Entrepreneurship
Professor C. Bhaktavatsala Rao
Department of Management Studies
Indian Institute of Technology, Madras
Technology, Business and Operations Strategies
Part 2

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And technology also helps startups in the not for profit segment as well. We should not think that startups are used only for creating businesses that churn out money, startups can also be used as a concept in not for profit as well. So, we have 6 examples here. Chimple is a startup, which is using artificial intelligence and gamification to help children who are in the age group of 4 to 8 years to learn on their own, using a software loaded on Android tablet.

And this has been developed by a person, who observed, that his security guard would not be able to teach his child once he moves out of this community for certain job or specific reasons, then he thought, that how would I ensure that the child is placed agnostic in terms of learning, she has been going to the school here, but she will not be able to go to school later.

So, I should provide a product which will be helpful to such underprivileged children. So, is a not for profit startup and it has come up. Similarly Dost education which gives audio curriculum to the parents, who can in turn provide it to the children, then reap benefit again builds up communities who solve social problems through gamified applications, Intelehealth tech based high technology, Primary Health Solutions for the health workers which can be communicated and which can be deployed in the rural areas.

Aquasafi, it's an IOT based clean drinking water supply solution for villages. Then Simpli Blood it is a tech based communication medium between the blood seekers and blood donors in case of urgent and non-urgent medical needs.

We also are having incubators and accelerators. who have mentorship from different experienced corporate executives and are backed by Indian and global multinationals in making that, in making sure that not for startup, we have organizations like NCORE with corporate and MNC support, and who also offer mentoring by experienced executives to make sure, that this kind of not for profit startup movement also gains momentum.

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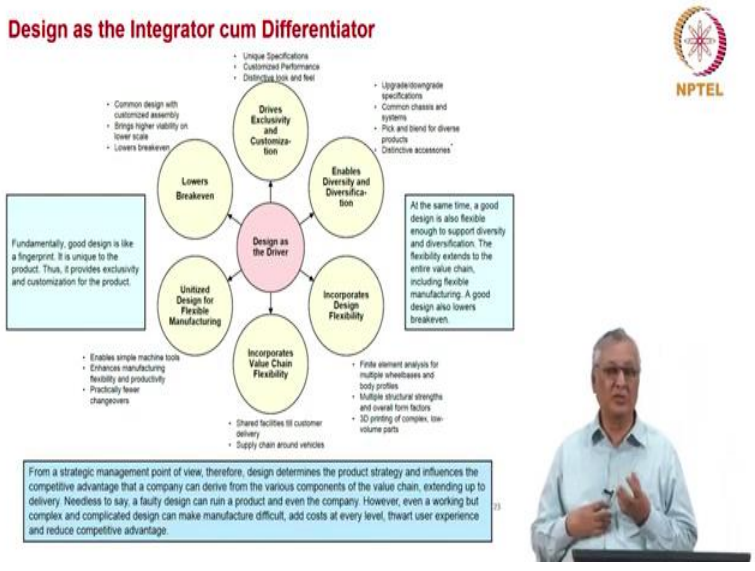

Now, when we look at all of these things, when we look at innovations, ultimately all innovations are to be express through design. So, how elegant is your design that is the

integrator. That is also the differentiator. When we look at design, there are several aspects of design as I have positioned here.

One, design drives exclusivity and customization, it could be the same capability in terms of technology, but the way it is designed and put into a product and provided a visual appeal, it drives exclusivity and customization, but at the same time design by ensuring that there is a match between variety and also standardization, it helps diversity as well as diversification.

Then design can provide flexibility both in terms of manufacturing and in terms of customer segmentation. Good design ensures value chain flexibility. It also has certain unitization parameters. So, the manufacturing can be undertaken in flexible manufacturing units. And when design is standardized and also diversified, it lowers breakeven point.

Because by the way of diversification, you are able to address larger market and by means of standardization, you are able to ensure repeatability and high manufacturing economics, therefore the breakeven is ultimately lower. So, a good design ultimately is like a fingerprint, it is unique to your product and very often you can understand that this product belongs to this manufacturer by the way this product is designed.

Therefore, it provides exclusivity and customization. But a good design also, is an internal aspect providing flexibility to the company, to be able to manage multiple SKU’s under the same shop floor. So, it reduces the breakeven. So, from a strategic management point of view, design determines, how the product strategy gets generated and product strategy in turn determines, how the business success is achieved.

So, when a startup makes its products, it has to configure how to be successful with a low volume of sale. When a startup configures its product, it has to be very clear on the design philosophy, it has to adopt in a manner that the breakeven is lowered, but at the same time the market exposure is maximized.

And that is where this skill lies, and providing this kind of strategic design solutions, providing this kind of integrated design cum manufacturing solutions itself, could be a

startup opportunity for people who are good in operational excellence algorithmic development, understanding of market needs and forecasting, etc.

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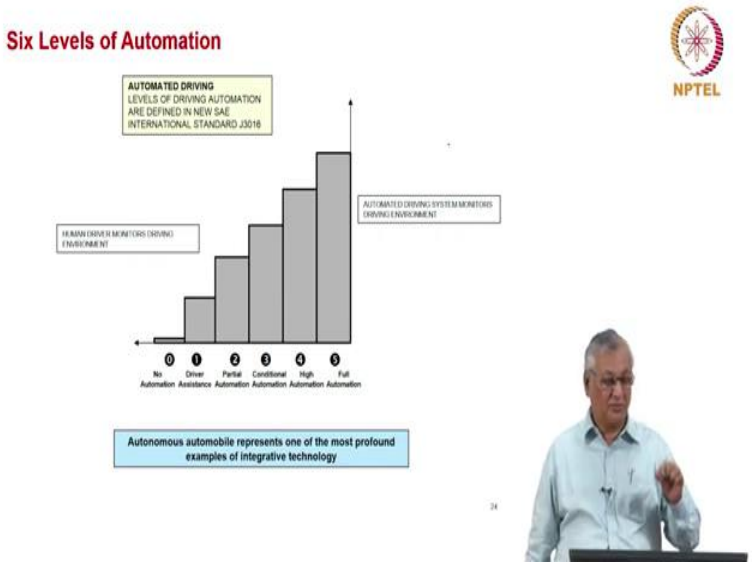

Let us look at automation. When we look at automation, we can look at it as a trend. But when we look at automation going from zero level, which is no automation, which is present, present in India I mean, to driver assistance, partial automation, conditional automation, high automation and full automation, you can easily perceive that there are opportunities all the way.

And it is a way of integrating all elements of technology into one new system and that itself calls for a lot of startup capability as we move forward.

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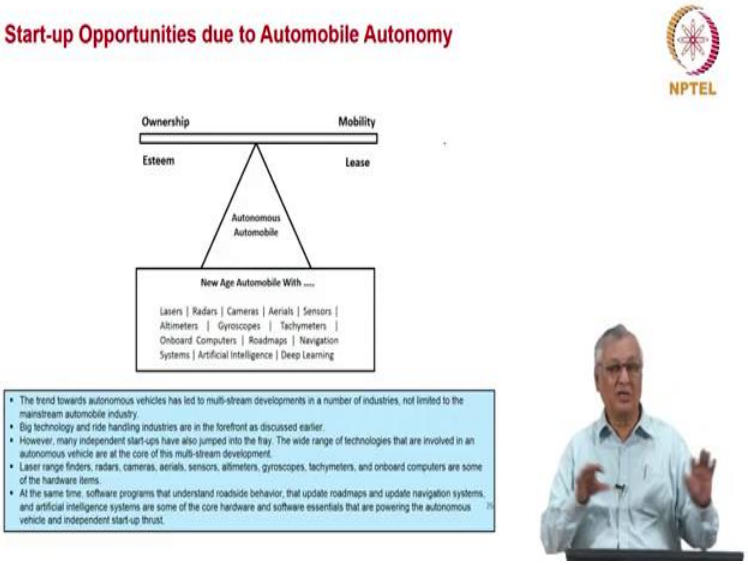

And when we look at the automobile autonomy, you will find that the entire thing has got several opportunities. One is the entire discovery piece of where the vehicle is positioned. So, you need a laser, you need a radar, you need a camera, you need the aerial, you need sensor, you need altimeter, gyroscope, tachymeter, onboard computers, roadmaps, navigation systems, artificial intelligence, deep learning.

So, all of these things provide automobile autonomy and today, none of these products is manufactured as an ancillary product to an automobile company, which means that the entire aspect is a veritable attractive field for startup activity.

Now, this is having certain philosophical overtones in terms of how the market evolves. For example, there is a shifting mix of ownership versus esteem. Ownership was used to be seen as giving esteem. But today, mobility is considered more important than ownership. Leasing of a vehicle is considered more important than owning the vehicle hundred percent.

So, there are some kind of behavioral changes which are happening in the marketplace which companies like Uber and Ola trying to capitalize that is one, at one level at which the startups operate at the market positioning area, but for those things to be operated in

the actual field, you need still automobiles, and that automobile has to be equipped with all these kinds of products.

So, this is another space where the startups will work. So, the more innovation you can think of in the products, the more opportunities come in the startup domain.

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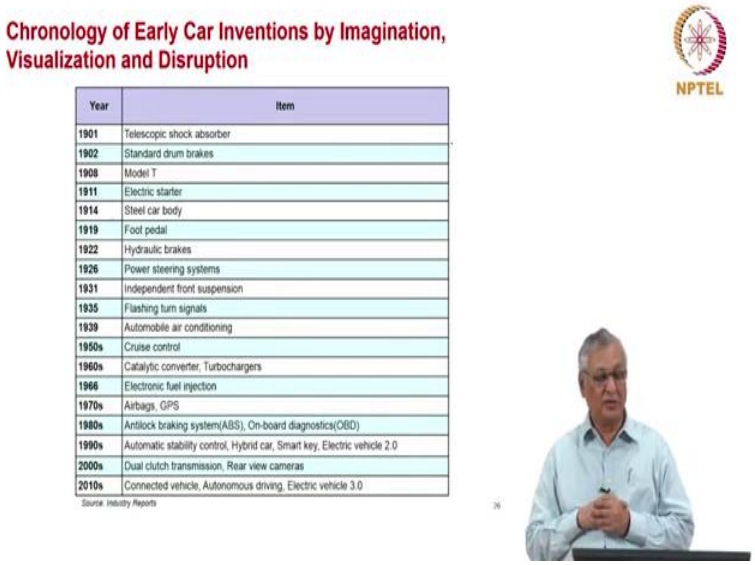

So, if you look at the chronology of early car innovations by imagination, visualization and disruption, you will find that from 1901 to 2010 a number of products have been visualized and then put into place by car manufacturers or the ancillary manufacturers and they have given rise to startups which eventually become big companies.

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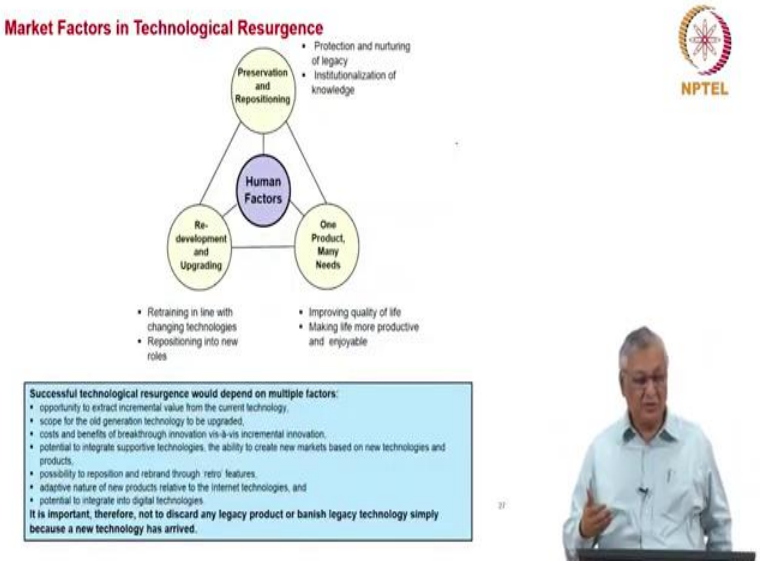

So, when you do this kind of market factors in technological resurgence, from innovation we are moving to resurgence, that is, you are enhancing the ability of the product, ability of the human being, to manipulate his product for his or her quality of life, and that happens through preservation and repositioning. It happens by providing one product which meets many needs. It also happens by redevelopment and upgrading.

In each of these things, there is a kind of tutorial aspect which is involved, when you are doing preservation and repositioning, you need protection and nurturing of legacy you need institutionalization of knowledge. When we develop a product for versatile needs, you understand that it improves the quality of life, but also you should enable the person who is using understand how he can use the product for many needs.

Then when you do a product in a different manner, you need to retrain your employees in line with the changing technologies and reposition them into new roles. So, it is not always necessary that legacy products should be forgotten and new products should be always embraced. We should also see to what extent the legacy products can be improvised and improved and ensure that material conservation takes place to the maximum extent possible.

Again, another area where startups can be used. For example, various state governments are today looking at having a 15 year time limit for registration of old vehicles that means any vehicle, which has crossed the 15 years from the date of first registration will be automatically computer locked and cannot be registered anymore.

So, it is a way of introducing, scrappage policy, or should that vehicle be scrapped completely? Should there be a methodology by which it is trained to be more efficient, and how does it happen? So, could engine tuning be a new startup activity? Could engine refurbishing could be a new startup activity? Or could engine retrofitting be a new startup activity?

Or could a portable vehicle testing system be a new way to determine how vehicles should be given an extra grace period, or how they can be viewed differently for different types of markets, perhaps non city market. So, these are all the opportunities, problems are coming up along with development, problems are coming up along with regulatory changes.

So, how do we address each of those aspects with a view to conserve resources, and therefore healthy society would itself be a business opportunity for startups.

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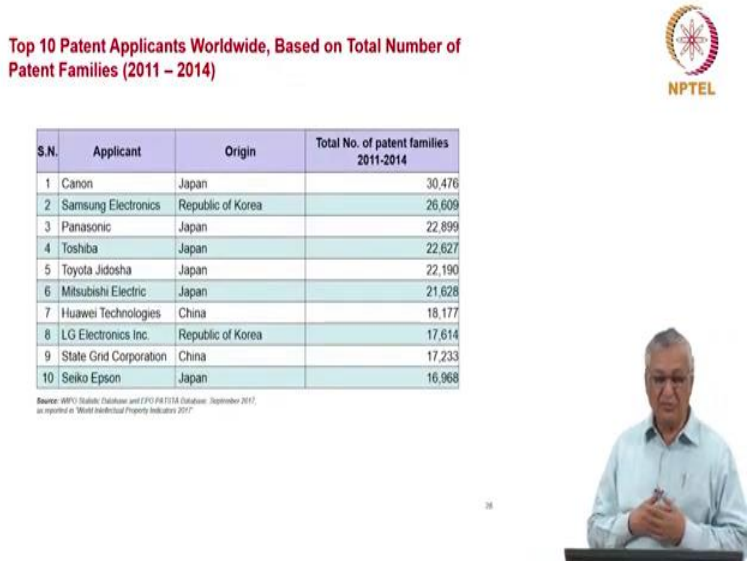

S.N.	Applicant	Origin	Total No. of patent families 2011-2014
1	Canon	Japan	30,476
2	Samsung Electronics	Republic of Korea	26,609
3	Panasonic	Japan	22,899
4	Toshiba	Japan	22,627
5	Toyota Jidosha	Japan	22,190
6	Mitsubishi Electric	Japan	21,628
7	Huawei Technologies	China	18,177
8	LG Electronics Inc.	Republic of Korea	17,614
9	State Grid Corporation	China	17,233
10	Seiko Epson	Japan	16,968

But to be able to do that we really need to enhance our patent application strength. As of today, if you see companies like Canon, Samsung, Panasonic, Toshiba, are filing thousands of patents each year and it is very important to ensure that our big companies are also in the forefront of patent filing.

And there should be a ground rule that no startup can really call itself a startup unless it has patented one or two of its core technologies and therefore there is an intellectual property which is built-in into the startup ecosystem.

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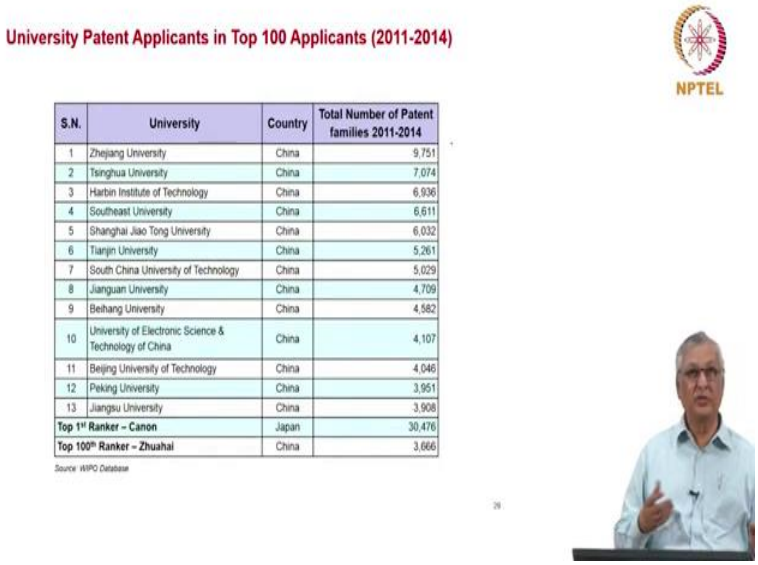
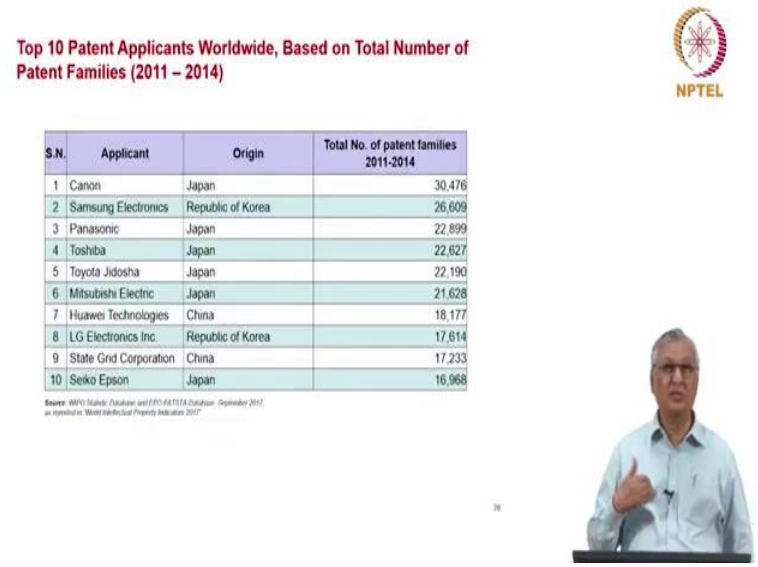


S.N.	University	Country	Total Number of Patent families 2011-2014
1	Zhejiang University	China	9,751
2	Tsinghua University	China	7,074
3	Harbin Institute of Technology	China	6,936
4	Southeast University	China	6,611
5	Shanghai Jiao Tong University	China	6,032
6	Tianjin University	China	5,261
7	South China University of Technology	China	5,029
8	Jianguan University	China	4,709
9	Beihang University	China	4,582
10	University of Electronic Science & Technology of China	China	4,107
11	Beijing University of Technology	China	4,046
12	Peking University	China	3,951
13	Jiangsu University	China	3,908
Top 1st Ranker – Canon		Japan	30,476
Top 100th Ranker – Zhuahai		China	3,666

Source: WIPO Database



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Source: WIPO Statistic Database and EPO PATSTA Database September 2017, as reported in "World Intellectual Property Indicators 2017"

So, if you have 10000 startups and each startup files 2 patents, at least for the core technologies it has, you will see that 20000 patents are filed, and that is a valuable input. And given, and when these startups derive their technologies from the university research, the multiplier effect of patent filing would only be much higher. It is remarkable that several Chinese universities are having patent filing levels, which are comparable with the patent filing levels of commercial organizations.

May not be exactly the same, but the level of research being done which is patent worthy in the Chinese universities, is extremely interesting. And that is some model which we need to really emulate in India.

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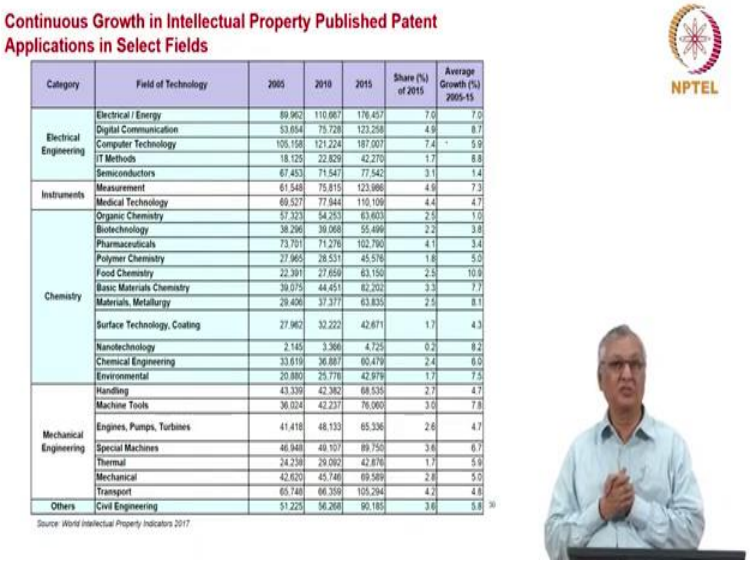

Category	Field of Technology	2005	2010	2015	Share (%) of 2015	Average Growth (%) 2005-15
Electrical Engineering	Electrical / Energy	89,962	110,667	176,457	7.0	7.0
	Digital Communication	53,654	75,728	123,258	4.9	8.7
	Computer Technology	105,158	121,224	187,007	7.4	5.9
	IT Methods	18,125	22,829	42,270	1.7	8.8
	Semiconductors	67,453	71,547	77,542	3.1	1.4
Instruments	Measurement	61,548	75,815	123,986	4.9	7.3
	Medical Technology	69,527	77,944	110,109	4.4	4.7
Chemistry	Organic Chemistry	57,323	54,253	63,603	2.5	1.0
	Biotechnology	38,296	39,068	55,499	2.2	3.8
	Pharmaceuticals	73,701	71,276	102,790	4.1	3.4
	Polymer Chemistry	27,965	28,531	45,576	1.8	5.0
	Food Chemistry	22,391	27,659	63,150	2.5	10.9
	Basic Materials Chemistry	39,075	44,451	82,202	3.3	7.7
	Materials, Metallurgy	29,406	37,377	63,835	2.5	8.1
	Surface Technology, Coating	27,962	32,222	42,671	1.7	4.3
	Nanotechnology	2,145	3,366	4,725	0.2	8.2
	Chemical Engineering	33,619	36,887	60,479	2.4	6.0
	Environmental	20,880	25,776	42,979	1.7	7.5
Mechanical Engineering	Handling	43,339	42,382	68,535	2.7	4.7
	Machine Tools	36,024	42,237	76,060	3.0	7.8
	Engines, Pumps, Turbines	41,418	48,133	65,336	2.6	4.7
	Special Machines	46,948	49,107	89,750	3.6	6.7
	Thermal	24,238	29,092	42,876	1.7	5.9
	Mechanical	42,620	45,746	69,589	2.8	5.0
	Transport	65,748	66,359	105,294	4.2	4.8
Others	Civil Engineering	51,225	56,268	90,185	3.6	5.8

Source: World Intellectual Property Indicators 2017

And it is also very interesting that there is continuous growth of intellectual property across the board. We may think that in patents may be filed only in machine learning artificial intelligence, neural networks or surgical robots and things like that, but you will find that electrical engineering instruments, chemistry, mechanical engineering, even civil engineering are open to high levels of patent filing still, that means what?

It means that even fundamental established industrial segments are also undergoing significant metamorphosis in terms of their technological edge. And when you look at chemistry, is no longer the chemistry of putting couple of chemicals and producing a new chemical compound.

Apart from organic chemistry, biotechnology and pharmaceuticals, we have got lots of improvements that are taking place in polymer chemistry in food chemistry, basic materials chemistry, we have seen how materials technology will influence both, consumption products as well as industrial products, materials, metallurgy, surface technology and quoting then nanotechnology, chemical engineering, environmental etc.

We will come to that aspect later additive manufacturing, but for additive manufacturing the core is to have materials which can fuse themselves into a product. How does that happen? It will only happen with materials technology being innovated upon, and that is a issue of chemistry, there is a challenge of chemistry.

Therefore, there is much hope that whether the domain is traditional or the domain is novel, there is going to be continuous technological change and the technological changes are going to impinge positively upon the changes that are required in the end product space.

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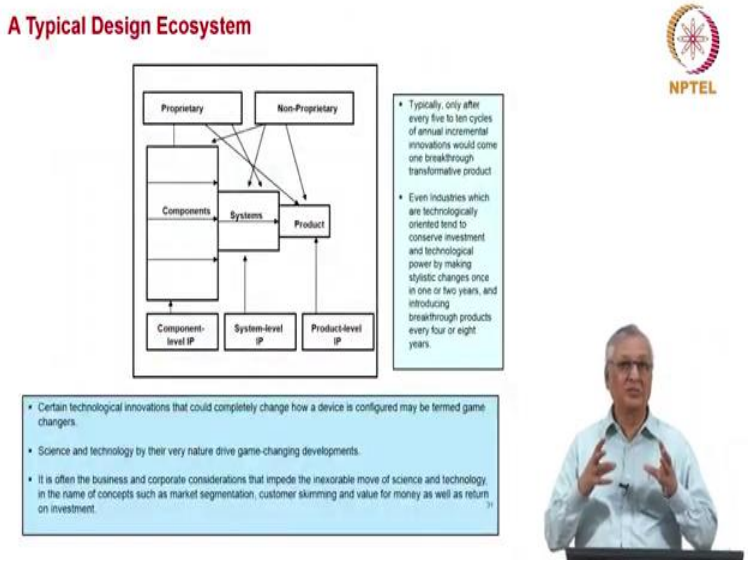

So, we should look at this design, the innovation the design as a total ecosystem, we may have proprietary designs, we may have a non-proprietary design system. Components would be there, systems would be there, products will be there. And we need to generate component level IP, system level IP and product level IP, when all of these things combine, then you will have a completely good design ecosystem.

There were times when we used to change the designs every 5 to 10 years, and have annual incremental innovations in the meanwhile, but today, changes are occurring at a much faster pace. And annual changes are becoming even 6 month changes. But certain

technological changes will occur every 10 years still, which could be game changers, how the industry is going to be used, or by the society.

So, science and technology by their nature drive game changing developments, and business and corporate considerations limit the kind of game changing technologies although they are in possession of those technologies, even a molecule like sugar, which may seem to be beyond any change and but is considered essential for ensuring some dietary habits, but also contributing to the issues of obesity and others human problems could be modified.

For example, a molecule of sugar can be combined with a molecule of honey and a better honeycomb could be developed or sugar molecule or the honeycomb itself can be fortified with more minerals, more new micronutrients, and serve twin purposes, or you may have to do it in such a manner that the product is able to withstand cold temperatures as well as high temperatures.

So, as you look at life, as you look at various activities we undertake, as we look at various inputs we consume, as part of our life, you will find that there are immense opportunities where new problems can be defined, and new ways of solving the problems are developed.

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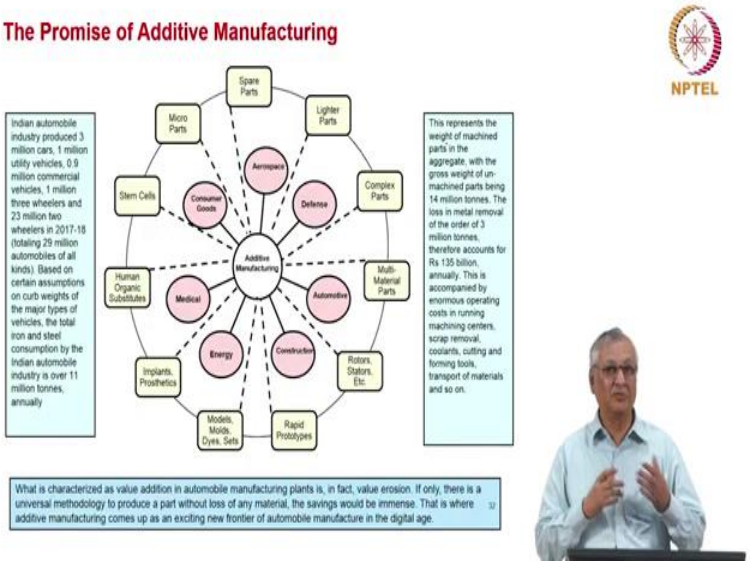

So, we have this additive manufacturing. It is going to change the manufacturing methodologies dramatically in future, typically we say that a lot of value is added in a shop floor, that is a manufacturing setup. In a way it is actually a misnomer because no value is added in the shop floor except that components are converted into a product, yes, that way value is added.

If you say that employees have spent X number of hours, Y watts have been consumed and certain support service have been taken all those costs become a value added for the product. Yes, it is true value added has been achieved or accomplished in the manufacturing shop floor.

But if you really look at the way the manufacture is undertaken, that is, you take a bar of steel or you take a flowing steel, cast it into an ingot or a bar of steel and that bar of steel is machined and lot of metal is removed to get a rough profile of the product you would like to fine machine.

And then you take it to a machine tool and then make it into a camshaft or crank shaft and then you do further grinding, honing etc to remove the final disturbing parts of the metal and make it into your fine product, you will know that you have removed a lot of

material and actually, it is not a value addition, it is a value erosion, that is happening in the manufacturing plant.

So, let us look at the Indian automobile industry just some hypothetical example not necessarily very accurate in terms of numbers. In 2017-18, the Indian automobile industry produced 3 million cars, 1 million utility vehicles, 0.9 million commercial vehicles, 1 million 3 wheelers and 23 million 2 wheelers all aggregating to 29 million automobiles of all types.

Based on certain assumptions on the unladen weight or the curb weight of each of the types of vehicles, we can estimate that the total iron and steel consumption by the Indian automobile industry is over 11 million tons annually. This represents the weight of machine parts in the aggregate, with the gross weight of un-machined parts being 14 million tons.

Now, if 14 million tons is put inside and then 11 million tons has come out, you know lost in material metal removal, 3 million tons, forgetting about the rejections and things like that, it therefore accounts for rupees 135 billion annually. And this is also accompanied by enormous costs in machining these kinds of losing materials.

Learning the machining centers, scrap removal, coolant, cutting and forming tools, transport of materials and then recovery of the coolants and the scrap and the effluent treatment facilities which are all adding to the thing.

So, compared to this, you may have seen a situation, where a powder is added together to make the crankshaft, so, that not even, even a speck of powder is wasted. And from design to manufacture, you do it elegantly through a 3D route, which is generally called 3D printing, but actually is additive manufacturing where you add particle by particle layer by layer of material to make sure that you get the product which you require.

And this has got enormous potential, micro parts obviously, can be made, parts which are got very complex, interior and exterior can be made by this, spare parts can be made because spare parts are typically have low usage in certain cases, so, it is not economical for big firms to produce therefore, smaller batch sizes this route is ideal.

This route could be ideal for lighter parts, it could be ideal even for complex parts, will be ideal for multi material parts. You cannot do multi material parts in the normal value conversion system which I described earlier, rotors, stators, etc, they are also very well used, rapid prototyping is another area, Dyes and fixtures, Jigs and fixtures can be made in this route.

Human implants and Prosthetics can be made in this route, human organic substitutes, and imaginatively stem cells can be made at one end and homes can be made at another end. So, the potential for this is so enormous that every industry aerospace, defense, consumer goods, medical, energy, construction, automotive could see additive manufacturing coming into full shape and they are likely to make a big difference.

So, again, you look at this wheel of progress for additive manufacture, two levels in terms of the parts which can be produced and in terms of the industries which can use those parts, huge opportunity upon startup activity.

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There are domains, which we thought were beyond the entry of small companies they had to be done only by Governments, Space Commissions, Space agencies, normal companies may not do. Then we had situation with some privatization, some kind of collaborative relationship between private companies and space companies.

And of course in the developed markets, such as US, we have got companies such as Amazon and Tesla, their founders, founding space companies, but then there is a growing requirement of Space Technology catering to multiple needs, there is a fundamental change that is occurring in the space industry where there is a requirement for a growing requirement for smaller low cost satellite.

And this provides opportunities for startups in space technology and they could cover various areas like lighter and smaller payloads, economical propulsion system, low earth orbit systems, optical communication systems, space infrastructure support systems, import-substitution efforts. So, it is an emerging opportunity.

So, while it has got relatively higher startup costs compared to the other areas, but the demand is determinate and the people who are looking for these kinds of services are very interested in paying the appropriate price to get these things. Obviously, integration of newer sensor technologies and the newer digital technologies such as artificial intelligence will provide the competitive edge.

But the role here is that there cannot be vanilla vendors, they need to be really technology driven vendors who take part in this space corporations R&D value chain from the beginning to the and understanding where the exact needs are.

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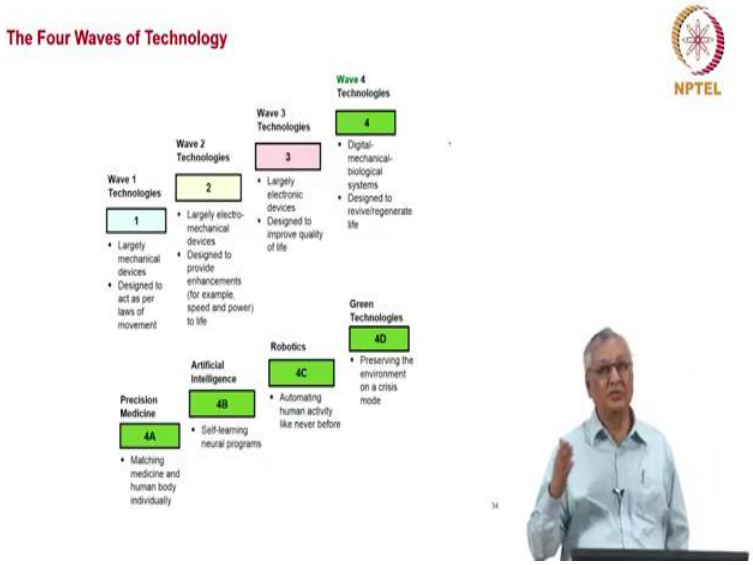

So, if you see the various industrial revolutions, we looked at this way, earlier also, first revolution, secondary revolution, third industrial revolution and the fourth industrial revolution. You can also kind of say, that first wave of technologies were largely mechanical devices, and they were designed to act as per loss of movement.

Whether it is a automobile engine or whether it is a printing press, they were moving mechanically, wave two technologies were electromechanical devices were in the power of electricity added impetus to the way the mechanical products perform their functions. So, speed and power got enhanced the versatility got increased.

Wave three technologies or electronic technologies, which provided the first means to bridge the distance they provided the first means to change the mode of communication. So, if you transmitted a message in a particular thought form to an actionable document, the document, for example, was electronically transmitted in a different form, and electronically re-produced in the original form.

Therefore, wave three technologies helped bridge the distances, enhance entertainment they were designed to improve the quality of life. But the current wave four technologies, they are combining the digital, mechanical, biological systems, they are trying to and revive regenerate life completely.

Now, if you look at wave four technologies there are 4-5 areas which I can think of one is precision medicine. Second is artificial intelligence. Third is robotics and fourth is green technologies. These are four important sub classifications of the wave four technologies which are having a big role as we go forward with technological development. And again, each of these sub segments is an important area of startup development.

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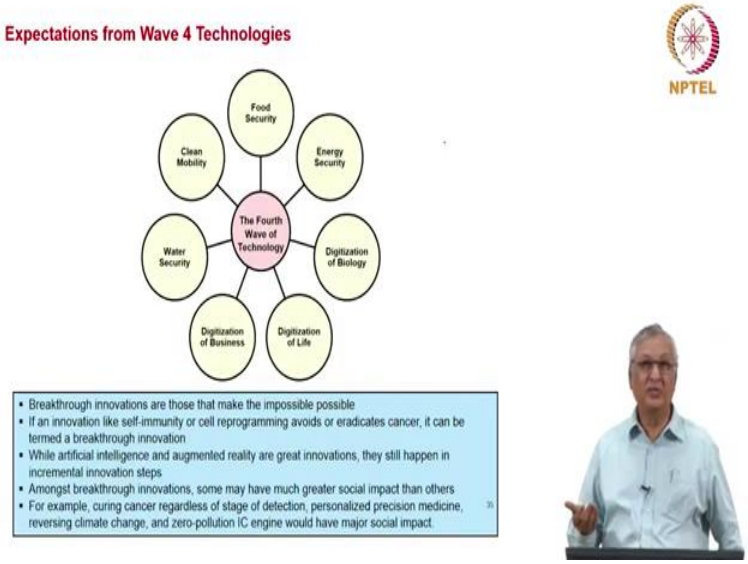

But the expectations from wave four technologies are quite different this time, it is no longer as I said in the beginning about more for more, it is more with less. So, people want food security, governments want food security. We all want energy security, but we want the least pollution. We want our age to be defined much better. We want to understand aging.

As a principle, we want to reconstruct, redevelop ourselves so digitization of biology, digitization of entire life, digitization of businesses has always been there. But understanding the business transactions with much greater depth and with more human intuitiveness than water security, and mobility essential, as always, but it should be clean.

So, when we look at these kinds of wave four technologies, we go back to what we said as the new developments that are happening which are fundamental innovations,

breakthrough innovations which make the impossible possible. How do we do self-immunity or self-programming a universal disease curing activity?

How can we eradicate cancer through ensuring our own cells have got the immunity to fight cancer and then destroy it, regardless of the stage of detection of a disease, we are able to cure the disease, how can we do those kinds of unimaginable things as possible that is the goal of wave four technologies.