

Degree of Complexity that Business Organizations can sustain and control

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Information Integrity/Integrity Information System/Management Information System

Course Lecture # 16-17

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LECTURES # 16-17:
Degree of Complexity that
Business Organizations
can sustain and control

OVERVIEW - 1

- Open System
- What is a closed system?
- Living organism – A view from Thermodynamics
- Open System – A view from Thermodynamics
- Genetic, Cultural, Exosomatic Systems as Open Systems

OVERVIEW - 2

- Requirement of Availability of Complex Information Systems
- Business Organization Complexity
- Degree of Complexity
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OVERVIEW - 3

- More about Market Price Mechanism
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- And which *IS* will prevail?
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OPEN SYSTEM -1

- One cannot help but marvel at the complexity of the information flow systems in the genetic, social, and exosomatic systems.
- A system, which, whatever else it does, necessarily processes (imports and exports) information from its environment is an open system.

OPEN SYSTEM - 2

- An open system is distinguished from a closed system in that it (open system) has:
 - Purpose (objective, i.e., end-directedness),
 - It possesses porous boundary,
 - It is impacted by and impacts its environment, and
 - **Whatever else it does, it necessarily processes information.**
- Said differently, unlike a closed system, which has impermeable system boundary, the open system has a permeable boundary.

WHAT IS A CLOSED SYSTEM? - 1

- In keeping with the first law of thermodynamics, the so-called principle of the conservation of energy, that matter and energy can neither be created or destroyed, in closed systems energy must remain constant.
- Because this total energy must remain constant, a closed system can only *lose* its ability to do work.

WHAT IS A CLOSED SYSTEM? - 2

- Inevitably, by the second law of thermodynamics, such systems must lapse into the state of totally unorganized, randomly distributed, inconvertible particles, the state of totally bound energy known – appropriately enough – as *heat death*.

LIVING ORGANISM: A VIEW FROM THERMODYNAMICS-1

- When thermodynamics theory was first developed, many scientists thought it to be violated by living organisms that sustain and even increase their organization, continuing to do work for years in apparent contradiction to the second law.

LIVING ORGANISM: A VIEW FROM THERMODYNAMICS-2

- *Resolution of the contradiction occurred as living organisms came to be seen, like the steam engines whose coal smoke blackened the skies of nineteenth century industrial towns (the problem of air pollution), not as closed systems but as open ones, that is, systems with continuous inputs and outputs of matter and energy.*

LIVING ORGANISM: A VIEW FROM THERMODYNAMICS-3

- Like steam engines, living things are open systems that continuously lose energy to their environments. Even the wastes excreted by living systems retain some energy in their molecules and this, too, is lost.

OPEN SYSTEM: A VIEW FROM THERMODYNAMICS

- Thermodynamics thus explains what it is that all living, i.e., open systems must control, and why such control is essential to life itself. All open systems, if they are to postpone for a time their inevitable heat-death, must control the extraction and processing of matter, its internal distribution and storage, continuous conversion into energy, and elimination as by-product wastes.

GENETIC, CULTURAL, EXOSOMATIC SYSTEMS AS OPEN SYSTEMS - 1

- We have earlier discussed information flow systems in respect of the genetic system, the social system, and the exosomatic system.
- Within the framework of the all pervasive thermodynamic principles, the genetic, social and exosomatic systems must also be open systems if they were to sustain their respective organizations against the progressive degrading of its collective energy.

GENETIC, CULTURAL, EXOSOMATIC SYSTEMS AS OPEN SYSTEMS - 2

- As a result, a view of the organisms or of organic compounds (i.e., of living systems) as concrete open processing systems applies equally to their biological or genetic, social and exosomatic aggregates.

GENETIC, CULTURAL, EXOSOMATIC SYSTEMS AS OPEN SYSTEMS - 3

- The essence of a genetic, a social, and an exosomatic system, in other words, is their continuous processing of physical throughputs, from their respective inputs to the concrete genetic, social and exosomatic system, as the case may be, to their respective final consumption and output as waste.

GENETIC, CULTURAL, EXOSOMATIC SYSTEMS AS OPEN SYSTEMS - 4

- Unlike the organic components, however, the genetic, social, or the exosomatic system is made of relatively autonomous components – components, sub-systems, individuals, families, groups, departments, enterprises - that can act for different or even cross-purposes.

GENETIC, CULTURAL, EXOSOMATIC SYSTEMS AS OPEN SYSTEMS - 5

- The above then offers the support to the proposition that the proper subject matter of the genetic, social and exosomatic system studies, if they are to complement studies of the flow of matter (input-output economics) and energy (ecology), ought to be information: its generation, processing, and communication to effect control.

REQUIREMENT OF AVAILABILITY OF COMPLEX INFORMATION SYSTEMS

- On one hand this presents information as a higher order or derivative of matter and energy on which it depends for its existence.
- On the other hand, for improved system performance, it suggests requirement of availability of complex information flow systems, which optimize the extraction (origination) and processing of information, its internal distribution and storage, continuous conversion into energy, and elimination as by-product wastes.

BUSINESS ORGANIZATION COMPLEXITY-1

- In our analysis, we have designated information flow system as ‘genotype’.
 - To recall, genotype means a matrix, a structure, a mechanism, a rule by which to play the game.
- Further, by genome, here, we don’t necessarily mean a living being, it could also mean a network of neurons or artificial intelligence devices, information processing hardware and software.
 - Ref.: Lecture # 5

BUSINESS ORGANIZATION COMPLEXITY-2

- Given the observation on control requirement at the level of information flow systems (Slide No. 16) and given that these information systems constitute genomes that include artifact, it becomes clear that for our purpose ‘organism’ *now* equates with ‘organization’, more aptly ‘business organization’.

BUSINESS ORGANIZATION COMPLEXITY-3

- The concept of a business organization that we understand here is a generic one in that it covers the entire enterprise wide supply chain from concept to delivery and feedback and review.
- Within the framework of the discussion so far, this brings us to the question of complexity of a business organization.

DEGREE OF COMPLEXITY-1

- Systems theorists and economists argue that the complexity of an organization is ultimately limited by the amount of information (it) can (economically) process and transfer.
- This holds for the open system (genetic, social, exosomatic, business enterprise, etc.) as a whole, for part systems, and for components.

DEGREE OF COMPLEXITY-2

- The degree to which higher efficiency through increased specialization (it *can* include I*I) is feasible is governed by the means that are available to control the ensuing complexity, that is by the cost and efficiency of the available information flow systems.

INFORMATION SYSTEM DESIRED - 1

- What kind of information system that will, in different cases, turn out to be the most cost-effective one depends on the circumstances.
- A certain – quite considerable – amount of specialization can be managed by means of contractually delegating decision making authority, thus creating a basically hierarchical organization.

INFORMATION SYSTEM DESIRED: SIGNIFICANCE OF MARKET PRICE MECHANISM

- For substantially more complex systems another (horizontal) kind of information system turns out to be more efficient in order to achieve control; it is that of a market pricing mechanism in combination with a universal medium of exchange, i.e., money.

MORE ABOUT MARKET PRICE MECHANISM –1

- Efficient systems, hierarchical or market-based, always exist on (or push) the edge of cost-effective information processing.
 - To elaborate, in economic terms a larger and larger percentage of our total resources is expended on information and information technology.

MORE ABOUT MARKET PRICE MECHANISM –2

- This creates the demand for information technology. The efficiency of information technology – amount of information handled per dollar spent – has increased dramatically during the last few decades because of breakthroughs in the field of data driven technologies.
- Consequently it has become more profitable to invest a larger percentage of available resources in systems that provide information.

MORE ABOUT MARKET PRICE MECHANISM –3

- The efficiency, degree of specialization, and sustainable complexity of both market-based social systems and firms have risen – these things hand in hand.
- This trend is particularly clear in the development of accounting information systems, which uses market price mechanism.

MORE ABOUT MARKET PRICE MECHANISM –4

- In order to function easily the market price mechanism requires a common denominator to work with: money.
- Accounting information is mostly information expressed in monetary terms, and such information is, indeed, expressed in a form which makes it particularly useful in the context of a market price mechanism.

MORE ABOUT MARKET PRICE MECHANISM –5

- Conversely, as organizations face markets where their products and production factors – and they, themselves – are valued in monetary terms, they will quite naturally tend to orientate and develop their intra-organizational control systems so that they operate in a corresponding manner.

MORE ABOUT MARKET PRICE MECHANISM –6

- Whether one says that the use of money as a medium of exchange and unit of measurement minimizes transaction or contracting costs or that it provides a efficient language in which to communicate information for comparing and selection decision making does not, in this context, matter much.
 - Of course, once it is recognized that in complex and changing market environment, for system continuity planning, systems must treat information as product and not as by product, it would become clear that indeed what is provided is information with integrity, which effectively and economically processed minimizes the comparing and selection decision costs.

INFORMATION SYSTEM DESIRED - 2

- For the purpose of present analysis, what need to be noted is that both internal and external accounting information systems – systems that provide information about economic events and conditions – tend to be emphasized as the complexity of society/market/business grows, and that the bottleneck character of information and information technology comes to the fore with great force.

...AND WHICH *IS* WILL PREVAIL?

- There are costs, direct as well as indirect (in the form of contracting problems and consequent inefficiencies due to information asymmetries, i.e., due to inadequate integrity) associated with hierarchical or horizontal information systems.
- The one that, for a certain type of transactions, is able to arrange them at the lower cost will tend to prevail.

COMPLEXITY ORGANIZATION CAN SUSTAIN AND CONTROL-1

- Thus, the degree of complexity that any organization can sustain and control depends on the cost and availability of information technology.
- The trade-off is between costs associated with providing and applying information, and residual losses that in the final analysis are due to remaining information asymmetries.

COMPLEXITY ORGANIZATION CAN SUSTAIN AND CONTROL-2

- Correspondingly, the efficiency of a market is, by definition in a sense, determined by how much information is aggregated into the market clearing price, and the optimal degree of market efficiency will depend on the costs associated with obtaining and applying the relevant information.

COMPLEXITY ORGANIZATION CAN SUSTAIN AND CONTROL-3

- In both cases information, and information technology, is a bottleneck resource; a, if not the, key constraining factor.
- The relative efficiency of the so-called second- best solutions will, in general, be determined by the amount of information symmetry remaining, which in turn will be determined by the costs of obtaining and applying information.

EXERCISES-1

- (E6.1) “A good example of of an open system is a cell within a human body. The cell membrane quite clearly defines the boundaries of the cell, but it also enables nutrients and information (electrical impulses from the nervous system) to enter and waste and information (electrical impulses to the nervous system) to exit. As open systems at a micro-level (cells) are enveloped in a more macro system (human body), they are referred to as nested open systems. A closed system neither imports nor exports energy, information, or material”.

Briefly discuss what are open and closed systems? How do they differ? What is it that open systems must control and to what purpose?

EXERCISES-2

- (E6.2) “The proper subject matter of the genetic, social and exosomatic system studies, if they are to complement studies of the flow of matter (input-output economics) and energy (ecology), ought to be information: its generation, processing, and communication to effect control”. Briefly elaborate.
- (E6.3) “Information is a function of source, process and recipient”. Explain with the help of an example.
- (E6.4) How can complex information systems contribute to improving system performance?

EXERCISES-3

- (E6.5) A genealogical view of information transmission leads to concept of a genome (a matrix, a structure, a mechanism, a rule), which goes beyond a living being, extending to include exosomatic information flow systems. How does this facilitate equating business organization to an organism? What is the benefit of this modeling choice? What is the benefit of this for modeling information?
- (E6.6) What is the view of systems theorists and economists in respect of complexity of an organization?
- (E6.6.) Why does open system view of business organization hold for its systems, sub-systems, and their components also?

EXERCISES-4

- (E6.7) “The degree to which higher efficiency through increased specialization is feasible is governed by the means that are available to control the ensuing complexity, that is by the cost and efficiency of the available information flow systems”. Explain with the help of an example.
- (E6.8) “Efficient systems, hierarchical or market-based, always exist on (or push) the edge of cost-effective information processing”. Elaborate.
- (E6.9) What do you understand by terms hierarchical and market based (horizontal) information systems?
- (E6.10) What is the significance of a market pricing mechanism in combination with a universal medium of exchange, i.e., money to make information system more efficient to achieve control, i.e., to compare and select?

EXERCISES - 5

- (E6.11) Why do both internal and external accounting information systems – systems that provide information about economic events and conditions – tend to be emphasized as the complexity of society/market/business grows? Explain (Hint: Because organizations, their products, and their product factors also get evaluated in monetary terms).
- (E6.12) Within the framework of Exercise (E6.12), explain why, as the economic society develops, the importance of accounting information is on increase.

EXERCISES-6

- (E6.13) “There are costs, direct as well as indirect (in the form of contracting problems and consequent inefficiencies due to information asymmetries, i.e., due to inadequate integrity) associated with information systems (hierarchical or horizontal)”.

Explain which information system will prevail?

- (E6.14) “Thus, the degree of complexity that any organization can sustain and control depends on the cost and availability of information and information technology”. Explain.

EXERCISES - 7

- (E6.15) Within the framework of Exercises (E6.13) and (E6.14), how is then the market efficiency determined from an informational angle?

In other words, how is the efficiency of a market related to the information aggregated into the market clearing price and the costs associated with obtaining and applying the relevant information?

THANK YOU