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Using General Systems Theory as a Business Application Paradigm

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Abstract: General Systems Theory (GST) is reviewed as a paradigm for modeling business applications. The theory has been used and abused for over sixty years, oftentimes the subject of scholarly articles written by authors who felt the need to write, especially as GST was the current 'flavor of the day', but who hadn't reviewed the basic literature to learn what the GST concept actually entailed. The GST concept is reviewed, from its original documents, and the history is explored. A section is devoted to reviewing some of the literature that has been published in scholarly journals or books over the decades, and the general trend of ascribing much greater complexity to the application of GST to business and management is noted. This article presents a paradigm that is based in the simplicity of the original concept of general systems theory as offered by Ludwig von Bertalanffy, and using the time-honored concepts of business organization and management that have been studied, researched, applied, and taught for many years. The marriage of the business concepts with the explanatory power of the general systems theory provides a model that is easy to understand, teach, and apply.

INTRODUCTION

General Systems Theory (GST) has been around for six decades, and can be a viable and useful paradigm for modeling business organizations; in this author's view, it is the most useful paradigm for business, especially from a management view. There is evidence that many textbook authors feel that GST is a concept that should be introduced into the curricula of business schools, as there is generally a short, cursory section about how a business might be modeled as a system. Of about 100 textbooks reviewed by this author, only one actually presented General Systems Theory properly, and it was not a management text, but communications.

This paper concerns the use of a systems paradigm for application of systems theory and systems thinking to business systems, as opposed to the study of systems for the purpose of generating knowledge. This author has been presenting GST to every management course that he has taught for the past three years, finding that students are able to comprehend and retain management concepts much better than before, when systems theory was not presented. It is the author's belief that providing general systems theory, with a business management orientation, helps students to understand business concepts by presenting the concepts as integral to the whole system, with interdependencies between them. The author recommends that the professoriate in schools of business should investigate the General Systems Theory from its basic concepts, and provide their students with a good business paradigm that can assist them to understand the concepts we teach. This paper will start with a brief history of GST, followed by some illustrations of how GST has been interpreted and presented by business and management writers in the past, and then present the author's adaptation of GST to fit business as a model, retaining the basic principles developed by Bertalanffy and Boulding, incorporating some principles from later researchers, and modifying a few principles that the author felt necessary to better fit the model to business concepts.

GST HISTORY

A review of how GST came into being might be helpful before examining how it can best be used; examining the origins allows the intent of the concept to be considered. In his seminal article "The

History and Status of General Systems Theory" (Bertalanffy, 1972), Bertalanffy provided us a historical view of the development of GST and the rationale for its concepts.

He alluded to Aristotle's contribution to the development of GST with: "… the Aristotelian world view with its holistic and teleological notions. Aristotle's statement, 'The whole is more than the sum of its parts,' is a definition of the basic system problem which is still valid." (Bertalanffy, p.407) Aristotle is considered to be the inventor of teleology; from his interest in ends (final clause) and process (efficient clause), or the end and the means to get to the end. (Johnson, 2005) In fact, his four causes roughly approximate the basic elements of a system: material cause – *components*, formal clause – *structure*, efficient clause – *process*, and final clause – *purpose.* In his paper for the British Society for the Philosophy of Science, in enumerating the types of (system) finality, von Bertalanffy stated:

Finally, there is true finality or purposiveness, meaning that the actual behavior is determined by the foresight of the goal. This is the original Aristotelian concept. It presupposes that the future goal is already present in thought, and directs the present action. True purposiveness is characteristic of human behavior, and it is connected with the evolution of the symbolism of language and concepts. (Bertalanffy, 1950)

This brings to the fore one of basic concepts of open systems: a system exists to convert inputs into outputs through a transformation process. The output (the future goal) is already present in thought, and the requirement for the output directs the present action to produce it (obtain the materials necessary to create the output and accomplish the processes needed to transform the materials into the output). Without a conversion process, a system does not exist; many so-called systems are actually networks that are part of the structure of a system (for example, a highway 'system').

He further explained that the Scientific Revolution of the sixteenth-seventeenth centuries replaced Aristotle's doctrine, in research and writings, with Descartes' "break down every problem into as many separate simple elements as might be possible" (Bertalanffy, 1972, p.408). This study of everything by evaluating its constituent parts (reductionism) advanced science by leaps and bounds; however, the applicability to living organisms left many gaping holes in the theory. It did not account for the relations between the simple elements which actually defined the whole, separate and distinct from any of the single elements. [*Neither a male nor a female, separately, could produce offspring; nor could the two together, but acting separately as two individuals, produce offspring. However, when the male and female consort with one another as a couple, it is possible*]. Another example, from physics: {*neither hydrogen nor oxygen can exhibit the characteristic of wetness; yet, the combination of the two can do so.*] Aristotle's statement, 'The whole is more than the sum of its parts,' (the basic concept of holism) is the substrate of von Bertalanffy's protest against reductionism, which led to the concepts of open systems and GST. (Bertalanffy, 1972, p. 410)

In stating the foundations of general systems theory, he reiterated from an earlier publication:

Since the fundamental character of the living thing is its organization, the customary investigation of the single parts and processes cannot provide a complete explanation of the vital phenomena. This investigation gives us no information about the coordination about the parts and processes. … (Bertalanffy, 1972, p. 410)

He then described the evolution of a "dynamical" system theory which became his "open system" which was published by the American Association for the Advancement of Science (Bertalanffy, 1950a). The open system became the general systems model (Bertalanffy, 1950b), which initiated a rapidly spreading interest among researchers and led to the foundation of the Society for the Advancement of General System Theory (later renamed to Society for General System Research, and later still, to reflect

the broadening scope of inquiry, to International Society for the Systems Sciences) (Bertalanffy, 1972, pp. 412-413)

In discussing the trends (at the time) of general systems theory, he wrote:

General systems theory, then, consists of the scientific exploration of "wholes" and "wholeness" which, not so long ago, were considered to be metaphysical notions transcending the boundaries of science. Novel concepts, methods, and mathematical fields have developed to deal with them. At the same time, the interdisciplinary nature of concepts, models, and principles applying to "systems" provides a possible approach toward the unification of science. … "*System" being a new "paradigm*" (in the sense of Thomas Kuhn), contrasting to the predominant, elementalistic approach and conceptions, … (Bertalanffy, 1972, p.415) [Author's note: Italics added for emphasis.]

He went on further to caution that:

… 'system' is a *model* of general nature, that is, a conceptual analog of certain rather universal traits of observed entities. The use of models or analog constructs is the general procedure of science (or even of everyday cognition), as it is also the principle of analog simulation by computer. … "system" refers to the very general characteristics partaken by a large class of entities conventionally treated in different disciplines. … system-theoretical arguments pertain to, and have predictive value, inasmuch as such general structures are concerned. (Bertalanffy, 1972, p.416)

His caution was to ensure that general systems theory is used as intended, a *model,* rather than a description of the situation, itself, in general nature. The model is to simplify the complex situation in order to analyze the interrelations of the set of elements within the superordinate "whole" and its relation with its environment.

The General Systems Theory (GST) concept has been associated with management as a paradigm since 1956, when Boulding provided a 9-level classification of systems for the Management Science journal (Boulding, 1956). Boulding's 9-level classification of systems contains:

1. Frameworks
2. Clockworks
3. Thermostats (his definition should have named this "sensor-controlled systems")
4. Cells
5. Plants
6. Animals
7. Human Beings
8. Social Organizations
9. Transcendental Systems

With respect to management, we are primarily concerned with Social Organizations and secondarily with Human Beings.

GST enjoyed a period of robust investigation and research publications by business and management researchers in the late 1960's and early 1970's, then a resurgence in the 1990's, but has never caught on as a topic of enduring widespread research interest. This author's opinion is that the researchers, attempting to out-do all other research with their own, introduced layers of complexity in an attempt to make the theory fit every conceivable situation, primarily aiming at methods to create knowledge rather than applying the knowledge to actual situations in general nature. This rendered application of the theory unwieldy and difficult, causing loss of interest.

PRIOR PRESENTATION AND APPLICATION

A comprehensive review of the literature about systems cannot be accomplished here, but a sampling of some of the more noted authors will be presented.

Johnson, Kast, and Rosenzweig

In one of the first serious efforts to harness GST to management theory, these authors outlined a systems theory for business. They provided a substrate by first describing the GST rationale, then explaining Boulding's concept of system levels to establish the place of a human organization within the concept, and finally establishing a linkage to von Bertalanffy's open systems concept by comparing a business organization with the description of an open system

… The business organization is a man-made system which has a dynamic interplay with its environment – customers, competitors, labor organizations, suppliers, government, and many other agencies. Furthermore, the business organization is a system of interrelated parts working in conjunction with each other in order to accomplish a number of goals, both those of the organization and those of individual participants. (Johnson, Kast, & Rosenzweig, 1964, pp. 369-371)

Having established the foundation upon which their systems theory for business would be built, they outlined their suggested model:

There are certain key subsystems and/or functions essential in every business organization which make up the total information-decision system and which operate in a dynamic environmental system subject to rapid change. The subsystems include:

A *sensor subsystem* designed to measure changes within the system and with the environment.

An *information processing subsystem* such as accounting, or data processing system.

A *decision-making subsystem* which receives information and outputs planning messages.

A *processing subsystem* which utilizes information, energy, and materials to accomplish certain tasks.

A control component which ensures that processing is in accordance with planning. Typically, this provides feedback control.

A *memory or information storage subsystem* which may take the form of records, manuals, procedures, computer programs, etc.

A goal setting unit will establish the long range objectives of the organization, and the performance will be measured in terms of sales, profits, employment, etc. relative to the total environmental system.

This is a general model of the systems concept in a business firm. … (Johnson, Kast, & Rosenzweig, 1964, pp.372-373)

Although the goal setting unit and the control component were not specifically mentioned as subsystems, their description and placement with the list indicated that they were considered to be subsystems. As this model was developed in 1964, very little research on adapting general systems theory to business applications had been accomplished. Many theoretical writers seized on the model as something on which they could elaborate, perpetuating some of the errors included in this early model. The only subsystem that actually fits as a system is the *processing subsystem.* The *sensor, information*

processing, and *memory* subsystems are tools; decision making, controlling, and goal setting are management functions.

The remainder of the paper illustrated how the model would fit into a business; it seemed to be a presentation of the then prevailing concepts of management and organization with the word "system" inserted whenever possible. Although the beginning (establishing the foundation for the model) was an accurate portrayal of the systems theory concepts, it appeared to stray from the concepts in the model and application portion.

Katz And Kahn:

Katz and Kahn, both with doctorates in Social Psychology, took an interest in open systems. They developed an open system model which incorporated four phases: (a) energic input, (b) a process within the system to convert the input into outputs, (c) energic outputs, and (d) an event of recycling in which the outputs are converted into energy as inputs. They considered the inputs to include not only tangible items such as capital, employees, and raw materials, but also environmental intangibles, such as community appreciation and industry recognition, among other things. The throughput conversion process converts the inputs into products and services, which become the energic outputs sent into the environment. The environment provides the inputs in the recycling process by payment for the products and services which allows purchasing of new raw materials, payment of employees, and an additional amount of energy (profit) for growth.

Their model not only included the open system concept of negative entropy (an additional amount of energy for growth), but also dynamic homeostasis or balancing of the interrelated components (for example, increasing or decreasing organizational support to match production capability, which, in turn, changes to match expected requirements for outputs) and equifinality, which posits that the organization can reach a final state by more than one path or from different initial states.

The model defined five subsystems required for a business organization:

Production – the process within the system to convert the input into outputs,

Supportive – the processes of acquiring inputs, exporting outputs, and accomplishing the administrative tasks related to employees (pay, training, workspace, etc.)

Adaptive – gather information from the environment about opportunities and threats and develop plans, products, and services to adapt to the environment

Maintenance – provide the right employees for the various roles and provide for conditions to keep employees satisfied (work conditions, motivation, other needs)

Managerial – directs, coordinates, and controls the other subsystems and activities, using a feedback mechanism that compares outputs to inputs.

Their book was used as a reference and a basis for many of the writings about application of systems theory to organizational behavior that followed. (Katz & Kahn, 1966)

Given the date of the research, 1966, the model is surprisingly versatile. However, the adaptive subsystem's functional purpose is a normal function of management, the supportive and maintenance subsystems functional roles greatly overlap, and there are still many necessary functions that are not addressed by the model.

Kast and Rosenzweig:

Eight years after publishing the 1964 paper with Johnson, Kast and Rosenzweig reviewed the literature of organization theory which had adopted systems theory as a frame of reference. It is ironic that they concluded that most authors, beyond the beginning of presenting an accurate view of systems theory and its relationship to organizations, departed substantially from systems theory when moving into the subject matter applying the theory to their application content. (Kast & Rosenzweig, 1972, p.451)

The paper demonstrated a maturity in their conceptualization of using systems theory as a paradigm for studying organizations over the earlier one, but it still failed to fully apply the basic system theory concepts. In questioning the system effectiveness, they presented:

General systems theory with its biological orientation would appear to have an evolutionary view of system effectiveness. That living system which best adapts to its environment prospers and survives. The primary measure of effectiveness is perpetuation of the organism's species. Teleological behavior is therefore directed toward survival. …

General systems theory emphasizes the organism's survival goal and does not fully relate to the question of the effectiveness of the system in its suprasystem – the environment. Parsonian functional-structural views provide a contrast. "The *raison d'etre* of complex organizations, according to this analysis, is mainly to benefit the society in which they belong, and the society is, therefore, the appropriate frame of reference for the evaluation of organizational effectiveness" (Yuchtman & Seashore, 1967, p.896)

But, this view seems to go to the opposite extreme from the survival view of general systems theory – the organization exists to serve the society (Kast & Rosenzweig, 1972, p.456).

In stating "The primary measure of effectiveness is perpetuation of the organism's species. Teleological behavior is therefore directed toward survival.", the authors have apparently inserted an interpretation of their own; this author could not find the statements to corroborate it in von Bertalanffy's papers. *The primary measure of effectiveness is survival.* Survival depends greatly on the ability of the organization to fulfill its purpose; without a purpose, it ceases to exist as meaningful system. The better the system fulfills its purpose (to benefit the society in which it belongs) by exporting to the environment the output as mandated by the purpose, the greater chance it has of survival.

Kast and Rosenzweig went on to suggest that "organizational effectiveness must be concerned with at least three levels of analysis: The level of the environment, the level of the social organization as a system, and the level of the subsystems (human participants) within the organization." They further said: "… we see the systems approach as the new paradigm for the study of organizations; but, like all new concepts in the sciences, one which has to be applied, modified, and elaborated to make it as useful as possible." (Kast & Rosenzweig, 1972, p.456)

As suggested above, organizational effectiveness should be analyzed by measuring the ability of the organization to fulfill its purpose by providing the environment (society) with its output (goods, services, ideas, and information) that meet the expectations and requirements ultimately made by the environment, monitored at the interface between the environment and the organization.

Miller:

In 1978, James G. Miller published a book to describe his Living Systems Theory. Elaine Parent, a close associate and assistant to Dr. Miller, described the living systems theory as:

A fundamental concept in general systems theory is the notion of emergence and interaction. A system is defined as a set of interacting units with relationships among them. The properties (or behavior) of a system as a whole emerge out of the interaction of the components comprising the system.

The eight levels of living systems are: cells: a basic building block of life organs: the principle components are cells, organized in simple, multi-cellular systems. organisms: there are three kinds of organisms: fungi, plants and animals. Each has distinctive cells, tissues and body plans and carries out life processes differently. groups: these contain two or more organisms and their relationships. organizations: these involve one of more groups with their own control systems for doing work. communities: they include both individual persons and groups, as well as groups which are formed and are responsible for governing or providing services to them. societies: these are loose associations of communities, with systematic relationships between and among them. supranational systems: organizations of societies with a supraordinate system of influence and control.

The twenty subsystems and processes of all living systems arranged by input-throughput-output processes. Processes which take place in the Systems Input Stage: Input transducer: brings information into the system. Ingestor: brings material-energy into the system Processes which take place in the Systems. Throughput Stage A: Information processes: Internal transducer: receives and converts information brought into system channel and Net: distributes information throughout the system. Decoder: prepares information for use by the system. Ttimer: maintains the appropriate spatial/temporal relationships. Associator: maintain appropriate relationships between information sources. Memory: stores information for system use. Decider: makes decisions about various system operations. Encoder: converts information to needed and usable form. B: Material-energy processes: Reproducer: with information, carries on reproductive function. Boundary: with information, protects system from outside influences. Distributor: distributes material-energy for use throughout the system. Converter: converts material-energy into suitable form for use by the system. Producer: synthesizes material-energy for use within the system. M-e storage: stores material-energy used by the system. Motor: handles mobility of various parts of the system. Supporter: provides physical support to the system. C: Processes which take place in the Systems Output Stage: Output transducer: handles information output of the system.. Extruder: handles material-energy discharged by the system.

Because the Living Systems Theory of James Grier Miller is a general Theory, the aforementioned concepts are metaphorical only, meant to be algebraically translated to the particular living system in systemic inquiry (Parent, 2000).

The concept is very thorough, and considered to be a definitive work. It is, however, not designed to be a simple model that can be readily used as a paradigm for applying GST to business organizations. Putting the layman (or business student) in the position of developing twenty subsystems for analyzing any particular system practically guarantees a lack of interest in using the theory in a practical application.

Ashmos and Huber:

Ashmos and Huber (1987), in an Academy of Management Review article, lamented that the systems paradigm had:

… gone out of fashion among organization researchers. Explicit recognition of the paradigm by organization scholars peaked in 1972 with the *Academy of Management Journal's* special issue on general systems theory. The paradigm that was referred to in 1972 as "vital to the study of social organizations and as providing the major new paradigm for our field of study" (Kast & Rosenzweig, 1972, p.457) has certainly not received the kind of attention in recent years that might have been expected of a "major new paradigm." …

Millet:

Reflecting a resurgence of interest in applying systems concepts to organization theory during the 1990's, Millet (1998) wrote about the dominance of systems theory in the existing literature and explored viewing the emerging explanations of complexity and chaos theories as evolutionary system theories. He introduced the paper with an assumption that there is a definite black/white dichotomy between viewing an organization as one that blindly defines an endpoint and is only concerned with arriving there or defines and redefines endpoints as conditions change.

The reader can get lost in the verbiage which seems to provide a sense of being lost in the management jungle, discussing the emerging perspectives of chaos theory and complexity theory. Millet offers:

… The implication of sensitive dependence is that the future is unknowable. Consequently, strategic planning and the creation of visions to take the organization into the future, is questionable and dangerous. It could be more by sheer chance that some companies succeed in fulfilling their long-range plans. A structural adjustment from a functional to a process emphasis moves the stable/unstable borders with consequences for the organization's capability for self development. Although this switch is not necessarily undesirable, it merely points out that there will be long-term consequences in the trade off between functional and customer boundaries.

One does not need to even understand the implication of sensitive dependence or even to understand the meaning of sensitive dependence to know that the future is unknowable. If we had the ability to know the future, we would have invested everything we had to buy stocks at their lowest point and sold at the highest; we would have used our knowledge to change the course of nations such that the entire world would be prosperous and at peace. We do know that much of the future is predictable, given that we evaluate the environment and use our knowledge to define probabilities.

Taking Millet's reasoning to its ultimate conclusion, we should just allow things to happen. Chaos theory would seem to militate that planning is an exercise in futility; however this negates what we have learned over centuries, nay, millennia, since Aristotle developed the concept of teleology. We have known of many examples of businesses which have grown and prospered through strategic planning and creation of visions; this author has yet to find one with a history of growth and prosperity without planning or a leadership vision on which to base the planning. Ad hoc companies just seem to fail, for some reason.

Charlton and Andras:

Charlton and Andras (2003) specifically looked at management as a system (a needed perspective), beginning by defining management systems as "a form of social organization system which is engaged in modelling the organization it manages." (Charlton & Andras, p.2) Next, they suggest that, as management systems can only measure their performance by comparing actual outcomes with the predicted outcomes, if a discrepancy occurs, management will need to set up a new system to observe the management system in order to understand the reason for the discrepancy. They term this a 'management–of-management' system, which will not only model "the management system, but also the organization system and the external environment." (Charlton & Andras, p.4) They conclude from this that management is a system of global self-reference.

Taking this to its logical conclusion, if the management–of-management system has a discrepancy between its predictions and the actual outcomes, there needs to be another subsystem created to observe the management–of-management system, constituting a management–of-management–of-management' system. This author tends to disagree with the tenor of this argument. Management, as an expert on

management of its own suprasystem, can self examine itself and determine the reason for the discrepancy through logical analysis.

Later, Charlton and Andras refine the definition:

As a minimal definition, therefore, management is a form of self-representation by an organization, and management systems model organisation systems. But this definition is not sufficiently precise. Partial forms of self-reference are almost universal in human organizations require a substantial degree of inter-communication in order to function. This entails one part of a system referring to another. … We suggest that management is constituted by global self-reference by an organization: in which a management system operates on the assumption that it models all the necessary aspects of organizational activity, such that the model may be used for monitoring, prediction and planning of the organization as a whole. If global self-reference is taken as definitive of management, then it is clear that not all organizations will have a management system. Simpler forms of organizations typically neither need, nor benefit from, management systems. … Not all management occurs in the form of an organizational system – after all, management may be a single human individual. … The management system is defined as the pathway and processing of the sampled information. It can be seen that the management system may include human brains and bodies, but also the outputs of machines … and that processing may include non-human cognitive activity – such as computers which perform statistical analyses. Management is therefore not synonymous with human managers … Management systems are abstract information-processing systems, and their delineation requires empirical study of the specific system under investigation. (Charlton & Andras, pp.5-6)

Again, this author disagrees with the tenor of the argument; as the authors do not differentiate between management and the tools management might use in performing its activities as required by its purpose. In the next section of the paper, Charlton and Andras mischaracterize the function of management through obfuscation and perpetuation of a misinterpretation of systems theory. They state: "Due to the cognitive specialisation within modern management systems, the function of a management system is not necessarily understood by any of the participants in the system. … The function of any specific management system must be therefore be discovered by empirical investigation." (Charlton & Andras, p.6) The implication of this is that no one knows what management is doing, not even the managers, until an empirical investigation of the specific management system has been accomplished.

They further stated: "The primary function of a management system, as for any system, is its own replication. Without this attribute management would neither be observable, nor would it be a system – because all systems by definition process information in order to reproduce themselves." (Charlton & Andras, p.6) A cursory examination of this statement will show errors. All systems are not open systems. Only open systems can even have the capability to reproduce themselves, and that capability is not the primary function. The primary function of any system is to process inputs into outputs in accordance with its purpose. Only living systems can actually accomplish their own replication, but is a by-product of their system process functioning in an effective manner. A management system exists in an organization, and its primary function is to provide planning and control to the organization to assure that the organization's operations systems process inputs into outputs in accordance with the organization's purpose. The management system, if it proves to be ineffective, could be replaced; however, it does not replicate itself.

WHERE DO WE GO FROM HERE?

KISS

One of the old adages from the military is: "*Keep It Simple, Stupid!*" If you want people to learn a concept and to use it, the adage holds, whether in the military or out of it. Very few of the books and articles in the literature attempt this; mostly they either misrepresent GST or try to apply it in a very complicated manner (or sometimes, both). In an effort to keep things simple, this author's recommendation is to retain much of what we have already learned and accept about organizational theory, and restate it in terms of GST.

Each organizational system is a subsystem of a suprasystem, having relationships and interdependence with one or more other systems that comprise the structure for the suprasystem. Each organizational system is also a suprasystem itself, having subsystems which comprise its structure. Each of these subsystems is a system in its own right, with a purpose, and subsystems to accomplish the functions required to fulfill its purpose. The purpose of any system is to support the purpose of its suprasystem. Each system has two subsystems in common, and may have more that are designed and created to fulfill specific requirements of fulfilling its mission. The two common subsystems are management and operations; the management subsystem fulfills the planning, control, communications, and environmental evaluations for its suprasystem; and the operations subsystem creates the outputs for the suprasystem.

Even a very cursory look at the economic situation in the United States will reveal that, as with the advent of the industrial revolution, when the economic base changed from primarily agricultural to production of material goods, the technological revolution has changed the base from production of material goods to services. The paradigm suggested here fits well with the shift in the economic base, and is fully adaptable to all types of outputs: material goods, services, energy, electronic information, or ideas.

GST business model with KISS

The basic functional areas of a business are (a) management, (b) operations, (c) marketing, (d) finance, and (e) administration. These are the major subsystems of a business; their relationships and interdependence generate synergy and provide the business suprasystem the ability to fulfill its purpose (mission), as a whole entity. There may be other major subsystems, depending on he type of business, (e.g. legal), but the five are required for all businesses. Any subsystem could be represented by a single person, and a single person could represent all subsystems; the functional requirement remains as a subsystem – if one person performs the functions of more than one subsystem, that person is the staff of each subsystem. A human is very complex, and can be many systems: a manager, a worker, a mother, a coach, a cook, and a student. Each is a different system, with different inputs, different outputs, and different purposes, but the same person.

The management subsystem's purpose is to perform planning, control, communications, and environmental evaluations.

Its planning mission depends on the level of the suprasystem in which it is a subsystem; however, the planning will include the mission requirements for all of the subsystems to support the business mission, including its own requirements. The plans, at the business level, will be strategic. The planning mission requires coordination with (a) the marketing subsystem to determine the type of outputs that are needed to satisfy the desires and expectations of the suprasystem, in accordance with the system mission, (b) the operations subsystem to establish design, development, and production requirements to support the output

expectations, (c) the administration subsystem to establish the requirement for plant, equipment, personnel, training, and other support that will be needed to implement the plans, and (d) the finance subsystem to ascertain that the available funding will support the plans, or that additional funding will be required, or that the plans will need to be able to fit to the constraints of the available funding. The planning mission will require a separate subsystem, which might have subsystems of their own.

The control function is to monitor the output produced by operations to evaluate its adequacy for fulfilling the business' mission, and to signal when to plan for or implement change in operations. The control function requires close coordination with the operations subsystem and interfaces with the planning function to indicate a need for plan changes, and may require a separate subsystem.

The communications function requires communicating with stakeholders in the environment and with all subsystems within the structure. Communication is the central and primary reason that social organizations can exist; without communication, no system could convey coordinating, planning, directing, or organizing information nor could liaison be conducted with another system within its suprasystem, any part of the environment, or with its own subsystems. Without communication, systems could not exist as systems; they might be an aggregated group of entities, but could not even know that they are aggregated or why.

The environmental evaluation function is how the system knows If (a) the output is satisfying the current suprasystem expectations, (b) expectations are changing, (c) an opportunity to satisfy new expectations within the current system capabilities has surfaced, or (d) if a situation has arisen that poses a threat to the business as it is currently structured. This function interfaces with the planning function to indicate a new need for planning.

The management subsystem of the business, *as a system*, has a management subsystem and an operations subsystem as its structure.

The management subsystem will provide the planning, control, communications, and environmental scanning functions for its suprasystem (planning subsystem for the business).

The operations subsystem will accomplish the functions required by the planning subsystem for the business: it will accomplish the planning; operate the feedback mechanism to monitor, record, and store output of the business system; and analyze/evaluate the environment (within the business structure, including the other business subsystems).

The operations subsystem's purpose is to do whatever in needed to provide the output required by the planning subsystem's plans. This entails analyzing the business output requirements to determine the inputs and transformation processes needed to convert them into the expected outputs. Once the transformation processes are determined, the structure (plant, equipment, personnel, training, utilities, and technology) that will be needed to provide the processes is evaluated and compared to the existing structure to determine if additional structure is needed. After determining the requirements and planning is accomplished, the plans are implemented to actually produce the outputs.

Depending on the business type, the operations subsystem, *as a system*, may require two or more subsystems as its structure. It needs, of course, a management subsystem and an operations subsystem (which may itself require many independent operations subsystems). If the business is a manufacturing firm, or a service firm, or a virtual marketing firm, or a financial brokerage firm, or any other different type of firm, the subsystems required will vary. Some will need a research and development subsystem. Some will need a special inbound or outbound logistics subsystem. Some will need engineering (design, development, manufacturability, software, etc.) subsystems.

The management subsystem of the operations system will provide the planning, control, communications, and environmental scanning functions for its suprasystem (operations subsystem for the business). It will analyze the business output requirements and determine, requisition, and schedule the input and structure requirements, and plan and schedule the operations needed to fulfill the business mission. It communicates all of the information to the business management subsystem for use in higher level planning. It also communicates all requirements to administration, which accomplishes the purchasing, hiring, and training functions; coordinates with marketing to align output processing with demand and with finance for inclusion of major requirements into finance plans, and accomplishes liaison with the environment for incoming and outgoing logistics.

The operations subsystem will accomplish the functions required of the operations subsystem for the business: it will implement the plans provided by the management subsystem (of the operations system) through its process subsystems.

The marketing subsystem's purpose is to research the environment to seek out opportunities for the business to exploit, evaluate customer opportunities and develop requirements in terms of customer benefits, create awareness of output within the environment through demonstration of benefits, obtain intelligence on the competitive state of the environment (competition developments and status or research and development news of competing or substitute products, for example), and market the output in the environment.

The marketing subsystem of the business, *as a system*, has a management subsystem and an operations subsystem as its structure.

The management subsystem of the marketing operations system will provide the planning, control, communications, and environmental scanning functions for its suprasystem (marketing subsystem for the business). It will analyze the business environment and provide the intelligence obtained to the management subsystem of the business. In addition to communicating with the management subsystem and the environment, it also communicates and coordinates with the administration and finance subsystems.

The operations subsystem will accomplish the functions required of the marketing subsystem for the business: it will implement the plans provided by the management subsystem (of the marketing system) through its process subsystems.

The other two major subsystems can be similarly described; however, it is not necessary. All of you undoubtedly understand business well enough that you can fill in the blanks with similar prose that fits the functional requirements for the finance and administrative subsystems.

The main point established is that a GST model to fit a business can be simply defined and allow analysis both systemically and systematically.

GST SYMBOLISM

Bertalanffy stated:

… the system is considered to be a "black box"; its relations to the environment and other systems are presented graphically in block and flow diagrams. The system description is given in terms of inputs and outputs (*Klemmenverhalten* in German terminology); its general form are transfer functions relating input and output. … external description, typically, is given in terms of communication (exchange of information between system and environment and within the system) and control of the system's function with respect to environment (feedback) … (Bertalanffy, 1972, p. 419)

The representation of a system is normally seen as a box (representing the transformation process), with an arrow into the box (representing inputs), an arrow out of the box (representing outputs), and a return arrow from the output arrow to the input arrow with a "control mechanism" in the middle (representing the feedback look). See figure 1.

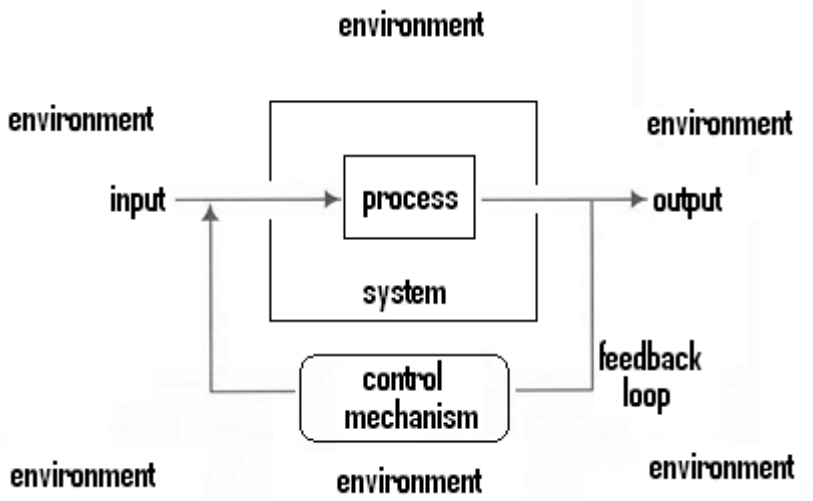

FIGURE 1. COMMON REPRESENTATION OF A SYSTEM

This is confusing, as the feedback mechanism is not a self-standing subsystem; it is contrived as a tool for a subsystem that does exist. A better representation might be: See figure 2.

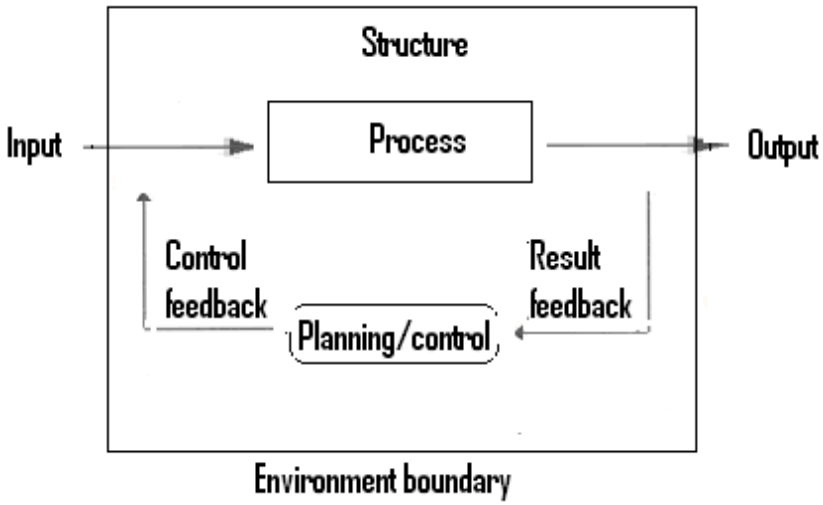

FIGURE 2. A BETTER REPRESENTATION OF A SYSTEM

The graphic representation at figure 2 shows the feedback loop inside the structure of the system, as described above, so that the management subsystem (part of the structure) operates it and uses it for control purposes.

A graphic representation of the business as a system, with its subsystems and relationships might be seen here in figure 3:

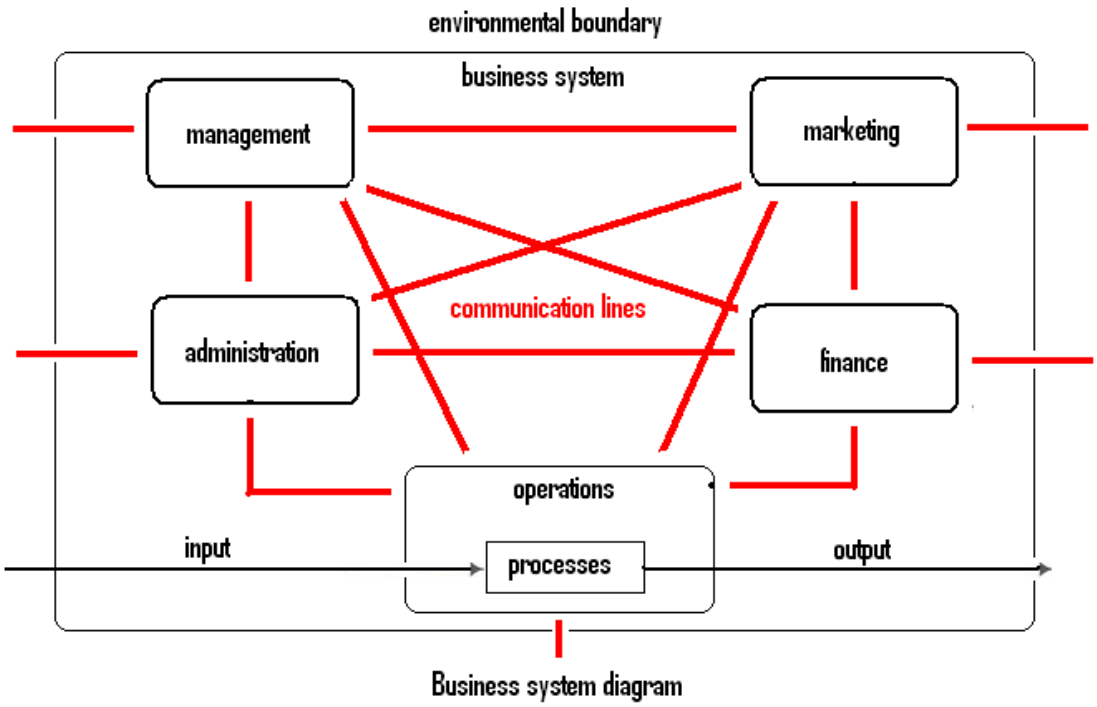

FIGURE 3. A BUSINESS SYSTEM WITH SUBSYSTEMS

This diagram shows the business system with the five major subsystems and lines of communication between the subsystems. The communication lines also define relationships and interdependencies. In each subsystem, its management subsystem accomplishes the communication.

BENEFITS OF THIS APPROACH

Using this approach greatly simplifies modeling a business for planning and decision-making. It uses the organizational constructs that have been learned, and trusted, in the past, but puts them into a format that is easy to understand and use.

Major functional business areas are represented as subsystems of the business; in fact, they are the structure of the business system.

The system at each level within a system of systems is a system (so defined), a suprasystem (to the subsystems below it in the system), and a subsystem (to the suprasystem above it.

All subsystems within a system comprise the structure of the system, and are interrelated and interdependent, while still functioning as a stand-alone independent system.

Each system has a purpose, and its output is designed to fulfill the purpose.

Outputs are exported out of a system into its environment and become inputs to the receiving system in the environment.

Inputs are consumed by the system and converted into outputs (which could be useful products or waste).

Although as an open, living system, the principle of equifinality (the final result may be reached by more than one path) implies that the same final form could be reached with different inputs and different processes, the same input transformed with the same process will each time result in the same output.

When an output requires change, a change in input or a change in process will result in a change in output.

Each subsystem in the business system has two subsystems (management and operations) with clearly defined functional requirements; there may be more as required to provide specialized output.

Each management subsystem's purpose is to perform planning, control, communications, and environmental evaluations.

Each operations subsystem will accomplish the functions required by the planning subsystem of its suprasystem: it will accomplish the planning; operate the feedback mechanism to monitor, record, and store output of the process; and analyze/evaluate its environment.

Having a structure that remains fairly stable enables the planning/decision-making elements to accomplish their functional requirements within a simple model. The system is teleological, implying that one must define an end and design processes to attain the end. This is a well-defined principle of management, and is the basis of planning and decision-making.

This author has also found that this simplified model of a business enables his students to grasp the concepts of management easily, and greatly facilitates business case analysis. Using the model as a substrate for each course enables students to examine the suprasystem as a holistic entity, looking at the interdependencies between subsystems in producing the output of the suprasystem and fulfilling the system's mission (purpose). At the same time, it enables them to examine changes to the output caused by changes in either inputs or processes of the various subsystems and how the changes in a subsystem can affect other subsystems in the interdependent system.

In the Introduction to Business course, the systems concepts enable the students to readily understand the relationship of business to the economic suprasystem and the relationship of a business firm to its suprasystem industry, or, from the viewpoint of a small business, to its suprasystem community. The concepts facilitate learning the components and relationships of the network of subsystems in a small business. They provide a basis for understanding the functions of management.

Systems concepts provide students in the Principles of Management course with a substantial substrate for understanding how management fits into an organization, as the management subsystem for its suprasystem. Students also learn, via the relationships between the subsystems, how management plans and controls all inputs, processes, and outputs for the business at the system level and for each of the subsystems at the subsystem level.

The General Systems Theory is especially helpful for Production and Operations Management courses, which essentially teach concepts of managing the business operations subsystem. The majority of textbooks are devoted to presenting management techniques and how to use various tools for measuring and controlling inputs, processes, and outputs. Providing systems theory training enables students to put operations into the proper context of a business, and show the interrelationships between operations, marketing, administration, finance, and management. All of the subsystems must coordinate in order to effectively and efficiently produce the output needed to fulfill the business purpose.

GST concepts are the most helpful in the capstone policy course. Presenting case analyses in the context of GST catches the imagination of students, who probe deeply the interrelationships to discover

the root causes of dysfunction, and evaluate how an original abnormality grew to spread to other subsystems and sometimes metastasized to cripple or destroy the business. Students become excited with finding probable means of early detection and corrective action, but also with discussing preventive measures to preclude the abnormality in the first place. They also use systems theory to look at cases of healthy companies, finding practices that fit and can be used as comparisons to the unhealthy company cases.

CONCLUSION

General Systems Theory is the most complete paradigm this author has encountered to explain the functioning of social organisms; in particular, business organizations. It provides the flexibility to fit to any business type, and allows inclusion of the basic time-tested principles of business management in such a way that it can be understood and applied by managers and students, as long as it is not distorted by well-meaning academicians who attempt to make the model fit every conceivable situation.

This paper presents a simple method of interpreting, and applying the systems paradigm to business organization.

Every system has a purpose, and accomplishes the purpose by importing inputs from its environment, transforming the inputs by internal processes into outputs which fulfill its purpose, then exporting the outputs into its environment, where they will be used as inputs into another system.

Every system has a management subsystem which plans the inputs-to-outputs process through monitoring the system environment to determine requirements and controls the operations through communications and operation of a feedback mechanism.

Every system also has an operations subsystem which accepts the inputs from the environment, performs the processing as needed to transform the inputs into outputs to fulfill the systems purpose.

Any system might need other subsystems to support the management and transformation processing requirements.

It defines the business system such that there are five major subsystems: (a) management, (b) operations, (c) marketing, (d) finance, and (e) administration. Each of the subsystems, as a system in its own right, has at least the two requisite (management and operations) subsystems; each will also have others as needed for its functioning. All components of the system are interdependent and communicate with each other and the environment.

This version of the paradigm has been tested on students in various management courses, and has earned praise and accolades from the students for the ease in understanding concepts that had been previously difficult. This paradigm should be presented to business students in their curricula on a much broader basis to improve their understanding of business concepts and assist in improving the economy through application of their better understanding.

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