Organization of Engineering Systems and Human Resources Management
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Module - B
Effectiveness and Performance
Lecture - 15
Cybernetics and Systems Framework (Contd.)

We have been looking at the issues of systems framework as applied to managing organizations, especially with business engineering perspective, and as a sub-concern of that analysis on systems framework. We have also tried to look at the cybernetics dimension, which throws up certain methods, techniques, approaches to calibrating organizations to keeping them on path, giving them a gold directed behavior, and generally keep the operational model of the organization and control.

However, to complete the discussion on the systems framework, which somehow gives the impression, that the world is a very orderly experienced, everything is systematic in terms of its own internal operations, in terms of its relationship with others and the processes are predictable, therefore to intervention and generally a notion, that you can design a system, which is perfect and therefore, orderly and therefore amenable to managerial interventions. Let me assure you, this is one of the fond fantasies of a lot of management experts, which has limited correlation to the actual realities of work situation.

The actual management of organizations is as often open to vagaries of attitudes, noblest of human emotions, the vilest of human emotions, ego trips, pure and simple, animated, mitigated, viciousness, ego trips, a desperate desire to rise to the top without really putting it in a comparative frame on whether you deserve to be at the top or not. And at the same time the ability to help others, the ability to be supportive, the ability to work for institutional interests, the ability to recognize that individual cannot prosper unless the organizational prosper. So, it is quiet about (( )).

It is very difficult to create a systems framework around emotions. It is even more difficult to create a systems framework on predictive validity of human behavior, but that does not mean, that systems framework does not exist. The system framework exists and it is very much a reality in terms of certain dimensions of organizational life, but between the

systems orderliness and the vagaries of human emotions and human foibles is what could be called the contingency situation.

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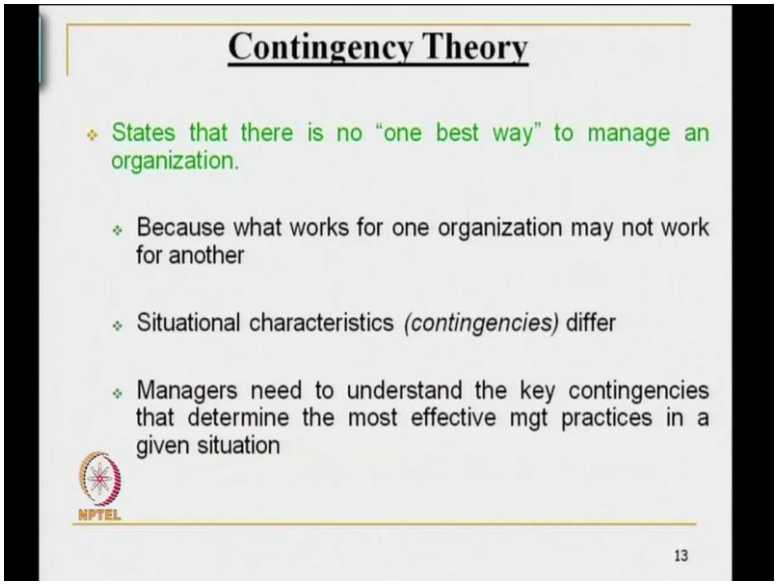

The contingency theory states, that there is no one best way to manage an organization because what works for one organization may not work for another, situational characteristics contingencies differ and this is the big catch. After you have just about solved all the world problems with the systems prospective and taken a position, that yes the intervention is possible and it is possible to lead everyone up to the path of salvation and heaven, you suddenly discover, that there is a factor, which was not accounted for when the planning processes took place and there is a factor, which is a sudden eruption of some undiagnosed dimension, which has to be handled. So, for want of a better phrase this has been called situational element.

The situational element has been often confused with what happens in a situation, but it is not a question what happens with the situation. It is a question of what happens on program, it is a question of what happens all of a sudden. So, the word situation, like many other words, are common to management discipline, has a, has a specific meaning in the specific area to handle this. There has been a need to theorize and that theory has been called contingency theory.

Now, contingency is a word, which derives its connotation from the word contingent. The word contingent has a meaning, we need not get into all those niceties here, but

operationally it means that, which happened all of a sudden that, which was not predicted, it is like an accident and even if it is not an accident, it is an eventuality, it is a, it is a sudden experience, very often unexplained. So, managers need to understand the key contingencies that determine most effective management practices in a given situation.

Some of you may have read the book, the hinge factor, which is the classical elaboration of how the chance events shaped history. The Spanish armada approached the British shores, I am talking of the medieval period and the Spaniards were all set to invade Britain. Britain was practically defenseless and then the mighty armada, and there was not another armada like this in world of those times, was just off the shores in the Bay of Biscay, ready to attack at the strike of dawn.

And during the night the storms came, the winds blew, lightning struck and there was a huge tornado. The entire Spanish armada was dispersed and the British historian writes, and God blew it away. Now, this is not something, which could have put in naval history as programmed. Naval experts could not have planned a typhoon, a tornado, lightning, winds blowing off a power, which drives away an entire navy, not on only in terms of putting it away, but in terms knocking it out of commission.

A contingent situation, one of the battles of Panipat, Hemu was leading the Indian contingent and was about to clinch victory when a stray arrow came and struck him in the eye. The pain of an arrow strucking an eye can be well imagined and he put his hand to the eyes and his elephant went out of control because Hemu was more busy attending to the arrow, which had struck him. The mahavat, the person driving the elephant was equally disturbed. He started attending to Hemu and the elephant turned and went into sprint. The army saw, that Hemu had turned around because they saw Hemu's elephant turn around and run. They thought, that Hemu, for reasons best known to him, had decided to beat a retreat. So, they all, while winning the battle turned around and followed Hemu. And the historian goes on to record a chance factor decided the day and the Indians lost the battle of Panipat to the invaders.

The Hinge Factor is the book worth reading. It helps to bring a lot of sobriety to the experiences of life and contingency theory brings to the manager to lot of sobriety to know, no matter how well you are prepared you still may have situations, which you have to bat as you come along. Therefore, in many ways this is the opposite of an approach, which

systems' theory propagates. So, very often, while talking of systems theory people also refer to the contingency theory. The managers, as I was trying to explain to you, need to understand, that the key contingency that determine the most effective management practices in a given situation may vary.

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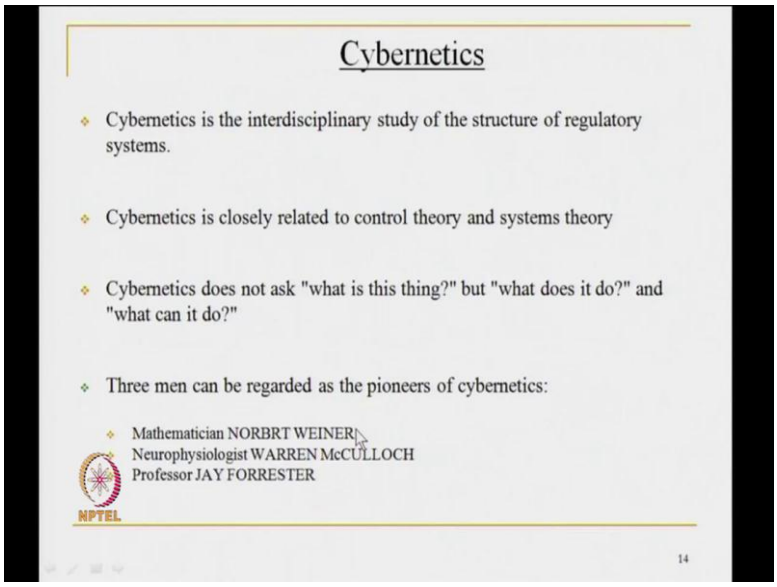

That brings us to the study of cybernetics and we will try to understand the application of cybernetics principles to organization management and see, to what extent it contributes in making up a sound framework of managerial action. Cybernetics is the interdisciplinary study of the structure of regulatory systems. This, I think, is a pithy definition of cybernetics and serves the purpose, which we have in mind. The focus here is on regulatory systems and the perspective is on the structure. Each organization has some regulatory system and as we go through experiences of running organizations we find, that there are regulatory systems indigenous to the organization and there are regulatory systems exogenous to the organization.

For example, to get to the illustration of the telecom industry there are regulatory systems, say, in a telecom form, which comes out of the policy and strategy outlined by the board and there are regulatory systems, which come out of the telephone regulatory authority of India or The Telecom Regulatory Authority of India, to put it more precisely, and as it should be captured, be that as it may, cybernetics is an attempt to read patterns to create a situation, which is amenable to scientific thinking.

Cybernetics is closely related to control theory and to systems theory, that you can clearly see is the derivation from what I have been explained. Cybernetics does not ask what is this thing, but what does it do and what can it do. This is a very important distinction to keep in mind while trying to understand the nature of cybernetics. Cybernetics does not get into fundamentalist dilemma, what is this thing, how was it created. No, that is not the business of cybernetics. The business of cybernetics is what does it do. It is an action discipline and if you ask what it can do, it also has to explain what can it do. Once you have got that perspective right, then it is about time we recalled some of the major contributors to the growth of cybernetics theory.

And there was one mathematician, at least one neurophysiologist and one academic by profession in terms of being a teacher and they all helped to create the present disciplinary knowledge, which is labeled cybernetics. The mathematician was Norbert Weiner; the neurophysiologist, Warren Mcculloch. Now, you need neurophysiologist to understand the laws of nature, to know how orderly nature can be and try to replicate some of that order in human behavior. And of course, Jay Forrester is a name, which is often referred to, very little to do with the actual appreciation of his editing and writings, but then these are names, which are almost buzz words and have been bandied around hugely.

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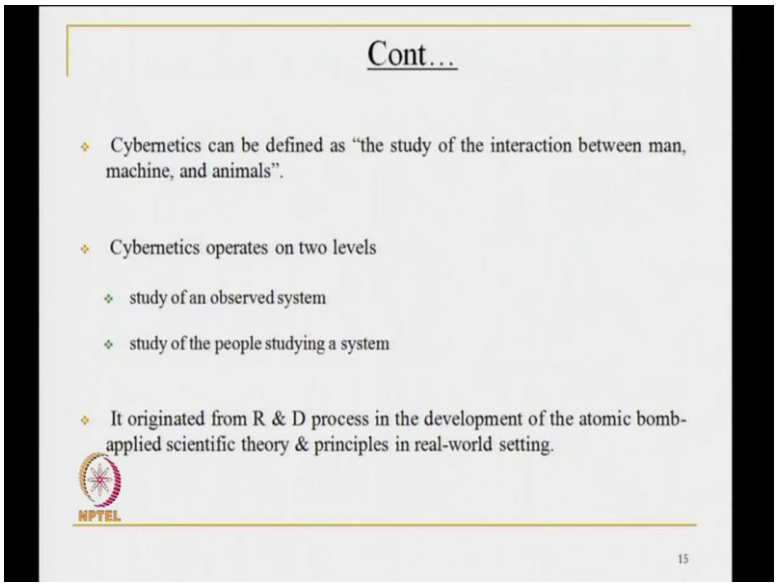

Cybernetics can be defined as the study of interaction between man and machine and animals. I do not want to dwell too much upon the business of interaction between man and

machine because we will be coming up with this treatment of the subject matter later on. Man-machine has several dimensions, which need to be understood in a holistic frame and not just that of cybernetics, but it is a question of finding one's way around it.

Cybernetics operates on two levels, the study of an observed system and the study of the people studying the system. Now, this is a very important distinction. The study of an observed system has to do with structure processes and it has to do with the predictable, the malleable, the manageable, the controllable and you can find as many synonyms of orderliness of an operational system. The other part of cybernetics is the study of the people who study a system. Now, that is an interesting component to which we shall pay some attention in course of time.

It origin, it originated from R and D process in the development of atomic bomb, an applied scientific theory and principles in real-world setting. So, cybernetics is relatively youngish approach, a relatively newer subsystem of systems analysis, systems dynamics and systems theory, but it has been found to be extremely useful and there are many people who would want to swear by it.

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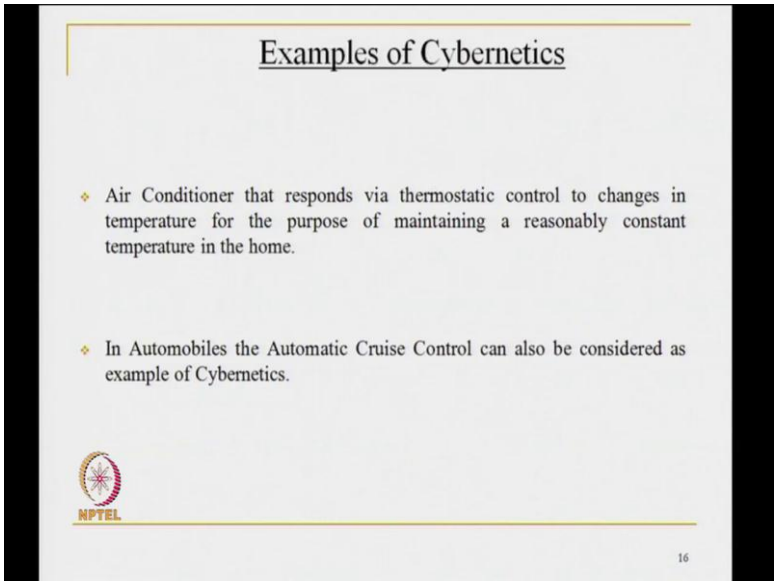

The examples of cybernetics are many in actual life. The easiest, which comes to mind, is the air conditioner. Air conditioner responds via thermostatic control to changes in temperature for the purposes of maintaining a reasonably constant temperature at its place of installation. It can be home, it can be office, it can be anywhere, but all air conditioners

are known to be calibrated to a given degree of temperature, which means, that following the principles of thermodynamics the control system switches off and thermostats makes it one where it will not cross, say, 24 degrees, if the temperature is calibrated to 24 degrees.

Similarly, the cooling system will be triggered off if the thermostat gives the command, that look, the actual temperature has fallen below 24 degrees, it needs to be restored to 24 degrees. So, the principle is to keep the temperature to a given point. If it goes above, reduce it; if it goes down, raise it. And that makes it necessary, that the principle of thermostat be understood to see how air conditioners work.

Apply that to organizations. If system's entropy, in terms of operational parameters, goes beyond a point, then we need to call for a rejuvenation, a revamping, which can be in the form of restructuring, redesign, relook on the information flows and the works. If however, there is an over control, there can be a command arising out of an analysis of how relaxing control may actually get better results in the organization.

In the automobile industry, the automatic cruise control can also be considered an example of cybernetics. The automatic gear system is symbolic of what cybernetics can do to machine systems and how it actually operates.

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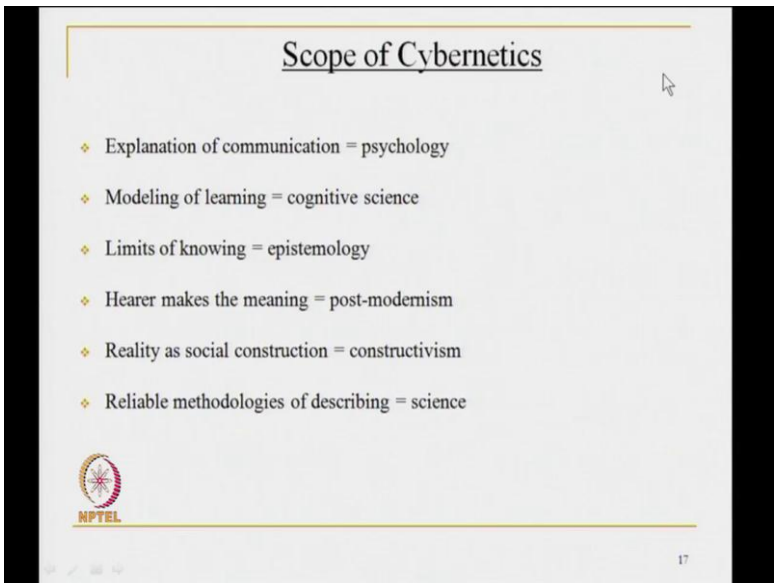

With these examples of cybernetics it is easy to get into our understanding of the scope of cybernetics. Go through this slide, I suppose you will find the description interesting. You

would had hardly believed when you started listening to these presentations, that at some stage psychology, cognitive science, epistemology, post-modernism, constructivism, science, will all be put together. Well, now you, that it can be put together, you may have picked up a new word or two in the course of narration. For example, limits of knowing, is epistemology. Not everything can be grasped. Yes, it is very important concept to have in the era of knowledge management. Hearer, and makes the meaning is an essential ingredient of post-modernism. It is not you intend, that is important, which is what the listener understands that is important.

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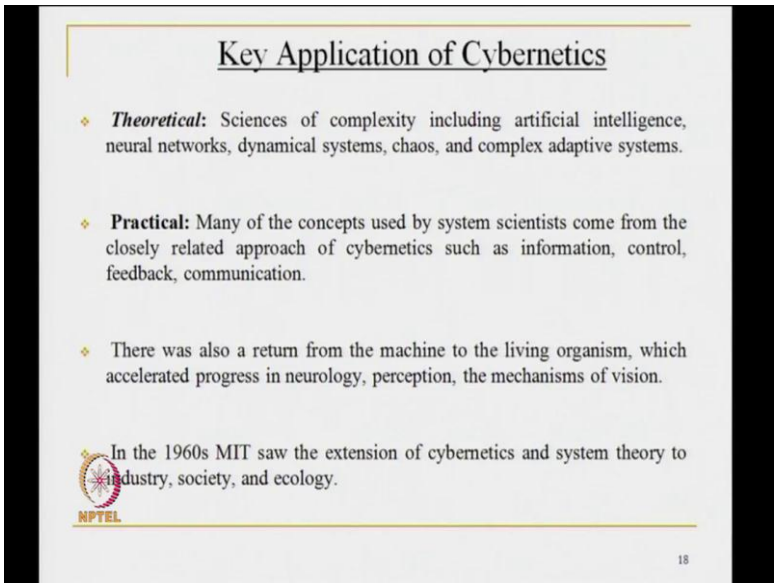

So, if that to recap is the scope of cybernetics, then what are the key applications of cybernetics? The key applications, predictably, will be theoretical and the key applications will be practical. Theoretically, sciences of complexity, including artificial intelligence, neural networks, dynamically oriented systems, yes, even chaos and complex adaptive systems, are the theoretical applications of cybernetics. Now, that is really pitching it at a level, which would grasp the interest of some because anything, which has to do with artificial intelligence, neural networks, dynamical systems and in fact, even chaos, why overlook the complex eruptive systems is considered high brow, is considered at the cutting edge and it invokes a lot of interest.

Perhaps rightly so but then the danger is all these components of the cognitive domain may get so emphasized, that the other more routine, but equally central characteristics are lost

because remember, it is not only necessary to keep innovating, which is again important, but is equally important to keep the routine going. But how often does one hear of paying attention to the routine and doing it thoroughly? But innovation is a chat, everyone claims to be innovative, everyone demands innovation, it has been sloganized so much in the last twenty years, that like many words it has lost its meaning or perhaps, that can be sobered down; anything to say, it has almost lost its meaning.

Then, there is the practical application of cybernetics. Many of the concepts used by, scientific, scientists come from the closely related approach of cybernetics, such as information, control, feedback, communication. Now, these are areas, which are more conventional with which people are more familiar and people practice it more. Now, everyone has heard of feedback, even those who are not in the domains of psychology or who are not in the domains of scientific analysis or who are not in the domains of management, yet know the word feedback and know the utility of it. So, so about communication much used. So, the practical applications of cybernetics are more widely known.

The theoretical aspects of cybernetics are less widely known, but are certainly more fashionable, be that as it may, it is important to realize, that applications of cybernetics are wide and are very, very effective in certain areas of management. There are also, there was also a return from the machine to a living organism, which accelerated progress in neurology, perception, the mechanism of vision, it was a result of the cybernetics approach.

Because of cybernetics people realized the logic of machine does not apply, can not apply and very often confuses the man-machine relationship and the man element very often is the key element in contributing to a decision frame. This obviously, had its impacts on neurological aspects, the perception studies, and of course certain physical analysis. In 1960s MIT saw the extension of cybernetics and systems theory to industry, society and ecology. And from that point of time, management theorists, management practitioners began to be curious about application of cybernetics to management and it has made a definite place for itself in management theory and management practice.

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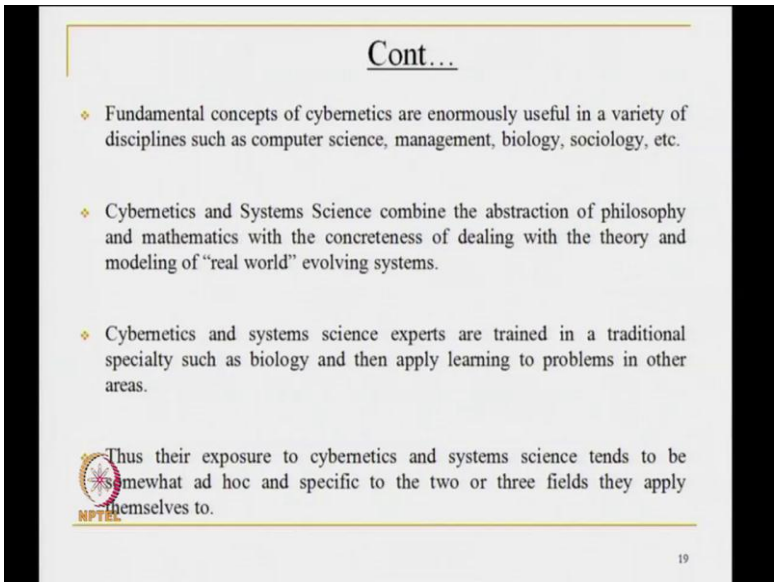

Fundamental concepts of cybernetics are enormously useful in a variety of disciplines, such as computer science, management, we have already talked about that, biology, we have talked about that, and even sociology. Understanding of sociology is to a great extent facilitated from the cybernetics perspective, because it facilitates the practice of social engineering. The predictive validity may not be as of such a high level of confidence as it would be in physical sciences, but still it is better than having no predictive validity.

Cybernetics and system science combine the abstraction of philosophy and mathematics with the concreteness of dealing with theory and modeling of the real world evolving systems. Now, that is a very important concept, I would like to repeat that for you, so that you get all the new answers. Cybernetics and system science taken together combine the abstraction of philosophy and mathematics with the concreteness of dealing with the theory and modeling of the real world evolving systems. So, cybernetics fulfills a very useful role in serving as a bridge between the abstract, the intangible, but important component of real life with the specific and the real world elements of the concrete, the specific things, which make an impact.

Cybernetics and system science experts are trained in a traditional specialty and that specialty may be from a conventional discipline. Once they learn the principles there they apply it to other areas, from the study of structures, design and indeed, processes. One gets a clear feeling, that a lot of principles of biology or botany or plant life, when applied to

organization theory and practice and functioning of organizations, are extremely (( )) and help to see a pattern or meaning, which prima facie seemed elusive and difficult to grasp.

Thus, their exposure to cybernetics and system sciences helps a management practitioner to be more scientifically ad hoc. Now, that is not a contradiction in terms because I have spent some time explaining to you how ad hoc situations have to be met, but when you go scientifically ad hoc, it means, that you have been trained into dealing with the unexpected. You have been drilled into n number of models and those models have given to your cognitive system a resilience to respond quicker to ad hoc situations. Therefore, ad hoc situations and specific to the two approaches would be the fields where they apply themselves and how you actually operate as a theoretician in the field of organization, management or indeed, even finance or marketing.

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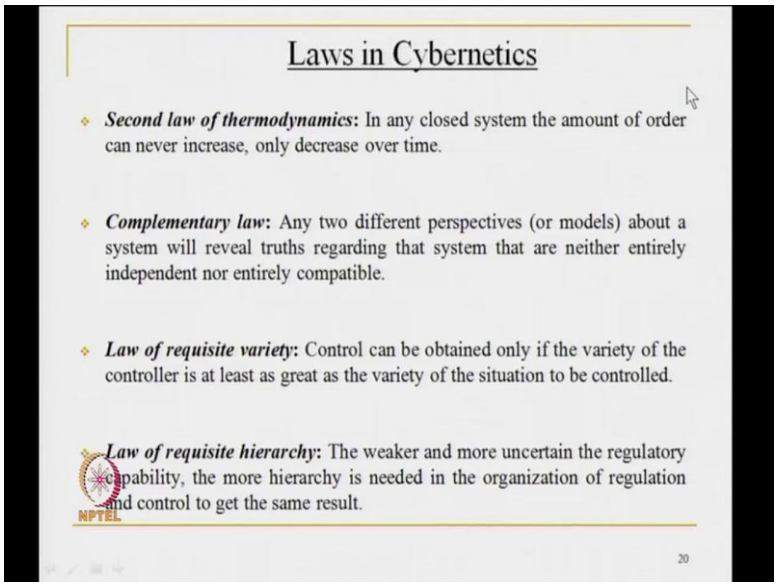

There are certain laws of the cybernetics, which I would like you to grasp because ultimately, if cybernetics have to do with creating systems, if cybernetics have to do with creating practices, if cybernetics have to do with creating practices, if cybernetics have to do with certain regulatory mechanisms, then clearly there must be certain laws. So, therefore, I will pause for you to read this slide. As you notice, the attempt is made to pick up laws from different places and postulate them in decision making and problem solving.

Take for example, the second law of thermodynamics. In any closed system the amount of order can never increase, only decrease over time. Very interesting theory, seen very often

when it comes to maintenance, seen very common when somebody takes over in authority, always begins with pleading for discipline control, systematization, almost cleansing when, what if the person believes is the residue of bad decisions of the preceding period. Then as time passes, the chant reduces in pitch, the reality perception dawns and the person learns to adjust with the way the organization has been functioning. Now, how that equation resolves itself is a matter of organizational vitality, individual temperaments, circumstances and we are not going to get into that.

But the larger principle is, the second law of thermodynamics says, that order tends to decrease rather than increase. Therefore, the randomness of situation gets priority and that is the very interesting thought. I would have almost said that is a worrying thought, but whether one is enthusiastic about it or worried about it cannot be made a factor of wish fullness. The second law of thermodynamics, therefore, is a very important framework of reference for organizations.

Then, there is the complementary law. Any two different perspectives or models about a system will reveal regarding that system that are neither entirely independent nor entirely compatible underscoring the reality of life. Much of human life is bounded in contradictions. Oscar Wilde is a great example of capturing those contradictions. There is a quotation from Oscar Wilde, some of you may relate to it, for everyone kills the thing he loves.

When I first came across this statement, my reaction was of surprise, one thought converted to horror because I could not understand how love and violence of this type could coexist. And then gradually, as I went through Oscar Wild's elaboration of things and the elements in the two emotions, it dawned upon me, that you can love so well, that you make it claustrophobic for the other person, or you can love so well that you can take it for granted, you love so well that you start demanding total congruence of lifestyle.

And there are a whole lot of possibilities where love, instead of nourishing, can become very, very inhibiting for the people who are involved in it. If that was not so there would be no narrations of how a man and a women can meet, get into an emotional relationship, get in love and then the predictable parting takes places and it ended, it ends in divorce. Not all love stories go that way, but the fact is Oscar Wilde felt, that the negative elements in love were very dominant. Be that as it may, that a discretion is brought up to explain, that a

system will reveal truths regarding the system, that are neither entirely, the systems, that are neither entirely independent nor entirely compatible.

There are other examples, one can have love hate relationship, but suffice it to say that the complimentary law is essential in terms of applying it into organization theory from the cybernetics perspective. There is a law of requisite variety control, can be obtained only if the variety of the controller is at least as great as the variety of the situation to be controlled. In other words, the situation to be controlled is a hugely complex one. Then the person in command has to be equally multidimensional to be able to operate it. It seems to me therefore, that control is a very active force, which has to be intelligently applied to have cybernetics overdose.

The law of requisite hierarchy is equally important. The weaker and most uncertain the regulatory capability, please note, the weaker and more uncertain the regulatory capability, the more hierarchy is needed in organization of regulation and control to get the same results. Again, a very interesting proposition, which establishes, that if you are not a Zeus, if you are not a strong leader, if you are not a person who lays down the laws, then you need a more extended hierarchy for the regulatory operation to be effective. At each stage, you take out some of the force of deviation.

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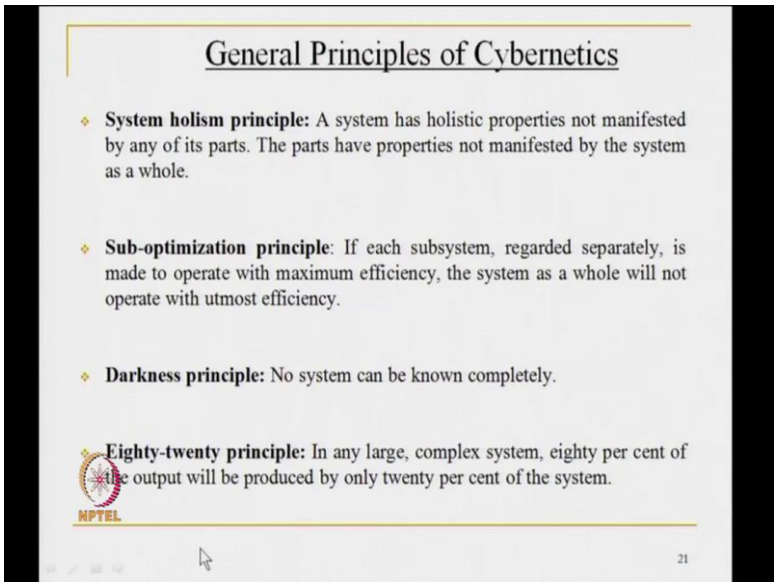

The general principles of cybernetics can be listed as the following, please read it. Well, the way I see it, there is nothing complicated in any of these four statements. If you are a

person of experience you would resonate with all of them to some degree and I personally do not think it is necessary to go through it other than to point out, that the system whole is principle, is a system, which is central to the study and application of systems theory.

If a system has holistic properties, then those holistic properties may not be available in parts in suitable fractions. Yes, please note that, if a system has certain properties, the holistic property may not be available in all the parts in certain fractions in ratio to the size of part with the whole. Similarly, the parts may have the properties, which are not, are not manifested in a system as a whole and we have discussed this earlier out.

The sub-optimization principle is that if subsystems tend to go on their own, then the whole system will not be as efficient as it could. Very simple to understand and of course, everyone knows, that no system can be known complete, everyone knows about, that human beings or at least, everyone should know it about human beings, no human being can be understood fully. There are always layers, which are unknown very often to the person himself, but here the reference is to the nature of organizations and what is being said is, it is very difficult to know the nature of any organization fully. And of course, the 20-80 or 80-20 principle, whichever you choose to produce first is altruism, which is their available in every real language, so one need not dwell upon it.

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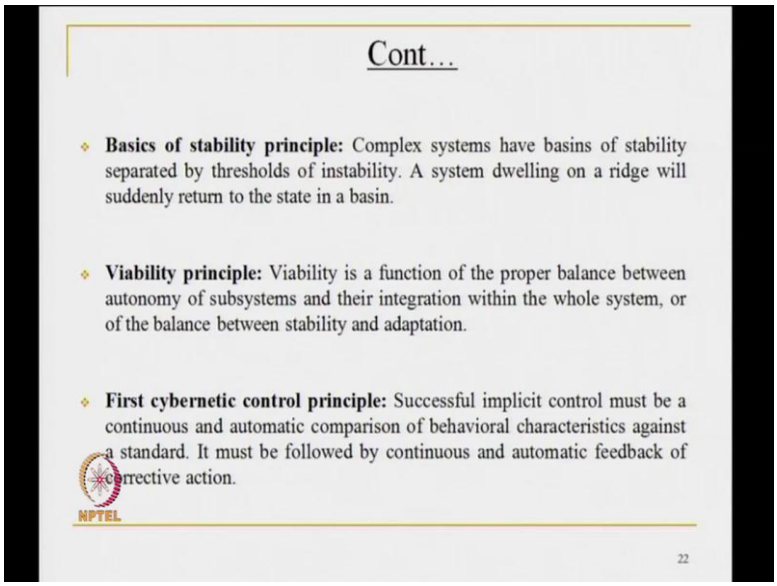

There are certain other principles to which I would like to draw your attention. The basics of the stability principle, that is a complex system, has basics of stability separated by

thresholds of instability. Please note, this is the complex systems, have basics of stability separated by thresholds of instability, a system dwelling on a ridge will suddenly return to the state in a basin. Abusing, but can be true.

Viability principles - viability is a function of the proper balance between autonomy of the subsystem and their integration within the whole system, or of the balance between stability and adaption. In the Indian philosophy this would be labeled as the middle path. One has to be clear, that there has to be forever a balance between polarities and that is how the system works.

The first cybernetic control principle, successful implicit control must be a continuous, must be a continuous and automatic comparison of behavioral characteristics against a standard. Now, that is something, which needs to be understood. Successful implicit control must be a continuous and automatic comparison of behavioral characteristics against a standard. It must be followed by continuous and automatic feedback of corrective action. In other words, you must be forever be in growing mode, you must be forever be in a mode, which leads to improvement, otherwise decay and decline will set in, or to convert it into modern balance it takes a lot of running to stay at the same place.

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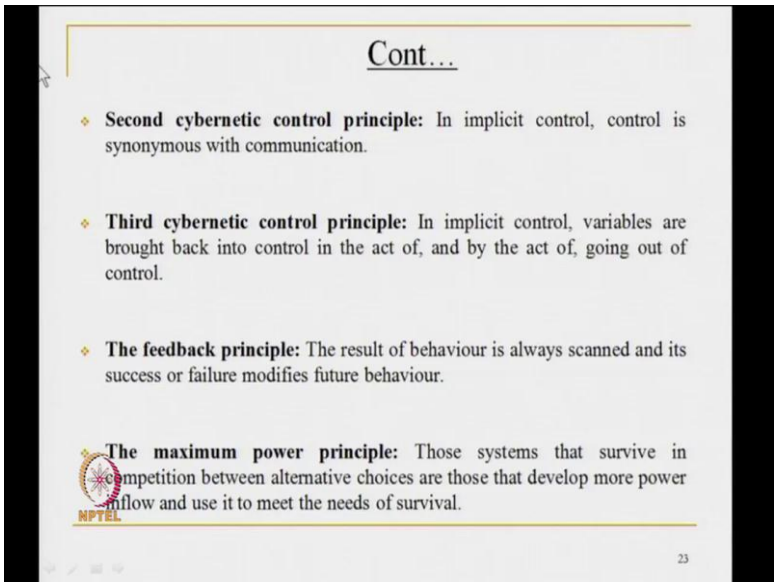

The elaborations continue and I present to you another set of four principles. Second cybernetic control principle, in implicit control, control is synonymous with communication, nothing much to explain, but plenty to understand. In implicit control, if

you want to control in an implicit manner, control is synonymous with communication, which is why nothing is so terrible to operating organizations than breakdown of communication between departments, among entities, among people. If you keep talking, then it is better to expect results. Then if you do not talk the implicit control is, as we have defined control always in the discussion, keeping the system on track and implicit means, every action leads there.

The third cybernetic principle is implicit control. Variables are brought back into control in the act of and by the act of going out of control. Now, read that carefully and you will find that it is not such a twister. In implicit control, variables are brought back into control in the act of and by the act of going out of control. This means, there are limits by which things can get out of control and there it will ultimately get back into control. The feedback principle, the results of behavior is always scanned and its success or failure modifies future behavior.

Very important principle to learn, the result of behavior is always can and its success or failure modifies future behavior. Of course, there are certain people who will never learn, but there are exceptions, they cannot be made the rule. The maximum power principle - those systems that survive in competition between alternative choices are those that develop more power inflow and use it to meet the needs of survival. Well worth remembering for any manager for effectiveness.

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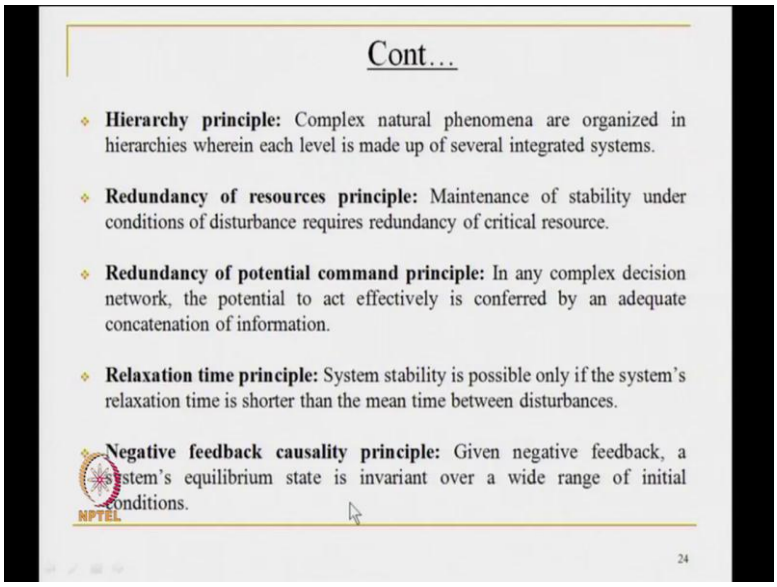

To conclude, therefore, the principle remains, that comes to mind is that hierarchy principle, complex natural phenomenon organized in hierarchies wherein each level is made up of several integrated systems. Redundancy or resources principle, maintenance of stability under conditions of disturbance requires redundancy of critical recourses. Redundancy of political command principle, in any complex decision network, the potential is to act effectively and this is conferred by an adequate consternation of information.

Relaxation time principle system, stability is possible only if the system's relaxation time is shorter than the mean time between disturbances. This is indeed a derivation of cybernetic principles, but very important in organizing organizations. And finally, the negative feedback causality principle, given negative feedback, a system's equilibrium state is invariant over the wide range of initial conditions.

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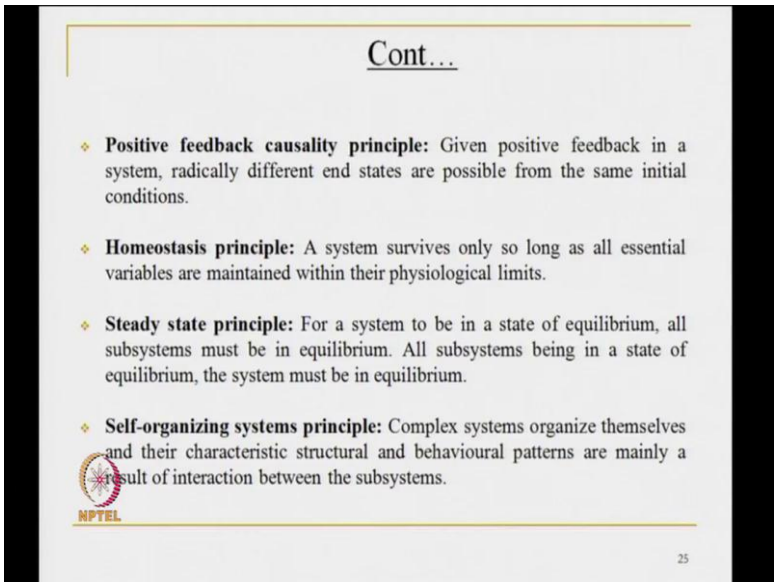

I hope you will see the applications of cybernetics more clearly to management, especially as it is a strong extension of systems theory, which leads to a situation where the positive feedback and the causality principle goes together. The homeostasis principle operates; steady state principle is borrowed from management to understand organizations and self organizing system principle dominate. Again, some time to you to read the application of system theory in cybernetic incarnation to running of organizations. You would be familiar with some of them, it is the application, that you have to know.

The last two principles have the greatest application to management, steady state principle where equilibrium of the subsystems is put out as a desirable condition for the equilibrium of the system itself. And self-organizing system where complex systems organize themselves and their characteristic in structural behavioral patterns, which results because of interactions between the subsystems. There is a lot of wisdom to it in operational terms, and that brings us close to the discussion of the application of system principles and cybernetics model to decision making, problem solving in the functioning of organization and in the operation of human resources in work environment.

Thank you.