Organizing Around Intelligence, Information Processing and Nonlinearity:
The Inherent Structure of Natural Intelligent Systems

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Abstract

As human organizations venture deeper into the information era, the intelligence era, a fresh mindset is inevitable. The paradigmatic shift requires organizations to redesign their structure and operations around intelligence, information processing and nonlinearity. In the emerging environment, organizations are perceived to behave as intelligent corporate beings, in the same manner as biological entities are competing for survival in an ecological system. To accommodate these unavoidable vicissitudes, human organizations need to nurture their own orgmind and to elevate their collective intelligence. A strong need to comprehend intelligent structure, in particular, the intangible deep structure becomes vital, as an effective surface structure emerges only from a coherent orgmind. In addition, as the spaces of order and those of complexity have rather dissimilar characteristics, they have to be planned for and managed differently. Consequently, both deliberate and emergent strategies have to be synthesized and adopted in varying proportions. A more wholesome concept for the new battle plan is the intelligent organization theory.

INTRODUCTION

1.1   Related Development

a.   Historical Perspective

A human organization is more than just a pure mechanistic economic production system. Basically, it has a physical structure as well as a conceptual structure. However, its economic production activities and efficiency coupled with the human relations issue, have been a key area of concern throughout the major portion of this century. To a great extent, this is justified. Numerous organization theorists have contributed significantly towards the understanding of this perspective (Barnard, 1938; Chandler, 1962; Davis, 1928, 1951; Drucker, 1964, 1974; Fayol, 1949; Gladwin et al, 1955; Katz and Kahn, 1966; Miles and Snow, 1978; Shenhav, 1955; Simon, 1976; Taylor, 1911). This domain will continue to remain as the primordial stratum of organization theory. However, by itself, this requisite is grossly insufficient in the new environment.

Today, human organizations have a machine-like structure that supports the requirements of the industrial era. Such a mindset is at least three centuries old. In the 17th century, Sir Isaac Newton put in place the study of classical mechanics, which explains the physical world in a linear, mechanistic manner. During the same period, Rene Decartes conceptualized cartesian geometry and preached the concept of a "clockwork universe", that is, the universe as a huge machine. In human organizations and management, the above perception was entrenched in the early 20th century by Frederick Winslow Taylor, who introduced the scientific management school of thought (Taylor, 1911).

The consequence of the above developments is a strong mindset in the management world that systems and organizations must be managed like physical instruments of production and human beings must be engineered and re-engineered to fit the mechanistic structure. However, it is a fact that most organizations managed in this manner are not operating at near optimal levels. Human beings cannot function like machines.

An additional perspective of organizational survival and competition is also receiving much attention. The increasing competitiveness of the global environment is cited frequently as the reason new strategies are needed. Several such models have been developed and put into practice (March and Simon, 1958; Miller, 1986, 1987, 1988; Porter, 1980, 1985; Porter and Miller, 1985; Radner, 1972; Simon, 1972). The significance of the conceptual structure is gradually elevated. The roles of information, and its systems and technology, are more closely scrutinized.

b.   Current Thought

At the moment, the mismatch between a structure constructed to support operations in the industrial era and the competitive requirements of the information era, is surfacing (Begun, 1994; Langloris and Everett, 1992; Levy, 1994; McMaster, 1996; Perry, 1995; Stacey, 1995; Thietart and Forgus, 1995; Westley and Vredenburg, 1997). This new awareness requires an organizational system to be examined as an intelligent being and not merely as an economic production machine. Similar to a human being, a corporate being must process intelligence. The industrial era and its mindset must be replaced. The new mindset suggested here integrates concepts that have been emerging since the beginning of this century, although from a rather

different domain. In 1927, in quantum physics, Werner Karl Heisenberg discovered the uncertainty principle which indicated that it is impossible to determine exactly both the position and momentum of a body at a given moment. This finding established the fact that it is impossible for the mind to contain a physical object but only a perception of it. Thus, our "real world" is merely a perception of the mind. A new science, the science of consciousness, has emerged.

The new scientific theory is chaos, established in the 1970s by Mitchell Feigenbaum, Edward Lorenz, and a few others (Gleick, 1987). The central axiom of the theory is the inseparability of order and chaos, that is, the universe is inherently chaotic and intrinsically orderly at the same time. And the universe is an immense tapestry of thought produced by the mind. This interesting transformation in how our existence is perceived has a profound impact on all of humankind including its organizations. The mind becomes the centre of analysis and experimentation. For human organizations, a new theory or a new organization science, centred around the orgmind, is being conceived. The mind and orgmind are driven by intelligence.

Therefore, intelligent organizations must possess what is known as "collective intelligence". And "collective intelligence involves the integration of intelligence sub-units into a coherent unit capable of solving problems beyond the reach of the individual units" (Stonier, 1991: p 261). In the context of human organizations, the intelligent sub-units comprise at least the minds of the staff members, and the constructed intelligent information processing systems. Very likely, there are some other intelligent agents. There must also be intelligence-associated activities that can release latent intelligence and hence help to elevate the intelligence level of

organizations. Thus, collective intelligence is a critical aspect that practising managers should focus more attention on.

c.   Science of Complexity

Within the same domain, supporting the study that human organizations are intelligent systems, is the newly emerging science of complexity (Anderson et al, 1988; Arthur, 1994; Gell-Mann, 1994; Gleick, 1987; Kauffman, 1993; Langlois and Everett, 1992; Langton, 1989; Levy, 1994; Lewin, 1992; McMaster, 1996;   Overman, 1996; Perry, 1995; Stacey, 1991; Thietart and Forgues, 1995; Waldrop, 1992). The key parameters that the science of complexity deals with are intelligence, nonlinearity and information processing. Systems in which information and information processing ability are intrinsically embedded are intelligent complex adaptive systems. All intelligent systems have structure and their intelligent dynamics are learning, adaptation, competition, and co-evolution with the environment.

Although the linear portion of the world is a very significant part of our existence, the remaining huge component is nonlinear. An awareness and understanding of their similarities and differences is extremely significant. In general, nonlinear phenomena are not easily predictable because a slight difference in initial condition can lead to a totally different outcome, a characteristic known as the butterfly effect.   Fortunately, it has also been observed that for such systems, even though the surface phenomena are complex, the underlying elementary processes generating them may be simple. In this respect, complexity is deterministic chaos, and such nonlinear phenomena can be analyzed and, more significantly, exploited.

5

Similarly, operations in businesses are not always linear, either. Very often, business operations behave nonlinearly, expressing the dynamics of complex adaptive systems. Such characteristics should not be suppressed. In fact, an innovative and competitive organization should be constantly testing the edge of chaos, searching for niches. If the strategies used are linear and highly predictable, than they are not very valuable. They cannot be strategic as they are common knowledge. It is in the nonlinear domain where niches can be identified, and where strategies can be mapped and used successfully.

d.   Organizations as Biological Entities

A better perception and understanding of the natural intelligent systems allows the structure of constructed intelligent systems to be compared. In recent years, the study of natural intelligent systems has been prolific.   Consequently, the studies of how the human mind operates, how an ecology evolves, and numerous other branches of natural sciences, including information-related theories, are significant sources for comprehending how human organizations should be structured and managed (Arrow, 1972, 1972a; Fox et al, 1994; Hayes, 1993; Liang, 1994, 1996, 1997; Radner 1972; Stonier, 1991). Such an approach establishes a totally new mindset, and a new revolutionary organization theory.

The new theory indicates that human systems designed based on intelligence are more adaptive and competitive. The inherent characteristics of intelligence blend more naturally with the requirements of the information era or the "intelligence era". In fact, an intelligence-based structure is the inherent structure that all organizations should adopt. At the moment, the

mechanistic setup of the industrial era that causes some unnatural twists in organizational structure must be removed, if they are to survive the next phase of competition.

Recognizing that a human organization is an intelligent system is a new awakening. This realization indicates that such a system is adaptive, and it evolves with time. Such a system is constantly responding to its environment, or at least to its immediate environment. Thus, it has to be organized and managed differently. Even the strategy adopted has to be changed. The connection between the two categories of systems, the natural and the constructed, must be scrutinized as they must be driven by the same objectives and motivations. In this respect, managing human organizations in the next millennium requires a totally new theory which perceives organizations as biological entities.

1.2   The Study

The spaces of order can be examined based on the exact scientific treatment of the discipline (Dublin, 1978; Kuhn, 1962; Popper, 1959; Simon, 1969).   In this study, as nonlinearity is involved, the science of complexity becomes a significant component. The primary focus is on the information processing and intelligence domain. The new theory to be conceptualized is the intelligent organization theory. The fundamental belief of the new theory is that intelligence is the attribute and the entity that provides the impetus for organizations to mould themselves, to evolve and to compete over time. Intelligence is the intangible entity that drives all aspects of human organizations. Unavoidably, this unique attribute also provides forward direction for an organization.

In the new context, human organizations must be examined as intelligent dynamic systems. Although some of their phenomena are linear processes, the major portions of them are not. The complexities of their surface phenomena thus require them to be analyzed and managed as complex adaptive systems. Their nonlinear characteristics cannot be suppressed as they are just too valuable. Thus, the understood nonlinear dynamics of the science of complexity must be introduced into organization theory.

In this analysis, three different areas are examined with respect to the above perspectives. The first aspect examines the intelligence traits of human organizations, and the different levels of intelligence that such organizations can manifest. The discussion focuses on the physical structure of human organizations.

The next section concentrates on the intangible structure. The different components, the information-related and nonlinear properties, are discussed. The significance and roles of the intangible deep structure is also scrutinized.

Finally, the intelligence-based approach is introduced. Concepts relating to the spaces of order and those of complexity, surface structure and deep structure, and deliberate and emergent strategies, are analyzed. An inherent structure comparable to and compatible with an intelligent being is examined. The structure and properties of an "intelligence enhancer" in intelligent organizations and the concept of intelligence strategy are conceived.

2.   INTELLIGENT ORGANIZATION THEORY

2.1 Preview

The human mind is the "epicentre" of all human setups, and the mind and orgmind are complex adaptive systems. In this respect, all human organizations are also complex adaptive systems. Such nonlinear systems have feedback loops. The basic elements of these systems, human beings, interact with one another to form the feedback loops. Any one member of an organization can have a direct or indirect influence on another member. Rather often, the impact is nonlinear as the influence from a message communicated is usually under-reacted or over-reacted upon. In addition, group behaviour is not simply the sum of the individual behaviours (Stacey, 1995). Hence, the dynamics and the outcomes of human interactions are usually nonlinear in nature.

In the new perspective, an organization as a whole is perceived to behave as an evolving intelligent corporate being. The economy is its ecological system. Similar to biological entities, human organizations are able to learn, adapt, compete, and evolve. The intrinsic force driving the above characteristics is intelligence. And higher levels of intelligence are best manifested as sophisticated information processing activities (Liang, 1998). In addition, any system that has a structure possesses information (Stonier, 1991). Therefore, understanding intelligence, information processing, and the structure of the organization, is the key to understanding the orgmind. Organizing around the orgmind is the quintessence for the next survival and success.

2.2 Fundamental Concepts

a. Intelligence and Intelligent Structure

Intelligence is the primary attribute that enables a biological system to compete for survival, to undergo evolution, and to save its species from extinction. The presence of intelligence allows the system to interact with its environment and to make adjustments to itself. The act of adaptation and evolution is a key to survival in nature. The same basic principles also ensure that organizations survive and compete.

So what is intelligence? Intelligence is a mental ability: it is the power of perceiving, learning, understanding and knowing. Such a definition of intelligence is closely associated with consciousness. It may be interesting to determine at what level of intelligence consciousness emerges. This is a puzzle of the mind that the mind itself cannot consciously resolve. It is a mystery that has pre-occupied some of the best minds for centuries. A school of thought believes that this mystery can never be resolved because it is beyond the capability of a physical network that has something on the order of billions of neurons. It is a structural constraint. Perhaps even a multi-trillion-neuron network is required to unveil the secret.

In this model, intelligence is perceived to be more than just an ability. Intelligence is an intangible entity similar to energy in the sciences and technologies. It is invisible, intangible, and at the moment, not easily quantifiable. But its presence can be felt. Its status is similar to energy a century ago. It is the existence of intelligence as an entity that enables intelligent traits to be manifested. It is the presence of this entity which allows intelligent mental abilities to be executed. The economic capability of an intelligent being is also fuelled by the same entity. This fundamental concept is stated as the first axiom of the model.

10

Axiom I

There exists an intangible entity known as intelligence in all intelligent systems which provides the most fundamental driving force for all their activities.

In this sense, there exists a relationship between intelligence and self-awareness. However, the exact formula of the relationship is unknown. As higher level self-awareness is associated with higher level intelligence, the presence of an intense intelligence source is significant. An intense intelligence source is needed to generate higher level intelligence. Physically, a dense and well-connected network with an enormous number of neurons must be present to create and sustain the strange phenomena. The above observation leads to the first postulation.

Postulate I

A necessary condition for higher level intelligence to exist is the presence of a sufficiently intense intelligence source.

The absence of the intense source indicates the absence of human-level or second-order consciousness. A feeble source or an intelligence web is not able to generate the same level of self-awareness. Lower level consciousness, mainly raw sensations, known as qualia in psychology, are not very useful by themselves. In this respect, a colony of ants is only an intelligence web, and its activities can never flourish above its present level, unless an intense intelligence source emerges. The weakly connected network of an ant nest is not sufficiently intense. This characteristic leads to the proposal of the next postulate.

Postulate II

The presence of an intelligence web is a necessary but not a sufficient condition for generating higher level mental activities and second-order consciousness.

However, the presence of an intelligent web in a living organism is significant because it is this internal network which allows intelligence to be transmitted from the intense intelligence source to the other parts of the organism, and vice versa. Such a web is also an internal information-related action and reaction system. It is a vital communication structure in all intelligent living beings.

An extension of this system is an environment scanning and responding system. Any intelligent system that learns, adapts and evolves must have an environment scanning and responding component. Otherwise, it is literally dead and consciousness does not exist. It is then no different from a crystal or a snowflake that contains only proto-information (Stonier, 1991). The observation indicates that an intelligent evolving system must be open and continuously interacting with its environment. The third postulate, below, captures the requirement of the environment interacting component in an intelligent system.

Postulate III

The presence of an environment scanning and responding component is a necessary requirement for the continuous survival and evolution of an intelligent system.

b.   Levels of intelligence

Although intelligence is manifested as a continuous spectrum, constructing a conceptual structure containing different intelligence levels renders the analysis of intelligent human systems more comprehensible. In this study, a four-level structure is proposed. And each level has certain unique characteristics as follows:

i   Level 0 Intelligence: Slavery

An organizational system operating at this level is only capable of economic production. It has literally no intelligence capability and has no environment scanning and responding component. It is a non-thinking, purely mechanistic system. It behaves like a slave whose intelligence is suppressed. As far as the intelligence domain is concerned, the system is dumb.

ii   Level I Intelligence: Instinctive

Besides economic production, a system in this case is capable of sensing simple changes in the environment, such as changes in demand, and responds by varying the quantity of its output. The behavior of such a system is instinctive. Its level of intelligence is low. Many business organizations, at the moment, exist in this state, similar to plants in an ecological system. There is not much "mobility" as such a concept is not in the management philosophy.

iii   Level II Intelligence: Survival

A system can be classified in this category if an attempt has been made to improve its environment scanning and responding component. Such a system is also aware of the significance of having a well-established intelligence web. It is increasingly reactive to changes, and has created learning and adaptive capabilities. It is a mobile intelligent being.

iv   Level III Intelligence: Intelligent

A system in this category has a sophisticated intelligent network. It is highly reactive, as well as proactive to the environment. It is intelligent enough to alter the environment to suit its existence. Whenever possible and necessary, this option will be exercised. Such a system can diversify, "migrate" and have "offspring". In this case, the organizational system also has its own collective intelligence and behaves as a highly intelligent biological being.

2.3   Intelligent Physical Structure

The fundamental assumption of the intelligent organization model is that an organization can only survive and compete if it is highly intelligent. It must evolve into a "level III organism" when the information era matures. Its span of existence and level of sophistication will be defined as a function of its intelligence. Thus, intelligence is and will be the most basic resource that any organizational system must possess. In this respect, it is even more significant than the economic resources that are of primary importance to economic production. The fact that the manpower resource is usually associated with labour and not intelligence must be altered. As

we move deeper into the information era, the new "epicentre" is the orgmind where intelligence, information-processing capability, and the knowledge structures of human organizations are embedded.

At the physical structure domain, an acceptable intelligent system must possess the three features listed below. The essential features are as follows:

i.   The presence of an intense intelligence source;

ii.   The presence of an environment scanning and responding component; and

iii.   The existence of an intelligence web that spreads and permeates the entire system.

The existence of these intelligent physical features is a necessary but not sufficient conditions for any intelligent systems to compete and survive. However, intelligence is itself the first "enabler". The presence of intelligence allows a system to undergo self-organization. It has the ability to identify and move toward an "attractor", an equilibrium state, spontaneously.

a.   Intense intelligence source

The presence of an intense intelligence source is critical to all higher level intelligent systems. Having an intelligence web alone can be fatal. The absence of the intense source indicates the non-existence of the key node or decision-making (leadership) node. The intense source can be embedded within the intelligence web. However, it must be intense enough to be recognized as a distinctly higher concentration of intelligence.

A colony of ants is an intelligence web. It lacks the presence of an intense intelligence source. A business organization cannot be structured or operated like an ant colony. Although the intelligence level of such a colony is fairly high, its main weakness is that its intelligence is spread too widely. Therefore, it is not physical size or structural complexity alone that decides the level of intelligence. It is the concentration or density of intelligence matter that is crucial. The density of the intelligence matter must reach a certain threshold in order to function as an intense source. Otherwise, it will remain a web.

The intense intelligence source of a human organization may not be physically or structurally identical to a neural network. But it must be a collection of key individuals supported by an integrated group of vital information systems. It is the key mode in the collective intelligence of an organization. The "compactness" of this source is important. In this respect, how the intense source communicates internally is crucial. In addition, the key node must be well-connected to and supported by the intelligence web.

Leadership of humankind is definitely a trait that the intense source must possess. In the new mindset, this node assumes a rather subtle role for the entire collective intelligence. It must be able to orchestrate the overall functions of the systems and yet not be overtly in control of the evolution process. It is the determination of the right balance point that is crucial. Otherwise, the emergent phenomena will be destroyed.

However, a human being is not necessarily a part of the intense intelligence source. A staff member can be a node in the intelligence web or a component in the environment interacting

subsystem. Thus, the mental contribution of different individuals is different. Nonetheless, "local leadership" can emerge at any nodes in the web, and such local leadership is extremely vital for the overall emergence of an organization as an intelligent organism.

b.   Environment scanning and responding component

A highly intelligent organization must be responsive to environmental changes. It must act, react, and think like an intelligent being. Therefore, an essential component of an intelligent system is the environment sensing, scanning, and responding subsystem. This subsystem enables the system to learn, adapt, and evolve better.

The environment scanning and responding component must possess certain characteristics before it can be regarded as having basic intelligence. Some of the necessary features include the following abilities:

> i.   To scan and detect environmental signals coming from environmental targets;
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> ii.   To process the environmental signals locally or to transmit them to the
>
> intense intelligence source for a decision;
>
> iii.   To respond to the environmental signals;
>
> iv.   To introduce changes, and thus have the ability to influence the environmental targets.

With respect to a business organizational system, the environmental targets are its customers, suppliers, competitors, and related government institutions. The environmental functions are to detect, evaluate, respond and change. And the target functions are sensing, influencing, buying, selling, competing, and entering into an alliance with another organization.

In general, a system can choose to interact with its targets through one of two strategies, namely, reactive interaction or proactive interaction. With reactive interaction, the environment scanning and responding component first detects signals coming from a target. The signals are evaluated and the system responds accordingly. The response can be a gradual or a quantum one. However, with the proactive approach, the intelligent subsystem administers a certain calculated influence on a target. It then detects the signals coming from the target and subsequently evaluates them. The system responds in an appropriate manner. Both the reactive and proactive interactions are cyclical processes.

Thus in an information intensive environment, if an organization does not have the necessary means to detect, evaluate, respond to, and influence its environmental targets, it is not sufficiently intelligent. Similarly, if the means are not effective and efficient, it does not have an acceptable level of intelligence, either. Such an organizational system will be operating at a competitive disadvantage. In an ecological system, such a species will be wiped out.

c.   **Intelligence web**

The intelligence web spreads and permeates the entire organization. It has a tangible component as well as an intangible one. The web must intertwine with and support the economic production subsystem, in the same manner that the nervous system spreads and becomes integrated with a living organism. The intangible content that permeates the physical web must further help to strengthen the nodes and to increase its intelligence.

The exact design of the web, and how it actually integrates and supports the economic production subsystem, depends on the state the organization is in. This state is defined by a number of parameters that are determined by the conditions, both internal and environmental, existing at the moment. In this respect, the required design may vary from one organization to another. However, the number of such states, the dynamic attractors, may not be many.

The tangible component of the web is the physical network that communicates information, decisions, and other intelligent entities. It has intelligent nodes which can be both natural and constructed (artificial). Therefore, knowledge bases and other intelligent entities, such as manual documents, are also part of the web. The manner in which the nodes communicate among themselves, the types of information that flow between any two nodes, the effectiveness and efficiency of the network, and ultimately the level of intelligence of the web, are some major concerns.

The intangible portion of the web is not well-recognized. A significant part of the intangible web is the language that permeates the web. It may not be too extreme to say that the existence of a written language within a society indicates that that community is civilized. The more sophisticated its language, the more advanced its culture, and the more competitive that system is. The intangible structure will be discussed more in depth subsequently.

2.4   Conceptual Structure

a.   Intelligence, Information and Language

It has been recognized that "any system which exhibits organization, contains information. The more intricately organized a system is, the more information has accumulated within that system" (Stonier, 1991: p258). From this statement, it may be assumed that a better organized system contains more structured information, and hence possesses a higher level of intelligence. A piece of crystal contains proto-intelligence but it is non-living. An ant colony is an intelligence web but an ant cannot survive on its own. However, a human being possessing an intense intelligence source with the capability of creating self-awareness, is also capable of individual survival.

Fundamentally, data are useful only with respect to a context, that is, data are transformed into useful information only when the necessity for consumption arises. The ways in which an information set is structured, communicated and utilized also determine its usefulness. Besides, certain relationships must be established between an information set and an existing knowledge structure. When an information set is consumed, the knowledge structure is altered, and internalization is said to have taken place in the mind (Hayes, 1993; Liang, 1998). Data and information in this respect are entities of a physical symbol system and they collectively form a language.

Underlying and quietly forging the thinking process is the presence of such a language. Without the existence of a language, human thinking activities would be simplistic, and human civilizations would not have flourished to their present levels. "Without language our mental capacities would be poor indeed, comparable to those of the higher animals..." (Einstein, 1954: p13). The processing of pictorial signals and sound signals would not have the same level of

sophistication and dynamism as manipulating a physical symbol system (Liang, 1998; Newell and Simon, 1976; Simon, 1969, 1989, 1989a). There seems to be an association among the number of neurons present within an intelligence source, its ability to manipulate and to create abstract concepts using a physical symbol system, and the level of self-awareness that can be attained by the source.

In operation, a simple piece of information is expressed as a linear combination of some characters in a physical symbol system. Communicating a concept is a more complex process. If the language used to transmit the concept is linear, some "richness" in ideas may be lost during communication. "A language rooted in a linear, mechanistic view of the universe creates different actions and opportunities from a language that emerges from a complex intelligent view of the universe" (McMaster, 1996: p32).

In fact, the relationships among information, concept, knowledge, and the language used to create and communicate them are intriguing, if not mystical. "Masters speak differently from anyone else in their field. When people reach a level of mastery, it is not merely their words that are different, but also the meaning of their words, and their understanding of the world" (McMaster, 1996: p31). A single word or a short collection of statements can convey a very deep thought or meaning.

In a human organization, language is the medium that helps to erect the intangible component of the intelligent structure. It penetrates and flows through the web and binds the organization. The automatic behavior and thinking of a human organization is made possible by language. A

change in the ways of speaking and thinking will change its cohesiveness and competitiveness. A change in the language of interpretation will generate new information from existing data. The new information may be crucial. Engagement, a critical activity in all human-related setups, is made possible by the presence of a language. In this respect, the long-neglected role of language operating in the deep conceptual structure of human organizations must be re-examined. This binding medium must be better understood.

Therefore, a human organization must make a conscientious effort to ensure that its level of interpretation using language is more advanced and sophisticated than that of its rivals. The exact communication between any two nodes in the web, the meaning of the language used, the more subtle interpretation of the language used, are areas for scrutiny. It is definitely not too extreme to believe that "a corporation can be said to exist, as a phenomenon, in language" (McMaster, 1996: p.33).

The above discussion leads to the proposal of the next postulate.

Postulate IV

The survival of an intelligent system depends on the cohesiveness and coherence of the intangible structure. An optimal physical structure can only emerge from a highly intelligent intangible structure, that is, the formal cannot be created and sustained artificially without a firm intangible structure as its foundation.

b.   Theory

Evolving from the physical to the conceptual use of a physical symbol system, within a certain domain, a theory arises. A theory is a set of statements which allows an intelligent being self-examination. It is a reference source for internal searching.   In addition, a theory also serves as an analytical lens that enables the intelligent system to examine its environment and the events happening in it. Without a theory, there is no proper basis for analyses and explanations. A thought that emerges without such a basis may not be very valuable. Therefore, a theory is an intelligence enabler.

A theory is not and cannot be stagnant. It emerges and evolves with time. In many instances, it has never been fully explicit or understood, even if its fundamentals may be well-established and widely practised by the community that adopts it. However, to understand the logic of a theory, and to use it consciously as an analytical lens, is a mindset that is critically needed.

In addition, new theory drives leadership. Leadership is meaningless without a theory to support its mission. When a person leads, a theory helps to explain his/her leadership by clearly indicating the direction and intention. Theory is a compass indicating the direction in which to steer. In fact, a theory also helps to ensure that an intention and its actions are coherent, and such a coherence is vital for any human organization to compete successfully.

A theory is not necessarily abstract - it is not always a "theory of relativity". In reality, an operational theory can be fairly simple. As mentioned, quite often people use theories without

realizing their existence and importance. Such theories are subconsciously built up in the collective intelligence and can be relatively simple. However, it is much more beneficial if a theory is well-understood, made explicit, and fully supported, especially in organizations. Its presence must be known and accepted before the theory can be exploited effectively. The existence of theory in intelligent systems is stated as the next axiom.

Axiom II

There exist one or more theories in all intelligent systems which serve as the compass and analytical lens for the systems.

c. Knowledge

It is through a theory that information is consumed and added on to a knowledge structure. A knowledge structure is a large-scale accumulation of related pieces of information over a long period of time (Liang, 1994, 1996). When a piece of information is consumed by a thinking system, it alters the knowledge structure of the system. The event is known as internalization (Hayes, 1993; Liang, 1998). The consequence of a decision-making process is influenced by internalized knowledge structures. In this respect, a knowledge structure is another intelligence enabler.

Therefore, the presence of knowledge structures in intelligent systems is essential and crucial. Such structures are the products of prolonged intelligent activities. When pieces of information are manipulated and consumed, a knowledge structure manifesting the relationships of the pieces will gradually emerge, if sufficient time and effort have been invested. These structures

are also reference sources when further pieces of information are brought into the thinking system.

In this regard, knowledge structures, theories, and intelligence are constantly enriching each other. These three entities form an enabler-triad. The triad is an intelligence-enhancer. It is the most significant dynamo of all highly intelligent thinking systems. This extremely significant cycle will be examined again. At the moment, the next axiom on knowledge structures is proposed.

Axiom III

There exist one or more internalized knowledge structures in all intelligent systems which are the reference sources for intelligent activities and actions.

2.5   Intelligent Design

a.   Space of Order and Space of Complexity

Intelligent design is a creation of nature. It is an inherent feature of the universe. As previously discussed, in the sea of chaos, billions of "bubbles of order" proliferate. The centres of these bubbles are the "local order centres". In the vicinity of each of these centres is a space of order which contradicts the second law of thermodynamics. A space of order is a region of rigid structure, where activities constantly reduce entropy, and relationships are linear. The characteristics of this sphere are significant to us as their predictability provides confidence, comfort and certainty.

However in a space of order, intelligence is not optimized. Information use is rigid and information redundancy is not acceptable or carefully avoided. Its dynamic is linear and simplistic. Consequently, creativity and innovation are unconsciously suppressed.

Just beyond a space of order is a space of complexity. Analyzing this new sphere creates new opportunities as it encompasses unexplored territories. The main attributes guiding activities in the space of complexity are intelligence and information. Its characteristics are nonlinear and dynamic. Even nature exploits the dynamism of this space. Human organizations, however, either have not realized its existence or have avoided this uncertain space. Operating within the spaces of order has always been the norm.

Intelligence is of paramount importance in the spaces of complexity where creativity and innovation can be stretched beyond their present constraints. These are the spaces where evolutionary activities are concentrated, where growth and enhancement take place. In them, matter can exist in a state in between solid and liquid, for instance. The fluidity and flexibility of such spaces provide a great amount of potential. Whoever ventures into one of these spaces and comprehends the unknown first will reap tremendous benefits.

Human organizations as complex adaptive systems contain spaces of order and spaces of complexity. As a space of order is linear and its events are more easily understood, operating in a space of this nature can only sustain survival for a certain period of time. Niches cannot be easily found in a territory that is commonly understood. However, to examine the nonlinearity of the complexity spaces which contain an enormous amount of unexplored knowledge requires

innovativeness and creativeness. Anyone that is able to recognize some order and structure in such a space possesses an intelligence advantage.

In the process of understanding a portion of a space of complexity, the spaces of order are enlarged. The opportunities of the organization are broadened. The organization can then move on to explore the complexity spaces more deeply. Basically, the idea is to tap into and exploit the innovation and creativity of deterministic chaos to further enhance the understanding of order. As a result, the competitiveness of the organization is elevated.

Without understanding the spaces of order, the spaces of complexity cannot be explored fruitfully. There exist some relationships between the two types of spaces. Knowledge accumulated from understanding activities in the spaces of complexity ultimately reinforces the spaces of order. In the present mode of operation in most human organizations, their mechanistic structure must be redesigned to optimize the benefits of the intelligence era. Their spaces of complexity must be examined and understood quickly.

The present machine-oriented structure suppresses the analysis of the spaces of complexity. The structure of the spaces of order themselves in human organizations is also unnatural. It does not take on a form similar to biological systems which inherently support their own growth by reaping benefits from the spaces of complexity. The present mechanistic features of the spaces of order are just too overwhelming. The common existing practice of fitting fit human beings into a machine setup is not too familiar to nature or comfortable to human beings themselves.

Thus, human organizations have to be redesigned to ensure that their structure does not end abruptly at the edge of order. Intelligent organizational systems must venture into the spaces of complexity to reap the latent benefits. In general, structure fluidity, information redundancy, and intelligence enhancement, are some of the main characteristics that the new environment requires. These are the key life-supporting features of biological evolutionary systems. These are also the characteristics that are lacking in the present structure of human organizations.

Physically, the spaces of complexity are perceived to be encompassing the spaces of order. In reality, the two types of spaces are intertwined in a complicated manner and a high level of intelligence is needed to identify their boundaries. The co-existence of order and chaos is a natural phenomenon and their boundaries are always shifting. Therefore, conscientious effort must be invested to examine this highly dynamic space interaction. The benefits of understanding and exploiting the dynamic are enormous. The pioneers at a frontier can utilize the intelligence strategy.

b.   Surface Structure and Deep Structure

The existence of structure fluidity, information redundancy, and intense intelligence in a human organizational system allows fruitful engagement to evolve. Beyond the fairly rigid surface structure is always another layer of intangible deep structure. The non-physical deep structure that is described by language constructs the surface structure. It is in the fluid, deep and dynamic structure that the spaces of complexity are more likely to exist. The finer aspects and

intricacies of the surface are captured in the deep structure. And understanding and concentrating on the fluidity of the deep structure allow creativity and innovation to flourish.

Thus, ideally, the architectural setup of the surface structure should emerge from the deep structure. Such a process is evolutionary in nature. When the deep structure is changed gradually, the surface structure is also altered, but not vice versa. So, changing the organization chart and hoping that the philosophy of the organization will change, will never happen. Effort has to be put into changing the deep structure. It is only when the deep structure supports the surface structure it helps to create, that an organization can operate near the optimal level.

Embedded in the deep structure is the consciousness of the organization. The level of consciousness determines the level of orgmindfulness. The latter, in turn, is responsible for the connectivity of the system. It is only when an organisation is mindful and well-connected that innovative and creative ideas can flourish. This is the area where the emerging thought technology can play an important role (Ellinor & Gerard, 1998; Sanders, 1998; Senge et al, 1994).

The connectivity and cohesiveness of an organization is highly dependent on the mode of communication. Coherent thought is the social and psychological gel that binds human beings together, and it helps human organizations to achieve functional cohesion. A coherent and cohesive intangible structure is more intelligent. Its intelligence-enhancer is also more dynamic. Such an intangible structure supports its physical structure better.

Engagement of humankind is a key to the new competition. As discussed earlier, language facilitates engagement and the flow of information, and binds the elementary entities. Language also allows for more abstract and intense interaction. Very often, concepts can only be successfully explained using language. Language also enhances the linguistic act of interpretation. Therefore, language is a major concern when redesigning the deep structure, and when extending the boundaries of the spaces of complexity. Basically, language is the fuel of the intelligence dynamo. Without a language, the intelligence-enhancer cannot function effectively.

A language, an intelligence-enhancer, and an effective mode of communication enhance the awareness of an organization. Overall, a high level of consciousness, orgmindfulness and connectivity are needed to implement the intelligence strategy. Consciousness, connectivity, complexity, dissipation and emergence are the five core properties of chaos theory. These are significant mind-related properties. Thus, the primary focus of all human organizations should be on the orgmind. It is from an appropriate orgmind-set that an intelligent deep structure emerges, and only then can an effective surface structure be nurtured eventually.

## c.	Humanizing Organizations

The above discussion leads to a very important observation, the need to humanize organizations. Designing systems with an inherent intelligence structure into which human beings blend naturally and coherently with the economic production functions of human organizations is the new competitive advantage. Designing technically competent systems in which human beings are treated as machine parts, in which human productivity and machine productivity are treated

as exactly identical, only creates undue stress in the structure. Thus, the basic principle in the new mindset must be to design organizations around intelligence.

A humanized organization possesses the intelligence-enhancer (see Figure 1) described earlier. The three entities, intelligence, theory and knowledge, form the enabler-triad. These entities interact among themselves via information processing and they reside in the orgmind. The accuracy and appropriateness of the language used helps to enhance engagement. Therefore, through proper engagement within human organizations, the enabler-triad helps to build up the collective intelligence of the organization. Intense interactions within the triad enhance all three entities, in particular the intelligence entity. When the triad is enhanced, it in turn enhances the language used in the cycle. The whole process is an emergent phenomenon, an evolutionary process.

[Insert Figure 1]

In intelligent organizations, an important additional feature is co-learning. As an individual learns in an organization, the organization itself must also learn, that is, the organizational knowledge structures and theories must also be constantly updated. Without co-learning the orgmind is not cohesive or coherence. The collective intelligence of the organization cannot be elevated. In fact, such an organization is not intelligent.

d.   Deliberate and Emergent Strategies

An organization that is constantly learning, responding to the environment, changing, and evolving with time cannot take on a stagnant five-year strategic plan. As the internal and external parameters change, such a system will have to make adjustment to its intelligence-enhancer, its deep structure, and its surface structure. Naturally, its strategy will have to change. A revolutionary change may even be a necessity depending on the acceleration and complication of the dynamics. Thus, deliberate strategies alone may not be feasible in the new context. A combination of deliberate and emergent strategies becomes an inevitable option (Lawrence & Lorch, 1967).

Basically, a deliberate strategy is useful only when the environment is highly stable or fairly predictable. However, the environment is highly dynamic and the future cannot be well-predicted, an emergent strategy is needed. In the latter case, multiple checkpoints will have to be built into the strategic plan. The scan-respond-evolve cycle has to be used constantly. In reality, as order and complexity always co-exist, it is a combination of the two environments that usually predominates. Some characteristics of the two different strategies are summarized in Table 1.

[Insert Table 1]

3.   CONCLUSION

To conclude, it may be beneficial to re-capture the main concepts that have been proposed and analyzed. The most basic concepts of the intelligent organization theory are as follows:

1.   Human organizations are intelligent beings;

2.   They are corporate beings with an orgmind and collective intelligence;

3.   Their level of intelligence can be elevated through proper design;

4.   The more intelligent an organization, the more adaptive and competitive it is;

5.   Such a competitive advantage is intelligence advantage.

Therefore, there exists a critical relationship between intelligence and organizations, as there exists a similar relationship between intelligence and biological organisms. The requirements of this vital connection are summarized as follows:

1.   The presence of an intense intelligence source is crucial; otherwise, the activities of organizational systems will have no proper co-ordination and direction;

2.   The existence of a sophisticated environment scanning and responding component is essential because such a component not only enables organizations to interact with their environment, but also enables organizations to build up their intelligence;

3.   The spread and integration of the intelligence web with the economic production functions of organizations, connecting the components specified in (1) and (2), is a necessity as the absence of the web indicates that that organization is paralyzed.

4.   The intelligent physical structure mentioned in points (1) to (3) must be supported by an intelligent deep structure. An intelligent, coherent and cohesive deep structure, is the fundamental intelligent stratum of all intelligent organizations.

In addition, it is significant to realize that intelligence in organizations can be elevated with proper design. The key designing concepts are as follows:

1. Intelligence-based design helps to elevate the intelligence level of organizations so that they can compete better as intelligent beings in the information era;

2. This new designing approach allows organizations to settle into a natural competitive state, supported by an inherent intelligent structure more spontaneously;

3. Organizations with an inherent intelligent structure are more coherent with information-related functions;

4. The commonly found mechanistic structure designed to support their operations in the industrial era is a hindrance to intelligence and information-related strategies;

5. Thus, organizations designed with an inherent intelligent structure, that is, possessing both deep intelligent structure and surface structure, are better prepared to implement intelligence and information-related strategies.

Ultimately, the theory perceives the structure of intelligent organizations to be an intertwining of spaces of order and spaces of complexity. The boundaries that separate these two types of spaces are fluid. The locations at which the boundaries overlap depend not only on the internal dynamics of the systems but also on the environmental factors. Thus, comprehending the structure and the dynamics of the intangible deep structure is of paramount importance. Special attention has to be focused on the orgmind, collective intelligence, and the nonlinearity of intelligence. In this respect, all human organizations must be organized around intelligence, information processing and nonlinearity, if they are to survive the next wave of extinction. This paradigmatic shift in management philosophy and practices is inevitable. Those who understand the new strategy early will be the future victors. This crucial requirement affects all human organizations, including businesses, economies and nations.

Deliberate Strategy	Emergent Strategy
Presence of planned intention	Absence of planned intention
Destination and environment are highly predictable	Destination and environment cannot be well-predicted
Path of advancement can be charted	Path of advancement emerges gradually

A plan exists	A plan emerges
The plan is usually centrally formulated	Formulation requires broad consensus
The plan is implemented with high precision	Implementation requires high degree of tolerance

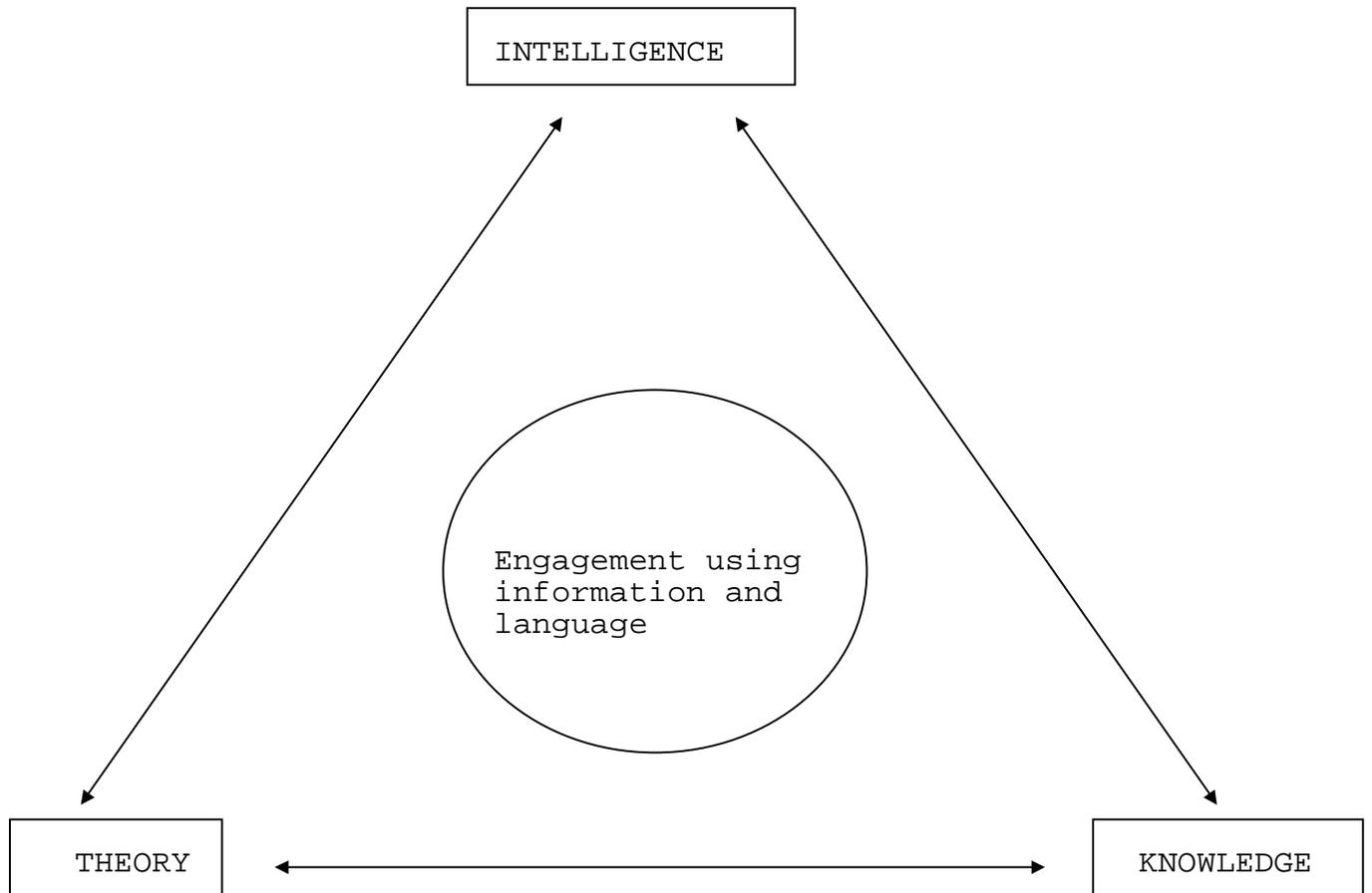Table 1. Some characteristics of deliberate strategy and emergent strategy.

Figure 1. The intelligence-enhancer of the orgmind.

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