Organization of Engineering Systems and Human Resources Management

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Module - B
Effectiveness and Performance
Lecture - 14
Cybernetics and Systems Framework

When one is trying to understand the organizational and the human resources aspects of engineering business systems, one of the useful perspectives is of systems framework; and in the systems framework, an understanding of the cybernetics dimension. In the coming presentation and the one following it, there is an attempt made to walk you through the systems component in understanding organizations, and how that creates a framework of reference for putting the organization and its elements to operational advantage.

The word systems really originated in social sciences several million years ago. And some would like to believe that it was rooted in Greek social theory, where they tried to understand social operations with their internal consistency and looked at it in an integrated form very often calling it a systems framework. As time passed, they were the predictable crusts and truffs of human civilization. But, the concept of taking an integrated look at the functioning of elements and the relationships continued to endure, and in the post industrial revolution situation of the late eighteenth century. And as it evolved into the nineteenth century, the concept of systems got progressively linked to science and engineering; and in course of time, more of engineering than anything else.

And since engineering is a very integrated discipline with a huge network of interdependencies, there is hardly anything in engineering, which does not use some kind of a systems framework to explain its functioning or to get to its results. Thus it is that in common, parallel systems became a parallel concept with engineering operations. In the presentation, however one is going to look at the use of the basic systems concepts in a managerial situation and see how it helps.

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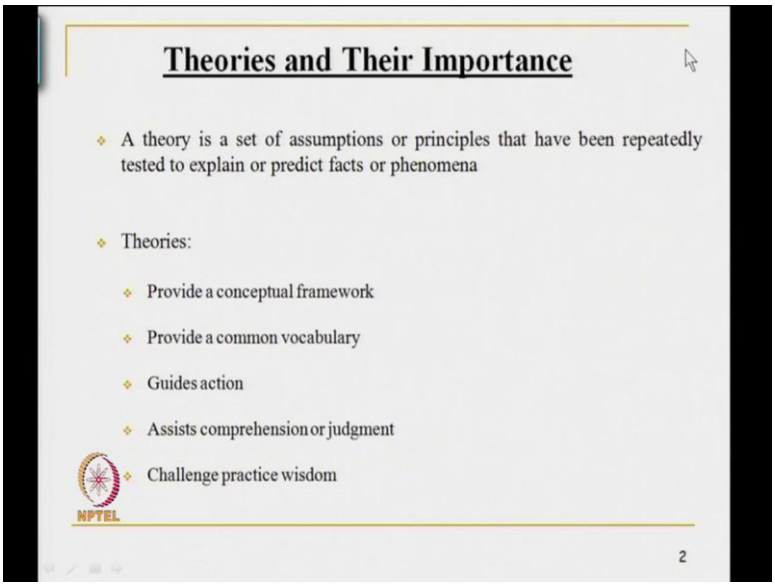

But before we do that, it is important to understand that systems, is essentially a theory. Now, it is possible to understand theories as an integral part of practice, because there is no good theory, which does not have a good practice. And, there is no such thing as a good practice without sound theoretical base. Therefore, to follow, what I am going to say here after, first and foremost, one must get over the limitations of seeing theory and practice in a mutually exclusive relationship, because they are not in a mutually exclusive relationship; they are in a mutually supportive relationship. There is nothing ugly about being theoretical and nothing grand about being practical and vice versa. To put it in as many words, there is nothing grand about being theoretical and nothing base about being practical. Having accepted that, it is important to recognize that, theories have their own importance.

And, please read this slide carefully. A theory is a set of assumptions or principles that have been repeatedly – and, the word is repeatedly – the emphasis on the word repeatedly – tested to explain or to predict facts and phenomena. Life, human and real is a set of atomized existences, which very often elude meaning at a prima facie level. But, a lot of people who know that what appears chaotic, very often has an underpinning of some kind of a systemic rational cognizable situation. And therefore, theories help to read meaning into random facts, because they go deeper than superficial perceptional facts. The same applies to the phenomena. Therefore, theories are an integral of the thinking process of the human mind and help to read meaning.

Theories provide a conceptual framework; theories provide a common vocabulary; theories provide guides for action; theories assist comprehension or judgment; and, they challenge practice wisdom. In other words, they are continuously pushing for the next level of growth. This is the function which theories fulfill. Theories are found in physical sciences; theories are found in many scientific pursuits; theories are also found in social sciences; and there are subtly theories in management. But, the shade of predictive validity of these theories varies. In physics, there would be no theory unless has been repeatedly tested and the predictive validity is established beyond reproach. In social sciences, the word theory is used in a little more open manner; a theory very becomes a framework of reference. In management, a theory helps to explain, but explanation can and do very often have exceptions.

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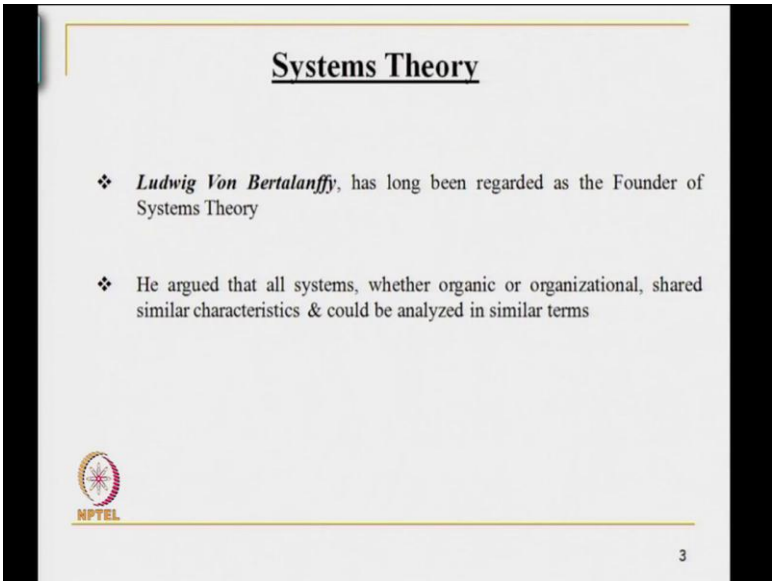

Systems theory is one which is often used as I told you in understanding management practice. A common name which is referred to as the first profounder of this approach is Ludwig Von Bertalanffy. Now, again, like many other fond notions, which are stated, often believed and very often decimated this is true only to the limited extent that you trace the current systems thinking to its post industrial origins; and, you trace it with the continuity factor. Let me explain, so that you get the analogy right. The present industrial revolution, which covers the globe, is not the only industrial revolution, which took place on this planet. Industrial revolutions have taken place for different periods of time and

different parts of the globe (( )). And, the results of that industrial revolution are today present in a physical manner for us to observe.

Given the limitations of time and cannot give many many examples. But, the existence of the rust-proof iron pillar to be seen near Qutb Minar – clearly shows that there must have been an industrial revolution, which created that kind of rust-proof iron. The technology of that was so evolved that even today with all our claims for industrial sophistication, we have not been able to create rust-proof iron in that sense. That pillar has been exposed to all the elements for million years and shows no signs of rust. What happened to that industrial revolution? What happened to the textile revolution, which was in India?

In the early medieval period, creation of fine muslin and silk, which acquired global fame, there was a break in that industrial revolution. And, those traditions died. They were lost. Which is why, today, we do not know how to make industrial revolution in a manner, where the result is the rust-proof iron. The distinguishing feature of the current industrial revolution is that it is unbroken is continuing and it is what touches our lives. Therefore, a lot on theory is traced to the first thinker in the present tradition, because this is a living tradition; the other traditions have died.

So, to get back to systems theory therefore, Ludwig Von Bertalanffy has often been regarded as the Founder of Systems Theory. And, we are not going to get into shredding it beyond recognizing that, yes, it is a popular notion and we have seen the logic which leads to the kind of conclusion. But, we have also seen the limitations of that conclusion; and, we have also tried to familiarize ourselves with what a truly scholastic mind would see as the origins of the systems theory; in fact, much else that goes with it. He argued that all systems, whether organic or organizational, shared similar characteristics and would be analyzed in similar terms. Today, our analyses of systems theory as applied to management, very often takes its take-off point from this state.

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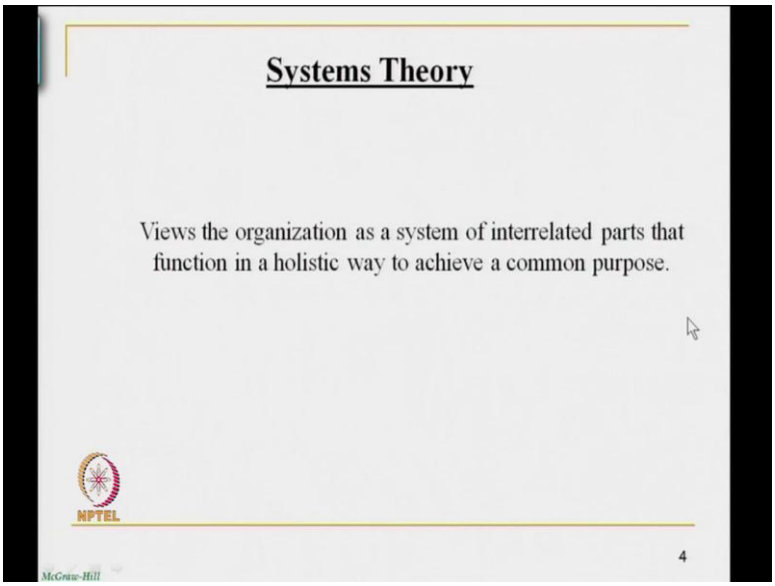

Systems theory views the organization as a system of interrelated parts that function in a holistic way to achieve a common purpose. The use of this approach in running of organizations is important, because like everything else, the sub-elements in management give a lot of importance to themselves. And, if you talk to a finance man, the chances are that he will be of the belief that, it is the financial sinews of an organization, which run an organization; you take away finance, then there is nothing to an organization.

You talk to a production or a manufacturing man – and, he will tell you, what is there to an organization besides production or manufacturing; you stop production, you stop manufacturing; and, there is no organization. You talk to a marketing man – and, the chances are that he will perhaps be of the view that, you cannot have an organization unless a marketing done, because how will the organization justify its existence. And of course, the human resources person would believe that, if you take away the human being, there is obviously no organization. And, so on and so forth this can be carried on with all the functions of management.

Systems theory tries to bring some sanity to it and says that all functions need each other. No function can survive without the support or the input of a cognate function. For example, manufacturing cannot survive without finance; finance cannot survive without marketing; none of these can survive without human resources. Therefore, to get back to

the projection, systems theory brings greater sanity to understanding relationships and emphasizes that interrelated parts create the whole and achieve a common purpose.

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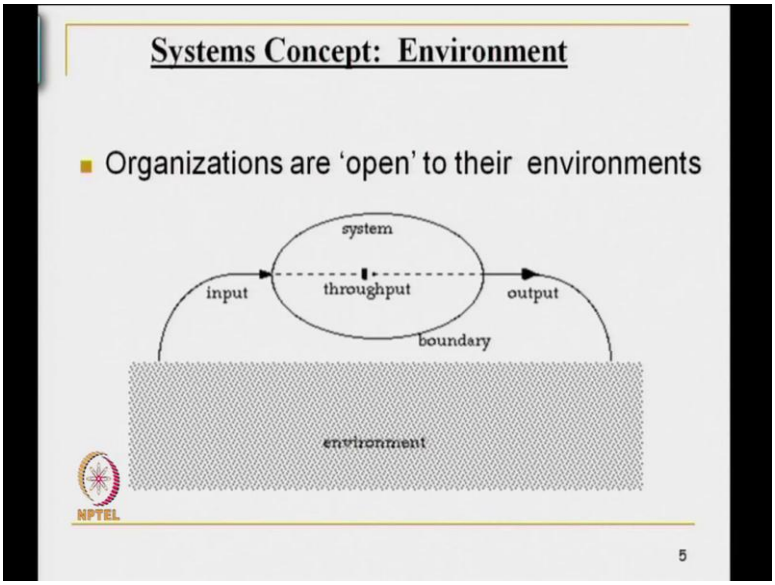

One will go on to see how systems theory is relevant to management in terms of concepts and environment. This is a very common system's diagram, which will help the uninitiated to understand. And, those who are aware of it to renew the relationship between input and output, which is through the throughput, there is this organizational boundary; systems operate here; and, the input is converted to the output. And, what is not stated here is, it is converted, processed put out into the environment through a mass energy conversion. And, that is the process of adding value to the raw material; and, added value to the raw material; creates a product, which is marketable. And, that becomes the output. Organizations are open to their environments.

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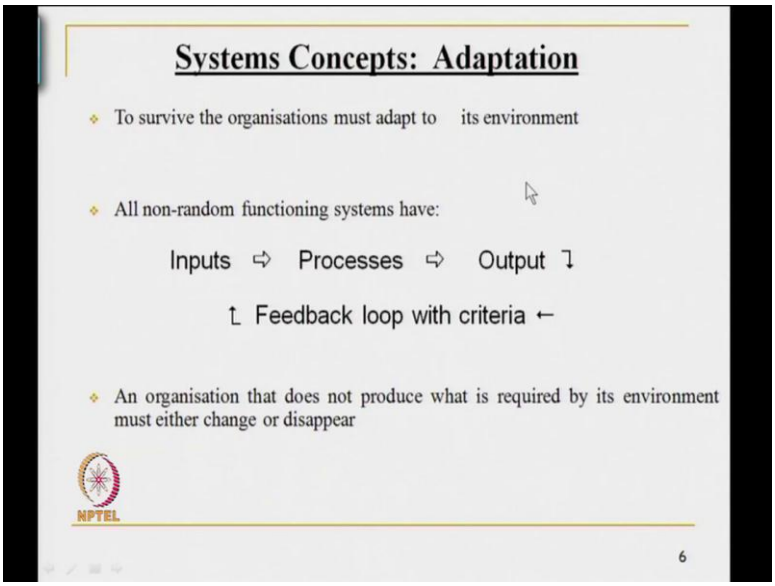

To survive, the organizations must adjust to its environment. All non-random functioning systems have input, processes, output, feedback loop with criteria. An organization that does not produce what it is required by its environment must either change or disappear. A very simple proposition; a proposition so simple that, is often over looked; the need to understand that we cannot have an organization, which is not rooted in an environmental need. In fact, if an organization is a set of people brought together for a fulfillment of organizational goals, then it holds to reason that those organizational goals must be embedded in some environmental need.

And, if the environmental need is not there, there is neither the justification for an organization nor will it survive, because any organization needs resources from finances to raw material to operate and somebody must have use for what the organization produces. Extend this further. The organization is continuously changing. It changes in very many materials and in very many intangible ways. The change is so sharp that if you do a comparison of two flows and frozen slides, 30 years apart, you will find that the basic elements constituting the slide, a frozen slide of the environment are there, but their characters have changed.

So, there is a state of dynamic experience in the environment. And, if the organization is to exist for some environmental need, then the organization must evolve with the environment. And, it is the evolution, which the environment that makes systems a

dynamic concept. That makes systems a concept, which is integral to reading meaning into what appears prima facie unrelated.

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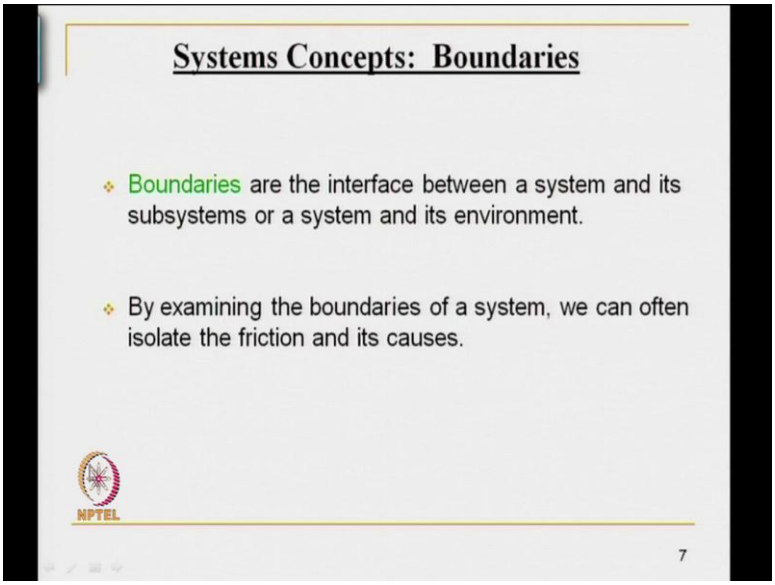

Now, systems concept has several building blocks. One of them is boundaries. Now, boundaries are the interface between a system and its subsystems or a system and its environment. It is important to understand this, because just about in everything in life, there are boundaries, there are limits, which should not and cannot be crossed. There is a situation, where boundaries become an integral part of a definition; especially so in the systems area. There are two types of systems: one is closed systems and the other is open systems. Closed systems are very often identifiable systems.

For example, organizations; they not only often have a physical boundary, but they have an operational boundary. And, the operational boundary determines the limits to which the writ runs. And, the writ becomes defunct beyond that boundary. So, it breeds a feeling of realism and a better relationship between one entity or another. There can be open systems also, because boundaries are difficult to identify. For example, agriculture is known to be an activity, which operates in an open system.

Be it the water of irrigation from the rivers or be it the water, which comes with the rains; there are no boundaries as such in the conventional sense of the word to limit that kind of input. Similarly, the results of agriculture are not confined in a natural sense; once something is produced, there is no knowing – how far it will travel; who will use it

and in what manner. So, there is the open system and there is the closed system. By examining the boundaries of a system, we often isolate friction and its causes. And therefore, it leads to a smooth evolution of the situation.

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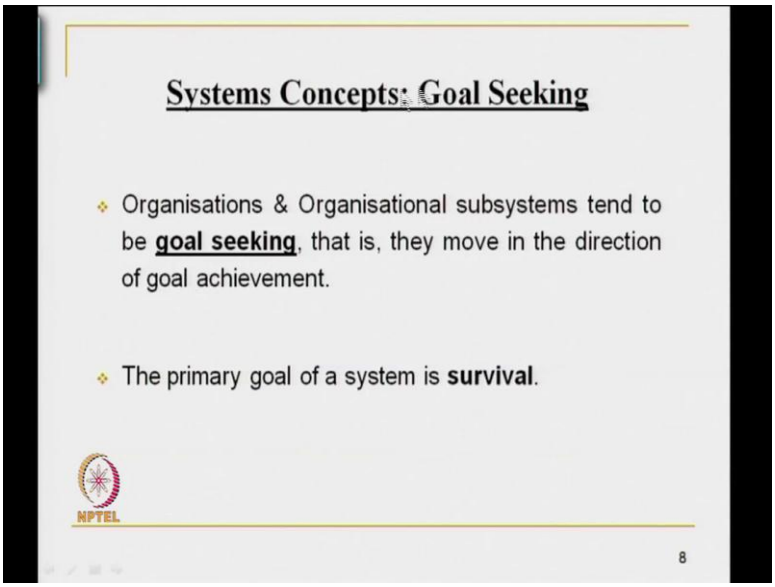

Systems concept therefore, for our purposes, is confined to closed systems. And therefore, goal seeking becomes an integral part of systems analyses. Now, there are physical systems. And, systems has been classified in a scalar format, which begin in a gross manner and can evolve to a very rarified level, which at times said to incorporate even spiritual systems. While talking of management, we may be interested indeed in all systems of one variety or another. But essentially, the decision making is rooted in physical systems theory.

Now, the physical systems theory has as one of its corner stones, what I have just referred to as mass energy conversion. The mass energy conversion, which is the characteristic of the throughput process, which converts an output into an input, is the core of the managerial function. This can be done in a structured manner. It very often is. And, this is how the products acquire their shape, their characteristic, their qualities and their ultimate marketability.

Now, in a strange way, the realization that mass and energy are mutually interchangeable and that, the sum total of mass and energy is constant, one of the basic laws of physics. Again, as a process of putting it in a wider framework, I find it necessary to point out

that the concept of the sum total of mass and energy being constant is nothing unique to post-industrial ethos though the theory itself may have come in the post-industrial ethos. And, very many distinguished names are linked with it and stand being one of them. The fact of the matter is, the traditional Indian texts have always recognized it. And, one of the shlokas from traditional Indian texts goes means abstraction means matter. There is no abstraction without matter.

Abstraction here meaning energy; there is no energy without matter; there is no matter without energy. [FL] without [FL] Is there any existence of [FL], Without matter [FL] Without matter there cannot be abstraction in this case energy. So, clearly, if [FL] is the truth, then there are two parallel existences of matter and energy. And, whatever matter and energy meet, creation takes place. And, the shlok goes on [FL] I do not want to get into that, because that takes one into the domain of metaphysics, which is important, significant. But, at this moment, we are looking at systems concept in managerial decision making.

The point I want you to grasp so far as this elaboration is concerned, is that organizations and organizational subsystems tend to be goal seeking, because goal seeking has to do with the throughput of mass energy conversion and has to focus on some product or process; in fulfillment of which, creation of that organization is justified. Therefore, they move in the direction of goal achievement, which is what management is about. And, systems concepts provide a framework of reference of understanding this. So, in operational terms, the primary goal of the system is survival. If you do not survive, then it will be difficult for you to be a participant anyhow. And, yet to survive, there are certain inputs. Hence, the concept of self renewal in management.

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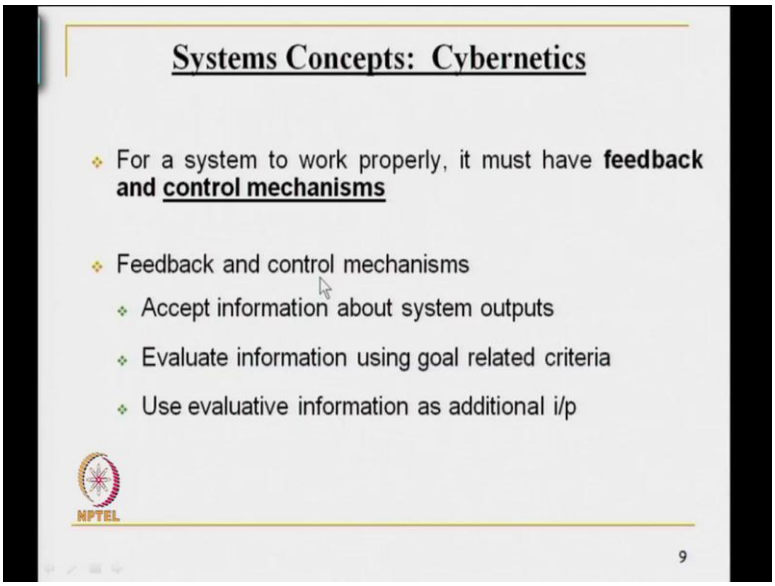

A feedback loop, which systems theory talks about – of the many concepts of systems theory, the one which is most relevant in this constructive cybernetics. For a system to work properly, it must have feedback control mechanism. And, you heard me just talk of feedback. Organizational entropy will take place in a continuous manner to a point, where the organization will cease to be a functioning goal unless through a feedback method, self renewal competencies are important to an organization, because self renewal and the ability to cope is central to organizational survival.

Cybernetics there has a critical role to play. And, the principles of cybernetics are very relevant for organizational development purposes. Indeed, many would say that, it is the natural organizations of the plants living systems, which have been analyzed by the cybernetics specialists to establish the principles of cybernetics. And, once the principles are established, they are applied to organization theory. And therefore, there is much in organization design, which can be rooted to the way some of the plants work or some of the theories the theories in botany have been formulated including that of anastomosis. But, that is another story.

At the level at which this elaboration is pitched, it is important to recognize that, for a system to work properly, it must have a feedback and control mechanism. The feedback shows the actual state of health of the organization. Now, you heard me use the word entropy. And, that may not be very clear to some of you. But the formula from

thermodynamics applies there – delta q r s over t; that talks of physical entropy. What happens at a physical level, a material level, can often happen at the rarified level, the intangible level, the conceptual level of what could be called the virtual world, because the principle of decay, the need for renewal and the need to rebuild, and that going on in an endless cycle remains constant.

And hence, the theory that, organizations are organismic existences; open to feedback from the environment; essential to have the new organization the capacity to self renew; the capacity to reinvent itself; the capacity to grow back into full bloom; and, to make sure that, it stays relevant to the organization. But, to do so, one requires a control mechanism. And, I have in my earlier remarks to do, drawn your attention, that control mechanism here is essentially a corrective mechanism to put together the requirements and coping strategies together, so that the entity really survives; be that as it may.

Cybernetics theory always orients the organization development person into possibilities and parameters of intervention. It helps to identify not only the possibilities, but also the techniques. Feedback and control mechanism have different operational parameters. And, there is a method in which this is undertaken. The first and the foremost is to accept information about systems outputs. If you are open to accepting information about systems outputs, you are a learning organization, you are a growing organization. Therefore, you will be a living organization and you will be an organization, which will be constantly coping with the environment proactively at that.

Hence, the realization at this stage of elaboration that the theory of learning organizations is not that all new; we assume many things to be new, where in many cases, they may be as old as the reverse. It is my case that for any organization to be a living entity, it must be a learning organization, because it must be responsive to the feedback. And that is the characteristic of a living system. If a living system is not open to feedback, it is not going to survive. So, if there are functioning organizations, they must by definition be learning organizations.

One must learn how to evaluate information using goal-related criteria. Now, evaluating information requires developing the yardsticks of measurement. And, those measurements must be related to the goals. Hence, management in its many many

aspects and operations, relies heavily on the scientific method. Now, the evaluative information is an additional input for organizational renewal.

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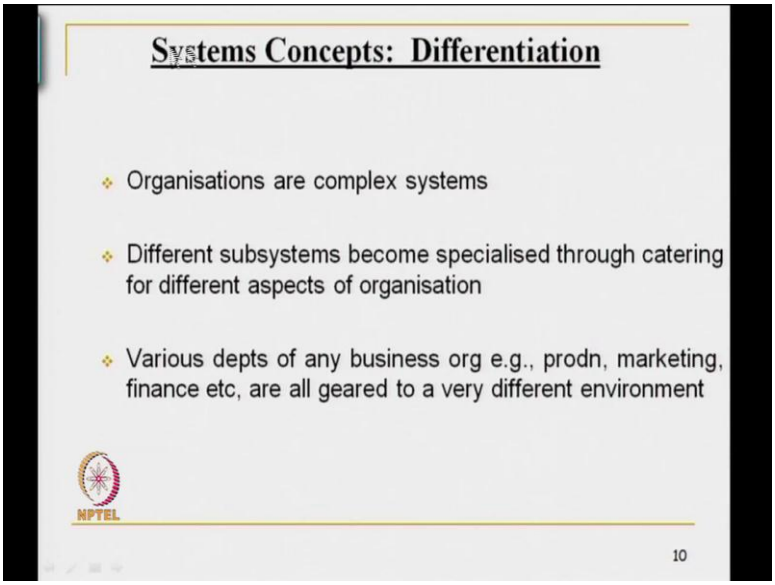

Systems concepts have two elements: one is differentiation and the other is integration. I will talk of differentiation here. And, later on, I will take it to integration, which has been labeled as synergy. But, all organizations require differentiation. If you do not have differentiation as a principle of organization theory, then organizations being complex systems as they are, will not be broken up creatively into comprehensible viable units. You will not be able to have divisions; you will not be able to have departments; you will not be able to have roles; you will not be able to have job descriptions. Therefore, the entire basis of analyzing organizations comes apart. The ability to apply the principles of differentiation to management, to organizations, helps one to recognize the imperativeness of having viable units of work and intervention.

If organizations are complex systems, different subsystems become specialized through catering for different aspects of the organization. Various departments of any business organization like production, marketing, finance are all geared to a different environment. The environment of manufacturing or production may not be the same environment as that of raising funds. Therefore, the concept of differentiation is central to running organizations well; and, it is there that the systems concept comes in very

useful. But, differentiation by itself does not work. We cannot let all functions of an organization be production, marketing, finance, whatever become laws on to themselves.

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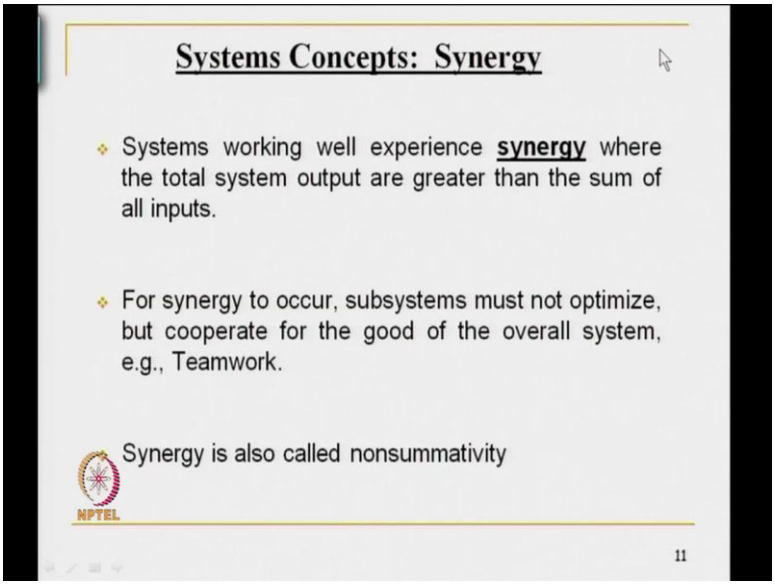

Somewhere, they have to be integrated. And, there are different words, which are used there. The words can be synergy; the words can be integration; words can be nonsummativity. But, essentially, systems working will experience synergy, where the total system outputs are greater than sum of all the inputs. And, this is a very important systems concept. A plus B plus C plus D taking A plus A B C and D as labels of the different elements in their summation, do not become A B C D if they are life entities; no.

As life entities, A plus B plus C plus D can end up as x or a y, which is what systems theory says. For a live entity, systems working well experience synergy, where the total systems output are greater than the sum of all inputs. In other words, developing organizational synergy is one of the central ways of taking an organization forward. For synergy to occur, subsystems must not optimize, but cooperate for the good of the overall system. Therefore, teamwork. If each function starts optimizing and looking at its own optimal gains, then collectively, there is a loss, which may be very likely. So, just as work requires teamwork, the principle of differentiation in an organization requires integration of the differentiated elements into a whole. And, that also is teamwork. Systems theory helps to operationalize this.

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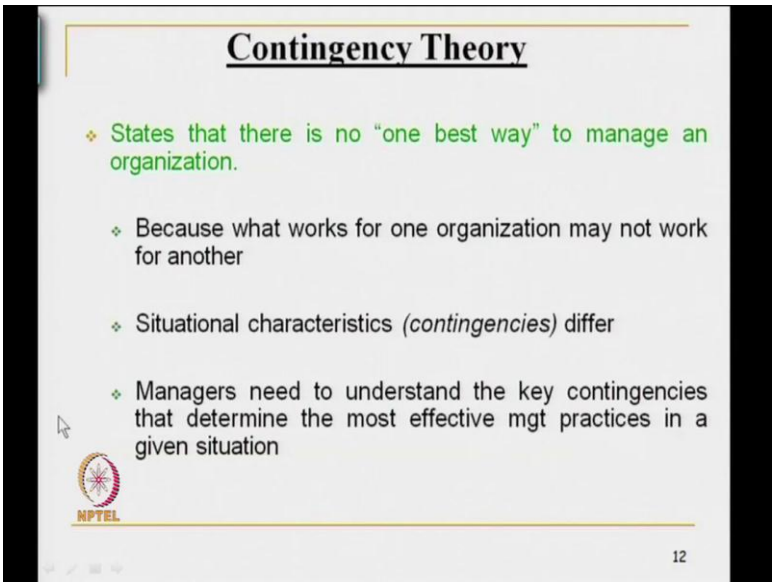

Along with systems theory, comes the contingency theory, because very often, something has to be responded to as and when it occurs, where it occurs. And, that we take up in the next presentation.