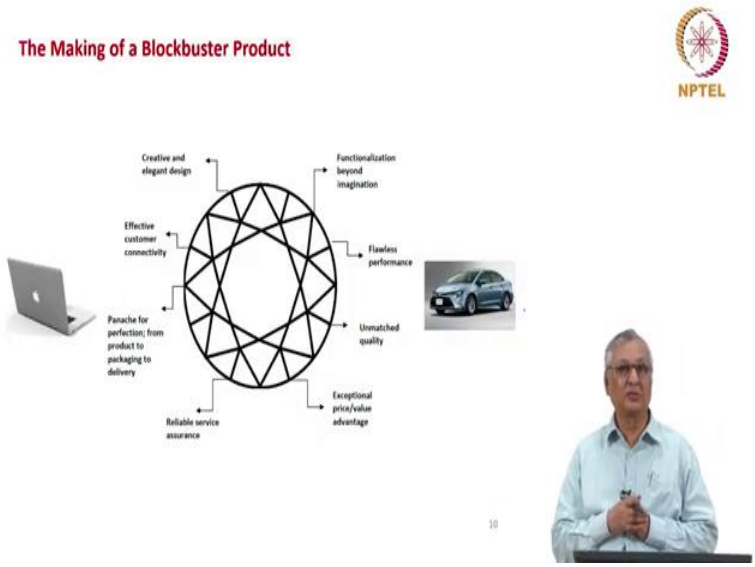

Now, let us look at product. We talked for example, on innovations and we said that the fundamental innovations are going to change the way we are going to have the product, create a new market for the startup. So, the product can be very simple it could be a just a sensor, which senses the noise on the railway track as the train moves and detect therefore whether there is any abnormality and then alert the driver on the kind of abnormality that could happen. Now, that sensor itself could be a simple sensor and very much bear borne product, or it could be a product that has been embellished in with various other features that it becomes really a blockbuster product and all the transportation networks particularly the rail railway lines take that as a very favored and important product. Therefore, there is this concept of a product and there is this concept of a blockbuster product. A blockbuster product is one which has got all the ingredients judiciously mixed, for example, it will have a very creative and elegant design it will have functionalization beyond imagination.

So, reverting to the sensor example we have, the purchase could be for finding out the nature of crack that could be developing in the railway track. It could be about warning based on the sound vibrations but then it could also generate so much data on the age of the rail and the quality of

the rail. It would also help the company do its own algorithms and predictive maintenance on likely need for improving upon the rail track system. Therefore, a kind of functionalization beyond imagination as far as the product could occur.

Then of course the flawless performance. When we talk about this sensor, the sensors itself should be so insensitive to the vagaries of the weather. But very sensitive to what it is supposed to measure that is the thermal heat profile or the noise profile of the rail and the engine and the railway track that you should have complete quality its development and in its performance. Then it should provide exceptional price value advantage. Now certain of the products for example this particular product cannot be charged on a per kilometer basis, neither they can be charged on the basis of one time acquisition costs. So, appropriate pricing models appropriate business models have to be developed which happened to be win-win for both the developer as well as for the user.

Then comes the need for reliable service and assurance and finally there should be a finance for perfection as far as the product is concerned. From the time it is produced to actually it is delivered it should be perfect, then once that has happened an effective customer connectivity has to be maintained. Therefore, this product with all these attributes becomes a blockbuster product. So, when you look at an Apple laptop or a Toyota Corolla which has been achieving design and manufacturing excellence ever since the products have been produced for the first time and the way the brands have maintained themselves in the tough competitive markets do indicate that there are blockbuster products and that is the emulation which startup should have when they are developing any product, yes, we discussed the concept of Minimum Viable Product but then the ultimate idea should be for the ultimate desirable product. So, that the innovation finds its product niche as we go forward.

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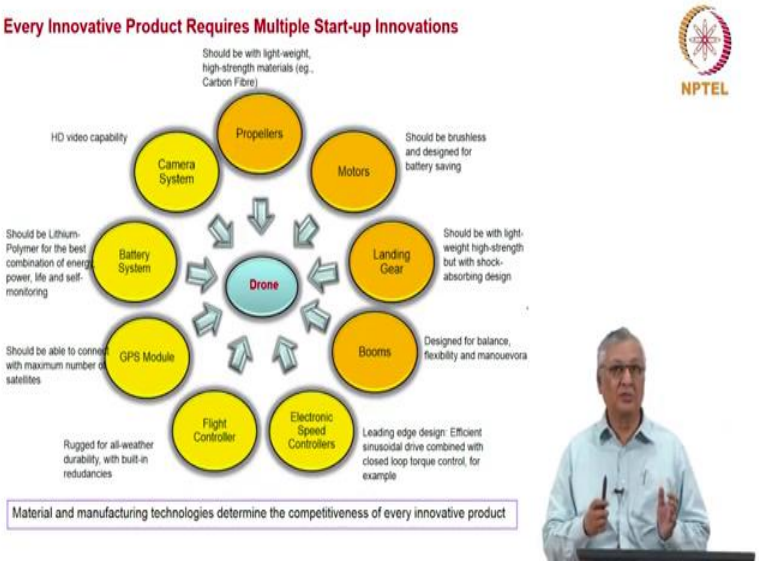

Now every innovative product requires multiple startup innovations. So, when we see a drone as a new product as a new technology, we will have to recognize that that drone itself could be improved could be reinforced in several ways and each of those ways could provide an opportunity for a startup or entrepreneurial operation. So, the more products come into the industrial space the more opportunities emerge for the startups and the entrepreneur firms. For example, a drone requires propellers, the propellers should be of lightweight but of high strength material because they assume high speeds as they rotate themselves to power the drone up and we need to use exotic materials.

For example, Carbon fiber as known today to ensure that the propellers the front as well as the back propellers have got the necessary strength. Then motors, we should have brushless motors so that there they save the battery. As far as the landing gear is concerned, obviously they should not be adding to the weight of the drone to any notable extent but they should have high strength but more importantly they should be able to withstand the weight of getting onto the land. Then, we have booms which should be designed for balance, flexibility as well as maneuverability.

Then, we have electronic speed controllers, it should have leading-edge design, efficient sinusoidal drive combined with closed-loop drop control. So that they are able to provide the kind of smoothness in which the flight is coordinated and the GPS system is put in place. Then we should have flight controllers which are which in a way are this CPU of the drone systems

and there should be built for all-weather durability with inbuilt redundancies. Then the GPS module, it should not be one satellite GPS module, you should be able to take in inputs from different GPS and satellite systems so that they can be used in any terrain. You may be making drones in India but probably the drones could be used in Africa as well as in America.

So, how do you really ensure that this GPS system is more perfect than a customer would know one at the time of purchase, that is your responsibility and your opportunity. Similarly, the battery system, should we have lithium polymer battery for the best combination of power density energy density and also long life. And then, what kind of camera system we have because the purpose of drone in certain cases is entertainment and video capture and in certain cases to look at, how the plant is evolving, how the soil quality is there for high-definition video capability is also extremely important.

So, when we look at all of these things again if all of these things happen in the best possible manner you will have a blockbuster drone product. But, to make all of these things happen in the blockbuster way, you require technology for each of these sub components. So, we are having technologically driven a new startup ecosystem every time a new product is manufactured. So, it is good to think of drone as the new product which a startup should aim at but that startup should also see how several other ancillary startups can be developed to ensure that the technology that goes into the drone is also of equally high caliber. So, material and manufacturing technologies in this case for example, are extremely important to determine how this drone performs. In the case of the consumer product like shaving cream, we felt that material technology probably is adequate to ensure that the product deliver superior value for the consumer. But, in the case of a drone, which is part industrial and part consumer the material technologies have to be combined with manufacturing technologies to ensure that the best possible end product is manufactured. Again, lot of opportunity for startups in making this happen.

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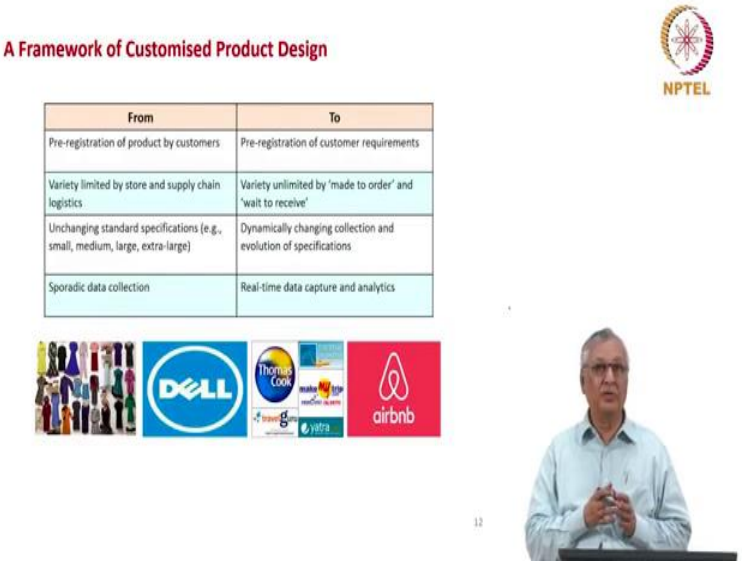

So, when we talk about innovation, innovation comes from customizing the product design and customization happens by recognizing different kinds of customer inputs and then making them happen. Earlier, we discussed this example, very exciting example, I would say of customized ready-made apparel, which is a kind of oxymoron because ready-made appearances are made ahead of the demand being known whereas customization means that you got to really measure the body dimensions and then stitch a parallel to suit that. But then, by ensuring that you have taken universal database over time and then you have applied the machine learning, artificial intelligence, you are going to develop an apparel which is as good as mass customized.

So, that is the feature of customized product design and customized product design could be in a very basic form, pre-registration of the product by customers saying that, I want ABCD. It could move to the pre-registration of customer requirements to finally it could go to the pre-forecasting by the database of the customer requirements. Then, when you look at customer product design you must be changing your mindset from store design or supply chain logistics. But and instead go to made-to-order and wait-to-receive that kind of system. Then we have in customized product design dynamically changing collection and evolution of specifications and in the case of other areas like data collection it is a kind of continuous 24 by 7 process which happens over and over again and there is no stoppage as far as the data collection is concerned. That is the kind of difference which happens. To some extent companies like Dell have started this movement

but that is not going to be as significant as what would happen in future when you apply data base big data analytics and machine learning to this activity.