Entrepreneurship
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Lecture 49
Entrepreneurial Thermodynamics Part 2

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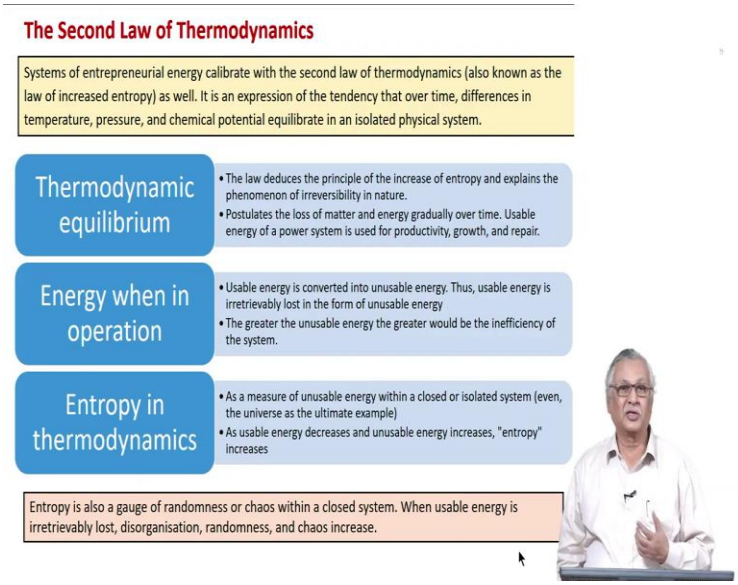

Then, we have the second law of thermodynamics, it says that the systems of entrepreneurial energy calibrate with the law, which talks about increased entropy. It is an expression of tendency over time, that difference, that differentiates differences in temperature, pressure, and chemical potential and how they equilibrate in an isolated physical system. So, what does it say? it talks about three aspects.

One, thermodynamic equilibrium, the principle of increase of entropy and explains the principle of irreversibility in nature. Second, it postulates the loss of matter and energy gradually over time. The usable energy of the power system for example, is used for productivity, growth, and repair.

When you have a battery fully charged, over a period of time the power of the battery gets discharged, unless it is recharged again. And, even after several cycles of recharging, it does not mean that it will be permanently at the same level of capability to charge itself as it was when it was factory-fresh. Therefore, there is increasing entropy, which comes into the system over time. So, that is the principle of thermodynamic equilibrium.

Second, energy when in operation, usable energy is converted into unusable energy. Usable energy is irretrievably lost, in terms of unusable energy and the higher the unusable energy, the more inefficient the device is. So, the efficiency of the system will be bench-marked against the minimization of unusable energy. Then, we have the principle of entropy in thermodynamics. It is a measure of the unusable energy within a closed or isolated system, and even in the universe as an example of the ultimate nature.

As usable energy decreases and unusable energy increases, entropy increases. So, that is the hallmark of differentiation between efficient companies and inefficient companies. In efficient companies' unusable energy decreases, usable energy increases, in inefficient companies' usable energy decreases, unusable energy increases.

So, it is a gauge; it is a measure of the randomness or chaos within a closed system. When usable energy is irretrievably lost, disorganization, randomness and chaos increase because a limited amount of energy, probably even decreasing level of energy is sought to be used for objectives which required higher level of energy. So, there would be randomness, there would be disordered, there would be chaos in the system. Therefore, the balance between usable energy and unusable energy should be maintained at a very healthy level.

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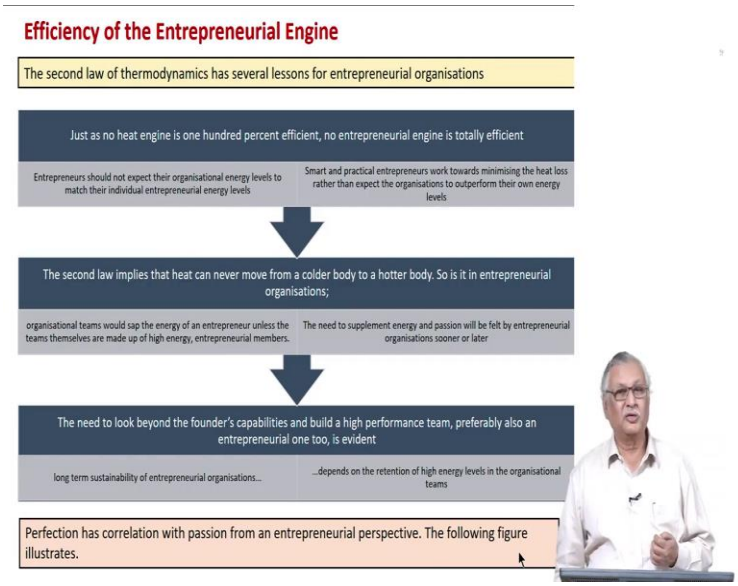

The second law of thermodynamics has several lessons for entrepreneurial organization. The first lesson, just as no heat engine is 100 percent efficient, no entrepreneurial engine can be 100 percent efficient. So, this is the first reflection or introspection which an entrepreneurial firm needs to have. Therefore, the law says, and we interpret from the law that entrepreneurs should not expect that their organizational energy levels will be matched by the individual entrepreneurial energy levels.

So, having high level of energy quotient on the part of founder does not ipso facto mean that the rest of the team members would have similar level of organizational energy. Therefore, what do smart and practical entrepreneurs do, they work towards minimizing the heat loss, rather than expect the organization to have near 100 percent heat efficiency. So, they would like to have team members who could outperform their own energy levels.

The second law also implies that heat can never move from a colder body to a hotter body and so is it, in an entrepreneurial system. The energy can move from higher body, namely the founder or the co-founder team and capable provision leaders to the rest of the members and not the other way. So, organizational teams could at times sap the energy of an entrepreneur unless the teams themselves are made of high energy entrepreneurially oriented members.

So, it is important for entrepreneurs to fill their teams with highly energetic passionate individuals. And, the need to supplement teams with such, such types of individuals will be effective sooner or later. And, the sooner this kind of transformation with reference to the entrepreneur teams is done, the better it would be for the organization as a overall. Which means that the founder should start looking beyond himself or herself and see, how the entrepreneurial energy can be sustained by high performance team, which is also ideally entrepreneurially oriented too.

So, this ensures the long-term sustainability for the organizations and also it ensure the energy levels are retained in the organizational teams. So, perfection has a correlation with passion, from an entrepreneurial perspective. So, when we talk about passion, when

we talk about the laws of thermodynamics, they all will be expressed not only in terms of an output, but more essentially in terms of perfect output.

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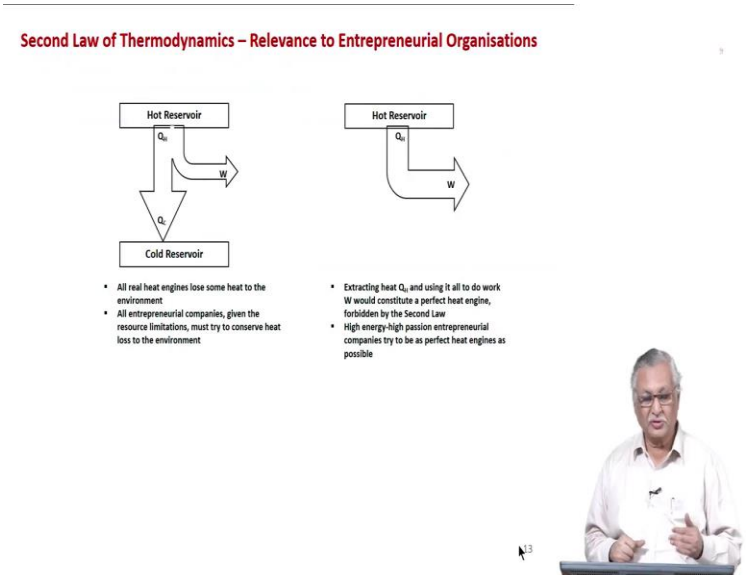

So, the second law of thermodynamics is relevance to entrepreneurial organizations. We can look at it from this angle, we have a hot reservoir and we have a cold reservoir. And, all heat engine lose energy to the cold reservoir, that is the environment and work is done. In an ideal situation, a hot reservoir converts itself to do all the work and lose no energy to the cold reservoir. So, extracting heat QH and using it all to do work W, would constitute the perfect heat engine; which of course is forbidden by the second law but it still remains as a goal of an entrepreneur. High energy, high passion entrepreneurial companies try to be as perfect heat engines as is possible, physically.

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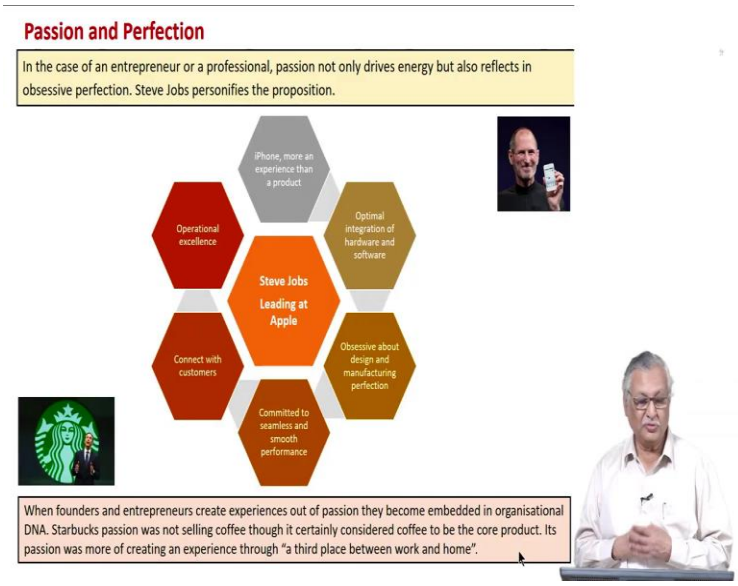

So, we talked about passion and perfection. How do they figure, we have two examples here. One is of Steve Jobs, and the other is Schultz who head, who headed the Starbucks. And of course, Steve Jobs needs no introduction. In the case of an entrepreneur or a professional, passion not only drives energy, but also reflects itself in an obsessive perfection, obsessive perfection means whatever we do, should be perfect. So, it could be in terms of tolerances, it could be in terms of look, it could be in terms of feel and experience; there should be perfection.

So, iPhone, the legendary cellular phone, developed by Apple is more an experience than a product, that is why it has been such a phenomenal success. Second, it also ensured optimal integration of hardware and software. There have been phones earlier, probably technologically more advanced, but they did not provide for the optimal interface and integration of hardware and software. The entire phone has been developed with an obsession that focused on perfection in design and manufacturing.

And the development and manufacture as well as supply of the phone was committed to seamless and smooth performance. From the whole system of un-boxing the phone to the final usage in the hands of the new customer, the whole cycle has been optimized for seamless and smooth performance. The launch of the products, the distribution of the

products, the build-up of expectations and anticipation has been done through very simple but effective connect with customers.

And finally, for the entire model to work out in a seamless and efficient fashion, a lot of emphasis on operational excellence. It could be supply chain efficiency, it could be design efficiency, it could be product lifecycle management, it could be the expression of quality parameters that are extremely appropriate for the kind of usage the phone would go through, selection of materials.

So, operational excellence has been at the core of these seamless and smooth performances of the product. So, these are the aspects of obsessive perfection, which have come about because the entrepreneur, the founder was passionate and he was also energetic.

Similar is the experience with Starbucks. The primary purpose of Starbucks was of course, to provide coffee. But coffee drinking was never the sole purpose or the sole outcome or the transaction of Starbucks outlet. He, the CEO endeavored to develop Starbucks retail outlet as a place which is the third place between home and work. So, he considered definitely coffee to be the core product, but the passion was more of creating an experience through a third place between work and home.

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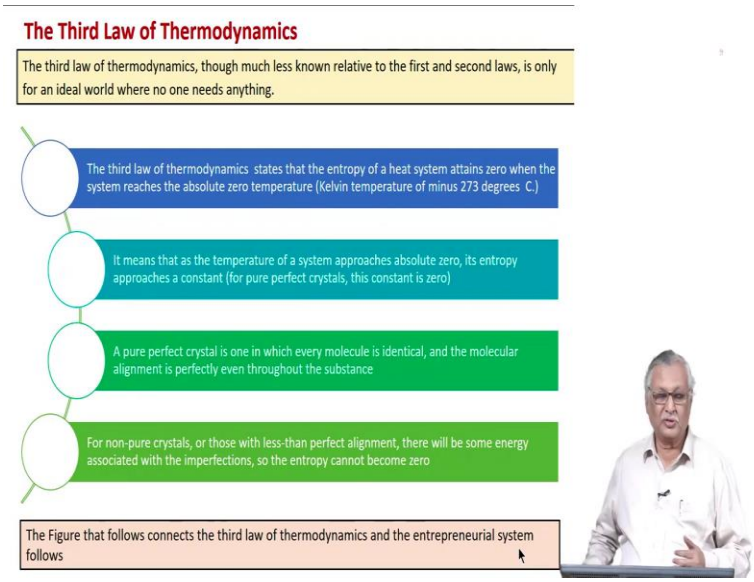

So, let us come to the third law of dynamics. The third law dynamics, though much less known relative to the first and second laws, is only for an ideal world where no one needs anything. The third law of thermodynamics states that the entropy of a heat system attains 0, when the system reaches the absolute zero temperature, which is Kelvin temperature of minus 273 degrees C.

It means, that as the temperature of a system approaches absolute zero, its entropy also approaches a constant. For pure perfect crystals, this constant is 0. And a pure perfect crystal is one in which every molecule is identical and the molecular alignment is perfectly even throughout the substance. And for non-pure crystals or those with less than perfect alignment, there will be some energy associate with the imperfections, so the entropy can never be 0. We have a figure that schematically connects the third law of thermodynamics with the entrepreneur system.

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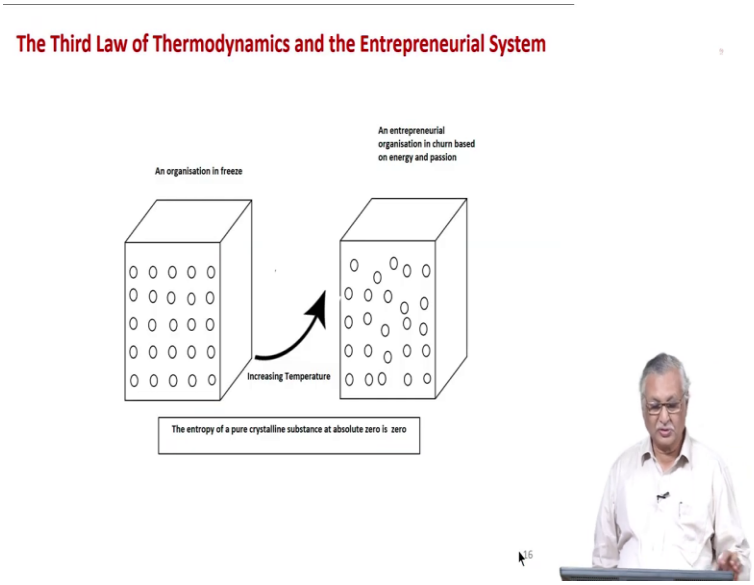

So, you have an entrepreneurial organization, imagine it to be freeze, then there would not be any temperature gradient. On the other hand, you have a temperature gradient, which makes for activity, which makes for energy, which makes for passion in an entrepreneurial organization. Then, you would see the organization to be in churn, in development mode. The entropy of a pure crystalline substance at absolute zero is 0. But an entrepreneurial firm cannot ever be an organizational freeze, it is always an organization on the move.

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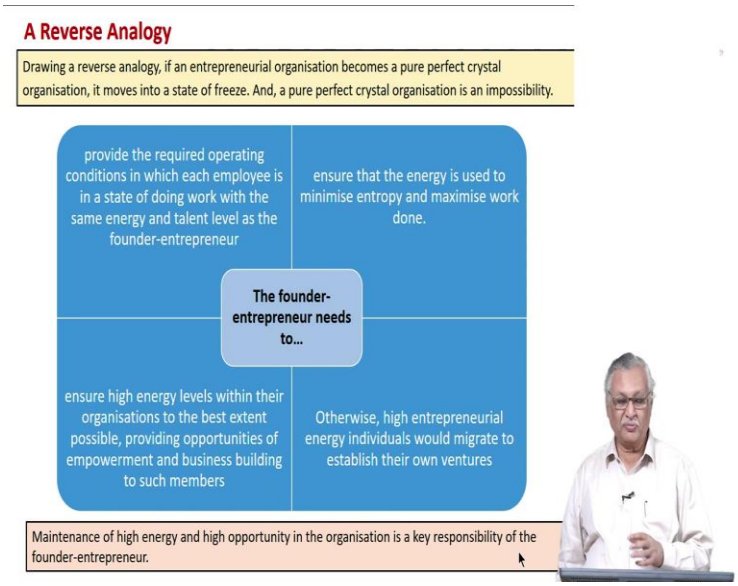

So, you can try a reverse analogy also. If the organization, what to ever become a pure perfect crystal organization, it moves into a state of freeze. And a pure perfect crystal organization is an impossibility. Similarly, an entrepreneurial organization shall never be or can never be an also ran company, it will always be dynamic, it seeks to achieve something. And to be able to retain these characteristics, the founder entrepreneur needs to do a few things.

One, provide the required operating conditions in which each employee is in a state of doing work with the same energy and talent as the founder entrepreneur would be able to do. Second, the entrepreneur needs to ensure that the energy is used to minimize entropy and maximize work done, that is the organization will be at a high level of efficiency and effectiveness.

Third, ensure high energy levels, high passion levels within the organization to the best extent possible, providing opportunities of empowerment and business building to such members. If these three things are done, the heat engine that the start-up is would be at high level of efficiency. If this is not done, there is a very possibility that members of this organization would move and set up their own entrepreneurial firms.

So, ability to retain and attract high energy, high passion individuals within the entrepreneurial system is also one mandate for entrepreneurs. So, maintenance of high energy at one level, and maintenance of high opportunity at another level in the organization is a key responsibility of the founder entrepreneur.

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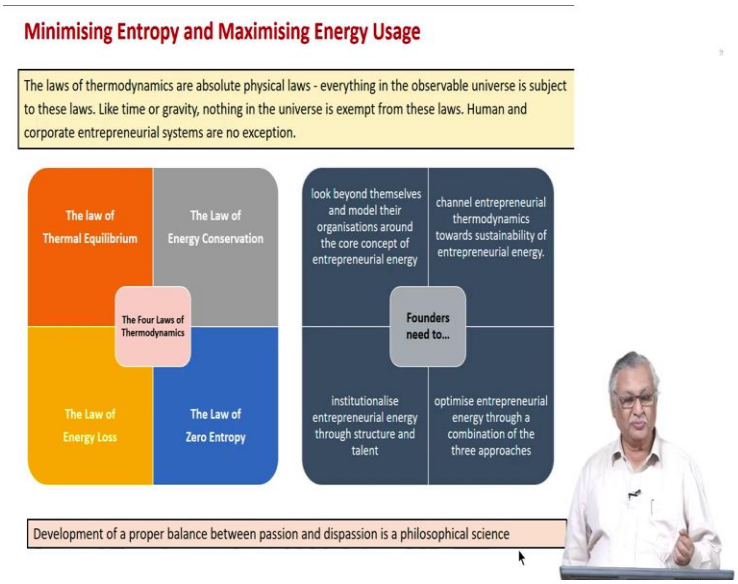

So how do we minimize entropy and how do we maximize energy usage, the laws of thermodynamics are absolute physical laws and everything in the observable universe is subject to these laws. Like time or gravity, nothing in the universe is exempt from these laws. Similarly, human and corporate entrepreneurial systems are subject to these laws, these laws of energy, these laws of gravity, these laws of demand pull.

So, the four laws of thermodynamics let us recall. One is the law of thermal equilibrium, second, the law of energy conservation, the law of energy loss, and the law of zero entropy. So, to be able to ensure that these laws are aptly and adeptly incorporated in their entrepreneurial systems, the founders need to do four things.

One, look beyond themselves and model their organizations around the core concept of entrepreneurial energy. How do I ensure the maximum possible entrepreneurial energy, by myself, by my co-founders, and the professional team. Channel entrepreneurial dynamics towards sustainability of entrepreneurial energy, it is not a burst of energy that

should determine the functioning of an entrepreneurial organization it should be the sustainability of energy over a long period of time.

Third, institutionalize the entrepreneurial energy through appropriate structure and talent. And four, optimize the energy through a combination of all these approaches. So, the proper balance between passion and dispassion interestingly becomes another important subject of entrepreneur thermodynamics.

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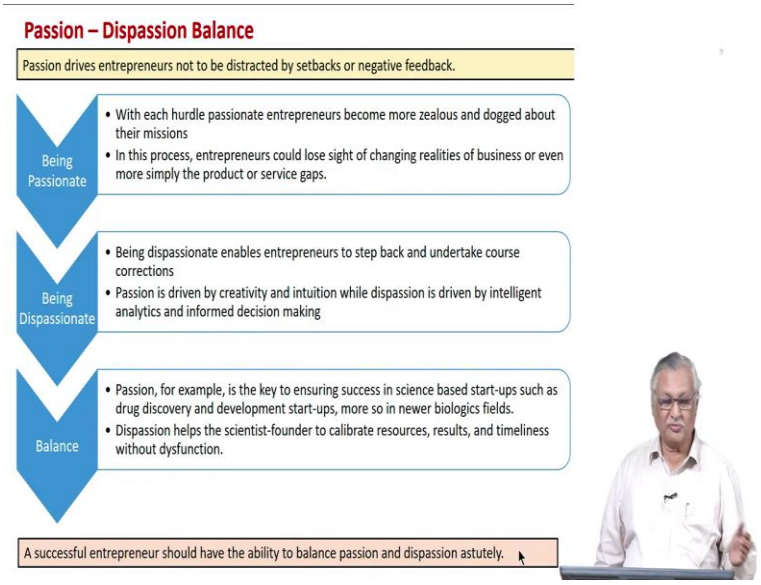

What is passion, and what is dispassion, passion drives entrepreneurs, as we saw earlier, not to be distracted by setbacks or negative feedback. Many times, passion is the essential ingredient for entrepreneurial success because without passion one tends to be distracted far too much or even become low; whether the objectives are going to be fulfilled given the vicissitudes one is facing. But, at the same time passion could be so over consuming, that one may really lose sight of actual impediments that are coming upon the way or the technological changes that are taking place. Therefore, we also require some dispassion.

That is, dispassion is the ability to see a thing objectively for its absolute logical, rational work. So, having passionate behavior, which is getting committed, devoted, inspired to a particular act, to particular thought, to a particular outcome is very important, extremely

important. But, being dispassionate about this whole process of entrepreneurial journey, entrepreneurial development is also equally important.

So, what is being passionate mean from an entrepreneurial perspective. With each hurdle, passionate entrepreneurs become more zealous and dogged about their missions. Normally, when people see obstacles, they tend to step back and they get worried, how do I really overcome the obstacle.

On the other hand, passionate entrepreneurs are like very gutsy mountaineers. The more hurdles they see, the more zealous and more dogged they become with respect to their missions. In this process, entrepreneurs could lose sight of the changing realities of business or even the changing technological foundation or the product or the service gaps that could emerge thereof.

What is being dispassionate mean, being dispassionate enables entrepreneurs to step back, even if it is for a moment and undertake course correction. Passion is driven basically by creativity and intuition. Because people intrinsically believe that this is the right thing to do, therefore, I am doing this whereas dispassion is driven by intelligent analytics and informed decision making. These two need to be fused somehow together in an entrepreneurial organization.

So, what is the right balance, so you got to get passion to driving success in science-based start-ups such as drug discovery and development start-ups, more so in newer biological fields. When the whole development is uncertain, when we choose a drug pathway, and believe that the chemical entity which we have discovered is going to work on the pathway with the least amount of side effects or adverse events. It is working in an uncertain environment. And, you will have hurdles in terms of toxic effects, in terms of adverse events as you try to progress the molecule.

So, the whole environment is completely uncertain. To be able to survive and be successful in such an environment, one really requires a high level of passion. So, when you are operating in fields of science and engineering, where there are huge uncertainties,

one need to be highly passionate far more passionate than one would be expected to be in a normal environment.

But at the same time, being dispassionate helps these, those scientists and technologists and the founders to calibrate their achievements, results, and timeliness without dysfunction. In drug discovery, for example, it is as important to discover a good new chemical entity as to junk non-helpful or non-efficacious new chemical entities, that is, you should kill a project if it is not efficacious quite early.

So, there is no point in being passionate about the compound you have developed, you should be passionate about the medical outcome which you are envisaging. It is not about taking the new chemical entity forward at any costs.

Therefore, the balance of passion and dispassion; highest level of passion because you are operating in an uncertain event but, also the required measure of dispassion to see that in an uncertain environment, what you are doing has got certain beneficial effects as you have envisaged or else, the product moves out of the canvas. So, the ability to balance passion and dispassion intelligently is an aspect of entrepreneurship, which is very important.

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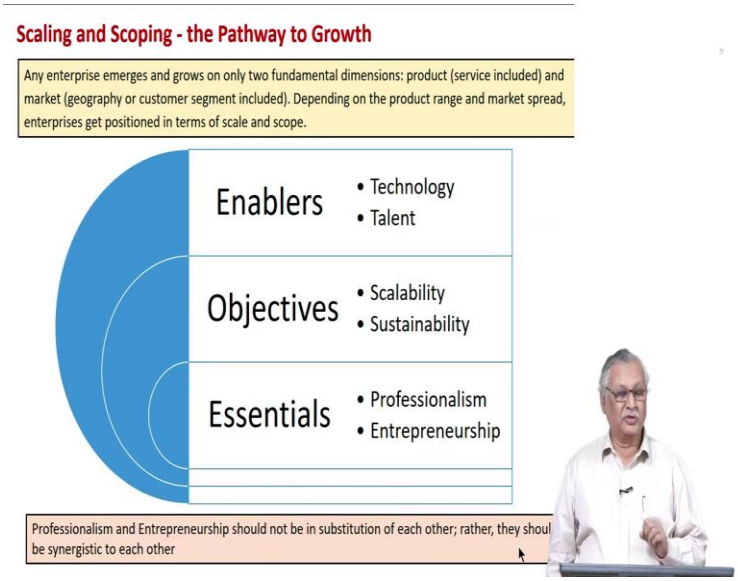

Then, we also have this challenge of how do we use scale and scope a thermodynamic entrepreneurial engine. For that, the product including the service, is one. The market, the geography or customer segment included is another. So, depending on the product range and market spread, enterprises get positioned in terms of scale and scope.

So, entrepreneurial engine is not like a heat engine which performs the same task at all the times, it is like an engine which moves from the first gear to the highest gear. For that, we have certain enablers, we have certain objectives, we have certain essentials. The enablers are technology and talent. The objectives at all times are scalability and sustainability. And, what are the essentials, professionalism and entrepreneurship.

So, just as passion and energy cannot be separated, professionalism and entrepreneurship cannot also be separated. They are actually part of the leadership coin, which is required for an entrepreneur firm. They should be synergistic to each other.

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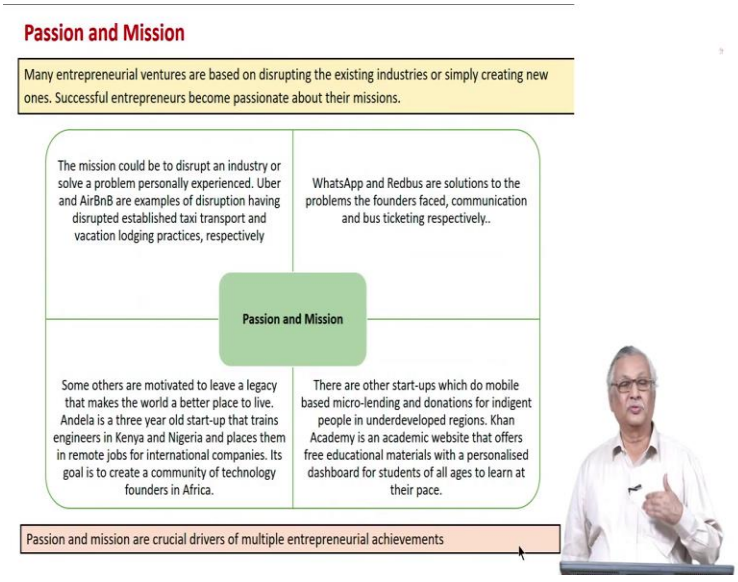

So, how does passion and energy translate themselves to the mission. Many entrepreneurial ventures, as we have considered earlier, are based on disrupting the existing industries or simply creating new products and around them new markets. When we discuss the technological innovation, we discuss the concept of new technologies

coming on a low scale, on a low volume, on the peripheries of the existing huge market and by virtue of their performance taking over the entire market space.

So, the mission for an entrepreneur could be to disrupt an existing industry, or to create a new industry. Or, it could simply be to solve a problem the entrepreneur personally experienced. We have companies such as Uber and AirBnB, which are examples of disruption; having disrupted established taxi transport and vacation lodging practices, respectively. But, on the other hand, companies such as WhatsApp and Redbus are solutions to the problems the founders faced; in this case, communication and bus ticketing respectively.

Some other founders, some other entrepreneurs are motivated to leave a legacy that makes them heroes, that makes them remember in the halls of fame. There is a three year old start-up that is training engineers in Kenya and Nigeria to place them in remote jobs for international companies. So, its goal is to create a community of technology founders in Africa. So, it is a mission to create a niche for oneself by doing some things which the country was never exposed to do.

Then, there are also other start-ups which do mobile based micro-lending and donations for indigent people in underdeveloped regions. There is again another noble cause, which is, which is being done as an entrepreneurial venture. Khan Academy is an academic website that offers free educational materials with a personalized dashboard for students of all ages to learn at their pace.

So, every organization will have a mission, a mission of commercial entrepreneurship or a mission of social entrepreneurship, a mission of technology driven commercial entrepreneurship, and a mission of technology driven social entrepreneurship. In one of the earlier sessions, I said that social entrepreneurship, I said that social entrepreneurship does not mean only doing socially relevant or charitable or philanthropic activities.

I also said that, if you are able to use technology to provide socially relevant and appropriate outcomes, you are doing social entrepreneurship. It is like providing clean air, clean water, clean technology, affordable healthcare, through application of

technology, provision of new products and new services, you are leveraging technology to provide social entrepreneurship.

So, the mission of different entrepreneurs could be different. And the heat engines they use for developing the work patterns and achieving the outcomes, the efficiency parameters could be different in each case. But having a mission and having the necessary passion and energy are the crucial drivers of multiple entrepreneurial dreams.

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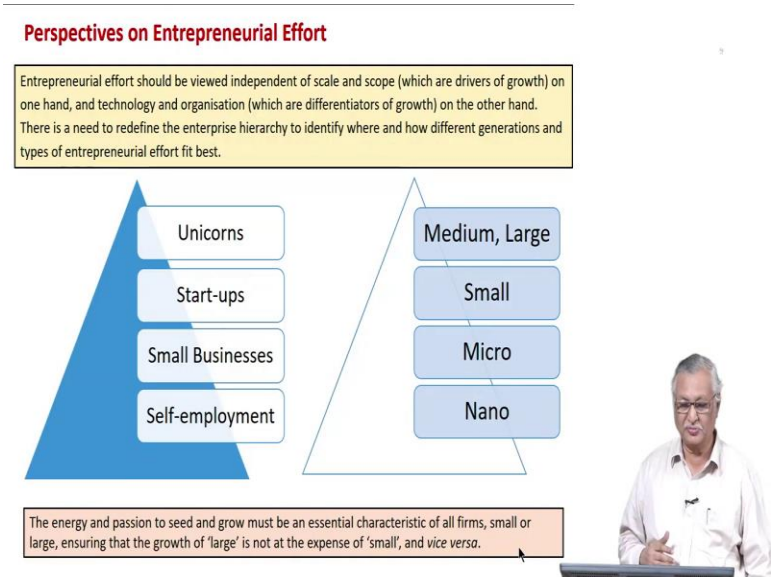

So, when we talk about entrepreneurial effort, we should see an entrepreneurial effort independent of scale and scope. We should not say that entrepreneurial effort is the highest in the biggest entrepreneurial firm and is lowest in this smallest, nano-entrepreneurial firm. Whether, entrepreneurial firm is in the area of self employment, that is only one person doing one job, that for example, a street vegetable vendor or a tea-stall owner, or somebody who is doing a small business like the corner bookstore, or mom and pop store, the kirana store.

Or, technology-based start-ups, which eventually become a 1 billion dollar plus unicorns, is not the scale that determines the entrepreneurial effort. The entrepreneurial effort is same; the passion, the energy that are required are the same. Whether, you are a Zomato or whether you are a Dabbawala, both are same. Therefore, it is important to see the

entrepreneurial effort that is required in a start-up independent of scale and scope. It does not matter whether the firm is nano-firm, which is let us say, a self-employed individual, whether it is a micro-firm, which is a small business.

Whether, it is a start-up, which is embarking on its journey of product, design thinking, and prototyping, and validating or it is a medium-large firm, which is a unicorn. The energy and passion to seed and grow must be an essential characteristic of all firms, small or large, ensuring that the growth of large is not at the expense of small and vice-versa. So, there is no need for small firms, small entrepreneurial firms to be overwhelmed by large established firms. Nor should large established firms grow at the expense of small, micro and nano firms, that is the logic of entrepreneurial firms.

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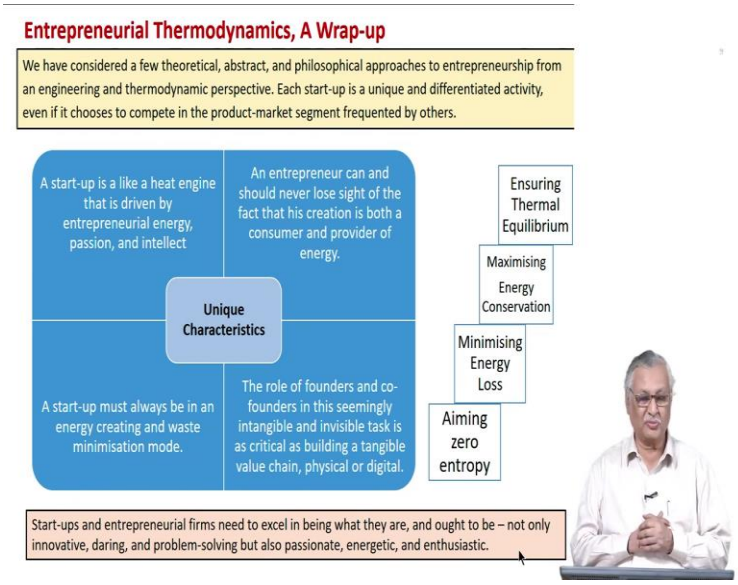

So, if we wrap up this entrepreneurial thermodynamics as a subject, we have very physical, very real thermodynamic principles that govern the behavior of all physical matters which are subjected to heat energy, which involve heat energy, and which delivers work output. They seem to be abstract; they seem to be philosophical as far as entrepreneurship is considered.

But, when we dwell deep, we know with some kind of philosophical correlation that the engineering and thermodynamic principles are very much relevant for entrepreneurial

activities. Each start-up is a unique and differentiated activity, no start-up can be compared with another start-up, no founder can also be compared with another founder. Even, if the activities are in the same product-market domain.

So, what are the unique characteristics from a thermodynamic perspective, one, a start-up is like a heat engine that is driven by entrepreneurial energy, passion, and intellect. Second, an entrepreneur can and should never lose sight of the fact that his creation is both a consumer and provider of energy. A start-up must always be in an energy creating and waste minimization mode. And the role of founders and co-founders in this seemingly intangible, invisible task is as critical as building a tangible value chain, physical or digital.

Many times, we focus on the aspect of creating a business value chain, a product value chain, making a physical product available to the customers. But the invisible act of channeling the passion and energy and making them available through the entrepreneurial heat engine, that is also equally important and that is also a major responsibility of a good entrepreneur.

So, recognizing that the start-up is a heat engine, which consumes energy and delivers work, and that the engine itself is both a consumer and provider of energy. And, the start-up should always be in an energy creating, energy optimizing mode and waste minimization mode, that is very important for an entrepreneurial firm to succeed and excel. So, we should aim at zero entropy by minimizing energy loss, by maximizing energy conservation, and ensuring thermal equilibrium.

Again, as we said earlier, zero entropy is a concept which must be aimed at but probably, not physically possible. Again, as with many things, we cannot be overtly focusing on certain things which are impossible to deliver, which is minimum, for example, we should not be overtly consumed with doing certain things which are impossible to deliver, like aiming at zero entropy, it is the name but is not an accomplishment that would happen.

Therefore, we must do certain things in such a way that we are working towards the objective and in the process, we are optimizing, maximizing our efficiency. But, not necessarily get distracted by doing some things which physical laws of nature would not allow us to do. So, maximizing energy conservation, minimizing energy loss are the two fundamental principles of ensuring thermal equilibrium in an entrepreneurial system.

And, start-ups and entrepreneur firms need to excel in being what they are, and what they ought to be. There should be not only daring, there should not only be innovative, they should not only be problem-solving, but they should also be very passionate, energetic and also enthusiastic.

So, the analogy between a thermodynamic heat engine and a thermodynamic entrepreneurial system is both philosophical and real. It has a science, it has a logic of science, it has logic of technology. And it has got a rational of performance-oriented behavior that drive the performance. Thank you.