The Hidden Connections: A Science for Sustainable Living

Fritjof Capra, 2002, Harper Collins

Preface

The purpose of the book is to present a conceptual framework that integrates life's biological, cognitive and social dimensions – to offer a unified view of life, mind and society and a coherent, systemic approach to some of the critical issues of our time.

Beliefs/focus of the book –

- that the philosophical school of deep ecology which does not separate humans from nature (i.e. that humans and their social life evolved out of the biological world) and that recognises the intrinsic values of all human beings is an ideal philosophical and spiritual context for the new scientific paradigm.
- Capra's focus is on the processes and patterns of organisation of living systems: on the hidden connections between phenomena
- that his extension of the systems approach to the social domain explicitly includes the material world because
  "…the key challenges of the new century – for social scientists, natural scientists and everyone else, will be to build ecologically sustainable communities, designed in such a way that their technologies and social systems – their material and social structures – do not interfere with nature's inherent ability to sustain life."
- That "the design principles of our future social institutions must be consistent with the principles of organisation that nature has evolved to sustain the web of life."

Chapter One –The Nature of Life

What are the defining characteristics of living systems?

To identify these Capra looks at the simplest system that displays these characteristics - a bacterial cell.

- *Ecological perspective - Morowitz "Sustained life is a property of an ecological system rather than a single organism or species"* **No individual organism can exist in isolation.**
- all cells include proteins and nucleic acids (DNA& RNA) which a) form part of the cell **structure** and b) are enzymes which catalyse the metabolic **processes** and the enzymes in turn are **specified by genes** – i.e. cellular processes are genetically controlled which provides **stability:**
- DNA is also responsible for self replication which is a crucial characteristic of life.
- the molecular structure of cells is not sufficient to define life – need to also look at the metabolic processes – i.e. the patterns of relationships between the molecules – i.e. focus on whole rather than on parts.
- **Identity** – the cell boundary (membrane) discriminates between the system or the "self", and it environment. Within this boundary there is a network of chemical

reactions. Membranes are a universal characteristic of life and display the same type of structure throughout the living world – they are always active, opening and closing, keeping certain substances out and letting others in and expelling waste. They are semi-permeable to keep the proportion of substances in balance for the metabolic processes i.e. the membrane maintains the distinct identity of the cell and protects it from harmful environmental influences.

- **Self-generation** - the ceaseless processes of metabolism (from Greek metabole "change") is the "incessant chemistry of self – maintenance " whereby "life continuously produces, repairs and perpetuates itself."(Margulis)
- The processes of metabolism form a chemical network**. Networks** are another fundamental feature of life. "Living networks continually create or recreate themselves by transforming or replacing their components. In this way they undergo continual structural changes while preserving their web-like patterns of organisation." i.e. they are self-making or "autopoietic." (Maturana and Varela) i.e. the phenomenon of life has to be understood as a property of the system as a whole – the entire bounded metabolic network.
- A key insight of the new understanding of life is that biological **forms** and functions are not simply determined by the genetic blueprint – but **are also emergent properties.**

Understanding the non-linear dynamics to explain the emergence of biological form is a youthful area of science. Widespread view is that biological form is the product of the genetic blueprint – that all the information is passed on through the DNA. But when a cell reproduces it also passes on the whole cellular network – its DNA, its membranes, enzymes, etc. i.e. a new cell is formed from the unbroken continuation of the entire autopoietic network – the genes can only function when they are embedded in the network Thus life has unfolded over 3B years in an uninterrupted process without ever breaking the **pattern of its self-generating networks**.

Emergence of New Order

All cellular structures exist far from thermodynamic equilibrium and would die if the cellular metabolism didn't use a continual flow of energy/matter from their environment to restore structures as fast as they are decaying and to get rid of waste. This process establishes its place in the food web.

This means that living systems are **organisationally closed** – they are autopoietic networks – and **materially and energetically open –** dissipative structures.

Living systems are "dissipative structures" which means an open system that maintains itself far from equilibrium yet is nevertheless stable: the same overall structure is maintained in spite of the ongoing flow and change of components.

The dynamics of dissipative structures specifically include the spontaneous emergence of new forms of order. When the flow of energy increases, the system may encounter a point of instability known as a bifurcation point at which it can branch off into an entirely new state where new structures and new forms of order may emerge…This spontaneous emergence of order....known **as self-organisation or emergence or creativity.**..is a

key property of living systems. This has been recognised as the dynamic origin of learning, development and evolution. "Life constantly reaches out into novelty."

Catalysts and catalytic networks make possible reactions that would not be possible without them. Catalysis → increased complexity. With the help of catalytic reactions, beneficial chance events, either from external or internal environment, are enhanced → increasing complexity → further from equilibrium →emergence/creativity.

Summary – Characteristics of Living Systems

"Membrane-bounded, self-generating, organisationally closed metabolic network which is also materially and energetically open, using a constant flow of energy and matter to produce, repair and perpetuate itself and which operates far from equilibrium, where new structures and new forms of order may spontaneously emerge and thus leading to development and evolution."

Chapter 2 Mind and Consciousness

The Santiago Theory of Cognition – Maturana and Varela

The central insight of the Santiago Theory is the identification of cognition, the process of knowing, with the process of life. Cognition is the activity involved in the self-generation and self-perpetuation of living networks. In other words, cognition is the very process of life. The organising activity of living systems, at all levels of life, is mental activity. The interactions of a living organism – plant, animal or human – with its environment are cognitive interactions. Thus life and cognition are inseparably connected. Mind – or, more accurately, mental activity – is immanent in matter at all levels of life. Cognition involves the entire process of life – including perceptions, emotions and behaviour and does not necessarily require a brain or a nervous system. This is a radical expansion of the concept of cognition and, implicitly, the concept of mind.

In the Santiago theory, cognition is closely linked to autopoiesis, the self-generation of living networks. The defining characteristic of an autopoietic system is that it undergoes continual structural changes while preserving its web-like pattern of organisation. The components of the network continually produce and transform one another, and they do so in two distinct ways.

One type of structural change is that of **self-renewal**. Every living organism continually renews itself, as its cells break down and build up structures, and tissues and organs replace their cells in continual cycles. In spite of this ongoing change, the organism maintains its overall identity, or pattern of organisation.

The second type of structural changes in a living system are those which create **new structures – new connections** in the autopoietic network. These changes, developmental rather than cyclical, also take place continually, either as a consequence of environmental influences or as a result of the system's internal dynamics.

According to the theory of autopoiesis, a living system couples to its environment structurally, i.e. through recurrent interactions, each of which triggers structural changes in the system. For example, a cell membrane continually incorporates substances from its environment into the cell's metabolic processes. An organism's nervous system changes

its connectivity with every sense perception. Thus **living systems are autonomous - the environment only triggers the structural changes: it does not specify or direct them.**

Structural coupling, as defined by Maturana and Varela, establishes a clear difference between the ways living and nonliving systems interact with their environments. For example, when you kick a stone, it will *react* to the kick according to a linear chain of cause and effect. Its behaviour can be calculated by applying the basic laws of Newtonian mechanics. When you kick a dog, the situation is quite different. The dog will respond with structural changes according to its own nature and (nonlinear) pattern of organisation. The resulting behaviour is generally unpredictable.

As a living organism responds to environmental influences with structural changes, these changes will in turn alter its future behaviour. In other words, **a structurally coupled system is a learning system**. Continual structural changes occur in response to the environment and consequently continuing **adaptation, learning and development are key characteristics of the behaviour of all living beings.**

As it keeps interacting with its environment, a living organism will undergo a sequence of structural changes. At any point the structure of the organism is a record of previous structural changes and thus of previous interactions. In other words, all living being have a history**. Living structure is always a record of prior development.**

Now, since the organism records previous structural changes, and since each structural change influences the organism's future behaviour, this implies that the behaviour of the living organism is dictated by its structure. In Maturana's terminology, **the behaviour of living systems is 'structure-determined'**.

This notion sheds new light on the age-old philosophical debate about freedom and determinism. According to Maturana, the behaviour of a living organism is determined, but rather than being determined by outside forces, it is **determined** by the organism's own structure – a structure formed by a succession of **autonomous** structural changes. **Hence the behaviour of the living organism is both determined and free.** By specifying which perturbation from the environment will trigger change, the living system "brings forth a world".

- Cognition = bringing forth a world through the process of living – "To live is to know" i.e. mind/cognition = the process of life

Cognition and Consciousness

- Primary consciousness = a cognitive process + basic perceptual, sensory and emotional experience (mammals and some birds and other vertebrates).
- Higher order consciousness = self awareness and reflection i.e. reflective consciousness. That is the ability to hold mental images which allows formulation of values, beliefs, goals, strategies and the evolution of language. It includes the inner world of concepts and ideas and the social world of organised relationships and culture.
- Consciousness = cognitive process which emerges at a level of complexity of neural activity (brain & higher nervous system).

The Social Dimension of Consciousness

Consciousness is a biological and social phenomenon – Maturana.

Communication is not the transmission of information but rather the coordination of behaviour between living organisms through mutual structural coupling (i.e. organisms change together as a result of recurrent interactions which trigger mutual structural changes).

Language arises when a level of abstraction is reached at which there is communication about communication i.e. coordination of coordinations of behaviour.

Language = a system of symbolic communication. Its symbols – words, gestures and other signs – serve as tokens for the linguistic coordination of actions. This in turn creates the notion of objects and thus the symbols become associated with our mental images of objects.

As we distinguish objects, we create abstract concepts to denote their properties, as well as the relations between objects. And finally, self awareness arises as we observe the distinction between the observer and the observing. When we use abstract concepts to describe ourselves we are using reflective consciousness.

Language doesn't occur in the brain but "in the flow of interactions and relations of living together". We exist in language. We coordinate our behaviour in language, and together in language we bring forth a world – not the world – but a world. This human world includes our inner world of abstract thoughts, concepts, beliefs, mental images, intentions and self awareness. In conversation, our concepts and ideas, emotions and body become tightly linked in a complex choreography of behavioural coordination.

The Origins of Human Language

Technology is an essential part of human nature, inseparable from the evolution of language and consciousness. Speech and precise hand movements arise from the same area of the brain. Speech = gesture of tongue. It is more sophisticated than hand gestures –you don't have to see to communicate, and it leaves the hands free. The more precise hand movements allowed the development of tools. Thus, the ability to make and use complex tools and produce sophisticated vocal sounds evolved together.

Language was originally embodied in gesture and evolved together with human consciousness. Recent findings suggest that conceptual thought is embodied physically in the body and brain i.e. human reason does not transcend the body, but is shaped crucially by our physical nature and our bodily experience. The very structure of reason arises from our bodies and brains For example: The spatial concept of in front/behind comes from our experience of our body and our experience of colour derives from reflected light on specific cones in the retina. In other words, **the structures of our bodies and brains determine the concepts we can form and the reasoning we can engage in.**

Human Nature

The Santiago Theory has shown that all levels of life, mind and matter, process and structure, are inseparably connected.

Recent research in cognitive science has confirmed and refined this view by showing how the process of cognition evolved into forms of increasing complexity together with the

corresponding biological structures. As the ability to control precise hand and tongue movements developed, language, reflective consciousness and conceptual thought evolved in the early humans as part of ever more complex processes of communication.

All these are manifestations of the process of cognition, and at each new level they involve corresponding neural and bodily structures. As the recent discoveries in cognitive linguistics have shown, the human mind, even in its most abstract manifestations, is not separate from the body but arises from it and is shaped by it.

This research makes it clear that the cognitive and emotional lives of animals and humans differ only by degree; that life is a great continuum in which differences between species are gradual and evolutionary. Cognitive linguists have fully confirmed this evolutionary conception of human nature. In the words of Lakoff and Johnson, "Reason, even in its most abstract form, makes use of, rather than transcends, our animal nature. Reason is thus not an essence that separates us from other animals; rather, it places us on a continuum with them."

Chapter 3: Social Reality

Three Perspectives on Life

Capra defines the ***pattern of organisation*** of a living system as the configuration of relationships among the system's components that determines the system's essential characteristics, the ***structure*** of the system as the material embodiment of its pattern of organisation, and the ***life process*** as the continual process of this embodiment.

When we study living systems from the perspective of form, we find that their pattern of organisation is that of a self-generating network. From the perspective of matter, the material structure of a living system is a dissipative structure, i.e. an open system operating far from equilibrium. From the process perspective, finally, living systems are cognitive systems in which the process of cognition is closely linked to the pattern of autopoiesis or self generation. In a nutshell, this is Capra's synthesis of the new scientific understanding of life.

The essential characteristic that distinguishes living from nonliving systems – the cellular metabolism – is not a property of matter, nor a special 'vital force'. It is a specific pattern of relationships among chemical processes that produce material components; the network pattern itself is nonmaterial.

The structural changes in this network pattern are understood as cognitive processes that eventually give rise to conscious experience and conceptual thought. All these cognitive phenomena are nonmaterial, but they are embodied – they arise from and are shaped by the body. Thus, life is never divorced from matter, even though its essential characteristics – organisation, complexity, processes and so on – are non material.

Meaning – the Fourth Perspective

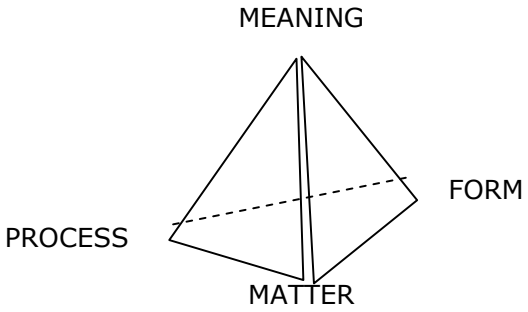
To extend the new understanding of life to the social domain, we have to account for many phenomena – rules of behaviour, values, intentions, goals, strategies, designs, power relations etc– that play no role in most of the nonhuman world but are essential to

human social life. However, these diverse characteristics of social reality all share a basic common feature, which provides a natural link to the systems view of life.

This link is self-awareness/reflective consciousness which emerged, together with language, conceptual thought and the social world of organised relationships, culture and technology. **The understanding of social reality is inextricably linked to an understanding of reflective consciousness**.

More specifically, **our ability to hold mental images of material objects and events seems to be a fundamental condition for the emergence of key characteristics of social life.** Being able to hold mental images enables us to choose among several alternatives, which is necessary to formulate values and social rules of behaviour. Conflicts of interest, based on different values, are at the origin of relationships of power. Our intentions, awareness of purposes and designs and strategies to reach identified goals all require the projection of mental images into the future.

Capra postulates that the systemic understanding of life can be extended to the social domain by adding the perspective of *meaning* to the other three perspectives on life. He uses 'meaning' as short-hand for the inner world of reflective consciousness. A full understanding of social phenomena, then, must involve the integration of four interconnected perspectives – form, matter, process and meaning.



Integrating the four perspective means recognising that each contributes significantly to the understanding of social phenomenon. For example, we shall see that culture is created and sustained by a network (*form*) of communications (*process*), in which *meaning* is generated. The culture's material embodiments (*matter*) include artefacts and written texts, through which meaning is passed on from generation to generation.

Extending the Systems Approach

Capra seeks to integrate all four perspectives of form, matter, process, and meaning to reach a systematic understanding of social reality.

Assumption

There is a fundamental unity to life and different living systems exhibit similar patterns of organisation. As life evolves these patterns become more and more elaborate, but are variations on a theme. The network is one of the very basic patterns of organisation at all levels of life and we can apply our knowledge of principles of networks to social reality

BUT we should not expect to transfer our understanding of the network's material structure directly from the biological to the social domain.

A cellular network is a non linear pattern of organisation and a social network is a non linear pattern of organisation – concepts such as feedback or emergence are likely to be relevant in the social context, but the nodes and links of the network are not biochemical. Social networks are networks of communication involving symbolic language, cultural constraints and relationships of power and so on.

Networks of Communications

Question: Are they autopoietic - self-organising/ self-generating?

Luhmann has developed a theory of social autopoiesis. Communications are the elements of social networks. They are produced and reproduced by a network of communications and cannot exist outside that network.

Networks of communication are self generating. Each communication creates thoughts and meaning giving rise to further communication thus producing generative communications. As they recur in multiple feedback loops they produce a shared context of meaning that is sustained by further communications.

Through this shared context of meaning, individuals acquire identities as members of the social network and this shared context of meaning generates a network boundary. This is not a physical boundary but a boundary of expectations, confidentiality and loyalty which is maintained and renegotiated by the network itself.

Human communication has a dual nature and involves:

a) continual coordination of behaviour (because it involves conceptual thinking and language); and

b) generating mental images, thoughts and meanings.

Social networks will have a dual effect. They:

a) generate ideas and contexts of meaning; and

b) generate rules of behaviour (or social structures).

Meaning, Purpose and Human Freedom

The metabolic network of the cell generates material structures (cell walls, carriers of information/energy, catalysts). Social networks generate material structures – buildings, roads, technologies, etc. – that become structural components of the network. They also produce material goods, artefacts, etc. that are exchanged between the network nodes.

BUT the structures are created for a purpose – to a design – and they embody **meaning.**

Meaning has to do with context i.e. we interpret something by putting it into a particular context of concepts, values, beliefs or circumstances. To understand meaning we need to relate it to other things in its environment, in its past, or in its future.

Meaning is essential to humans. We need to make sense of our outer and inner worlds, find meaning in our environment and in our relationships and act according to that meaning. This includes our need to act with a purpose in mind. Because of our ability to project images into the future, we act with the conviction – valid or invalid – that our actions are voluntary, intentional and purposeful.

The behaviour of living organisms is constrained but not determined by outside forces i.e. self organising behaviour is not imposed by the environment but is established by the system itself. More specifically, behaviour is determined by its own structure – as structure is formed by a succession of structural changes. The autonomy of living systems must not be confused with independence. Living organisms are not isolated from their environment. They interact continually, but the environment does not determine their organisation.

At the human level we experience this self determination as freedom to act according to our own choices and decisions. To experience these as our own means they are determined by our nature, including past experiences and genetic heritage. To the extent we are not constrained by human relationships of power, our behaviour is self determined and therefore free.

The Dynamics of Culture

Our ability to hold mental images and project them into the future not only allows us to identify goals and purposes and develop strategies and designs, but also enables us to choose among several alternatives and hence to formulate values and social rules of behaviour. All of these social phenomena are generated by networks of communications as a consequence of the dual role of human communication. On the one hand, the network continually generates mental images, thoughts and meaning; on the other hand, it continually coordinates the behaviour of its members. From the complex dynamics and interdependence of these processes emerges the integrated system of values, beliefs and rules of conduct that we associate with the phenomenon of culture.

The anthropological meaning of culture is defined as 'the integrated system of socially acquired values, beliefs, and rules of conduct that delimit the range of accepted behaviours in any given society' - *Columbia Encyclopaedia*. Culture arises from a complex, highly nonlinear dynamic. It is created by a social network involving multiple feedback loops through which values, beliefs and rules of conduct are continually communicated, modified and sustained. It emerges from a network of communications among individuals; and as it emerges, it produces constraints on their actions. In other words, the social structures, or rules of behaviour, that constrain the actions of individuals are produced and continually reinforced by their own network of communications.

The social network also produces a shared body of knowledge – including information, ideas and skills – that shapes the culture's distinctive way of life in addition to its values and beliefs. Moreover, the culture's values and beliefs affect its body of knowledge. They are part of the lens through which we see the world. They help us to interpret our experiences and to decide what kind of knowledge is meaningful. This meaningful knowledge, continually modified by the network of communications, is passed on from generation to generation together with the culture's values, beliefs and rules of conduct.

The system of shared values and beliefs creates an identity among the members of the social network, based on a sense of belonging. People in different cultures have different identities because they share different sets of values and beliefs. At the same time, an individual may belong to several different cultures. People's behaviour is informed and restricted by their cultural identities, which in turn reinforces their sense of belonging.

Cultural identity also reinforces the closure of the network by creating a boundary of meaning and expectations that limits the access of people and information to the network. Thus the social network is engaged in communication with a cultural boundary which its members continually recreate and renegotiate. This situation is not unlike that of the metabolic network of a cell, which continually produces and recreates a boundary – the cell membrane – that confines it and gives it its identity. However, there are some crucial differences between cellular and social boundaries. Social boundaries are not necessarily physical boundaries but boundaries of meaning and expectations. They do not literally surround the network, but exist in a mental realm.

The Origin of Power

One of the most striking characteristics of social reality is the phenomenon of power. 'The exercise of power, the submission of some to the will of others, is inevitable in modern society; nothing whatever is accomplished without it.....Power can be socially malign; it is also socially essential' John Kenneth Galbraith. The essential role of power in social organisation is linked to inevitable conflicts of interest. Because of our ability to affirm preferences and make choices accordingly, conflicts of interest will appear in any human community and power is the means by which these conflicts are resolved.

Relationships of power are culturally defined by agreements on positions of authority that are part of the culture's rules of conduct. A community is able to act much more effectively if some people have the authority to make or facilitate decisions when there are conflicts of interest. Such social arrangements would have given the community a significant evolutionary advantage.

The original meaning of 'authority' is not 'power to command', but 'a firm basis for knowing and acting'. From the earliest times, human communities have chosen men and women as their leaders when they recognised their wisdom and experience as a firm basis for collective action. In other words, true authority consists in empowering others to act. However, the power to command can be given to someone without true authority. In this situation its nature can easily change from empowering others to the advancement of an individual's own interests. This is when power becomes linked to exploitation.

As a community grows and increases in complexity, its positions of power will also increase. In complex societies, resolutions of conflicts and decisions about how to act will be effective only if authority and power are organised within administrative structures. In social theory, all rules of conduct are included in the concept of social structures, whether they are informal, resulting from continual coordinations of behaviour, or formalised, documented and enforced by laws. All such formal structures, or social institutions, are ultimately rules of behaviour that facilitate decision-making and embody relationships of power.

Structure in Biological and Social Systems

The generation of structures, both material and social, is a key characteristic of the dynamics of social systems.

The central focus of a systemic analysis is the notion of organisation, or 'pattern of organisation'. Living systems are self-generating networks, which means that their pattern of organisation is a network pattern in which each component contributes to the

production of other components. This idea can be extended to the social domain by identifying the relevant living networks as networks of communications.

In the social realm, the concept of organisation takes on an additional meaning. Social organisations, such as businesses or political institutions, are systems whose patterns of organisation are designed specifically to distribute power. These formally designed patterns are known as organisational structures and are visually represented by the standard organisational charts. They are ultimately rules of behaviour that facilitate decision-making and embody relationships of power.

In biological systems, all structures are material structures. Social systems produce nonmaterial as well as material structures. The processes that sustain a social network are processes of communication, which generate shared meaning and rules of behaviour (the network's culture), as well as a shared body of knowledge. The rules of behaviour whether formal or informal, are called social structures and may be documented. They are also embodied in artefacts, works of art, technology and other material structures. Indeed, the activities of the individuals in social networks specifically include the organised production of material goods. All these material structures are created for a purpose and according to some design. They are embodiments of the shared meaning generated by the society's networks of communications.

Chapter 4: Life and Leadership in Organisations

It is becoming ever more apparent that our complex industrial systems, both organisational and technological, are the main driving forces of global environmental destruction, and the main threat to the long-term survival of humanity. To build a sustainable society for our children and future generations, we need to fundamentally redesign many of our technologies and social institutions so as to bridge the wide gap between human design and the ecologically sustainable systems of nature.

Organisations need to undergo fundamental changes, both in order to adapt to the new business environment and to become ecologically sustainable.

When we look around our natural environment, we see continuous change, adaptation and creativity; and yet, our business organisations seem to be incapable of dealing with change. Capra believes that the roots of this paradox lie in the dual nature of human organisations. On the one hand, they are social institutions designed for specific purposes, such as making money for their shareholders, managing the distribution of political power, transmitting knowledge or spreading religious faith. At the same time, organisations are communities of people who interact with one another to build relationships, help each other and make their daily activities meaningful at a personal level.

These two aspects of organisations correspond to two very different types of change. Many managers see their company as a well designed tool for achieving specific purposes, and when they attempt to change its design they want predictable, quantifiable change in the entire structure. However, the designed structure always intersects with the organisation's living individuals and communities, for whom change cannot be designed.

It is common to hear that people in organisations resist change. In reality, people do not resist change; they resist having change imposed on them. Being alive, individuals and their communities are both stable and subject to change and development, but their natural change processes are very different from the organisational changes designed by 're-engineering' experts and mandated from the top.

To resolve the problem of organisational change, we need to understand the natural change processes that are embedded in all living systems then we can begin to design the processes of organisational change accordingly and to create human organisations that mirror life's adaptability, diversity and creativity.

Capra proposes a systemic solution to the problem of organisational change. Understanding human organisations in terms of living systems, i.e. in terms of complex nonlinear networks, is likely to lead to new insights into the nature of complexity, and thus help us deal with the complexities of today's business environment. It will also help us design business organisations that are ecologically sustainable, since the principles of organisation of eco-systems, which are the basis of sustainability, are identical to the principles of organisation of all living systems. Understanding human organisations as living systems is one of the critical challenges of our time.

Over the last few decades a new economy has emerged that is shaped decisively by information and communication technologies, and in which the processing of information and creation of scientific and technical knowledge are the main sources of productivity. In today's economy, both management and technology are critically linked to knowledge creation. Increases in productivity do not come from labour, but from the capacity to equip labour with new capabilities, based on new knowledge. Thus 'knowledge management ', 'intellectual capital' and 'organisational learning' have become critical to organisational success.

According to the systems view of life, the spontaneous emergence of order and the dynamics of structural coupling, which results in the continual structural changes that are characteristic of all living systems, are the basic phenomena underlying the process of learning and the creation of knowledge in social networks is a key characteristic of the dynamics of culture. Combining these insights and applying them to organisational learning enables us to clarify the conditions under which learning and knowledge creation take place and derive important guidelines for the management of today's knowledge-oriented organisations.

A study which looked at large corporations that had existed for over a hundred years, which had survived major changes in the world around them, and which were still flourishing with their corporate identities intact concluded that resilient, long-lived companies are those that exhibit the behaviour and certain characteristics of living entities. (Arie de Geus) The study identified two sets of characteristics:

1) a strong sense of community and collective identity around a set of common values; a community in which all members know that they will be supported in their endeavours to achieve their own goals.

2) an openness to the outside world, tolerance for the entry of new individuals and ideas, and consequently a manifest ability to learn and adapt to new circumstances.

De Geus argues that the principle strategy to create these characteristics is for managers to 'shift their priorities, from managing companies to optimise capital to managing companies to optimise people' - shift from viewing a company as a machine to viewing it as a living system.

Social Networks

Living social systems are self-generating networks of communications. This means that a human organisation will be a living system only if it is organised as a network or contains smaller networks within its boundaries.

Many large corporations today exist as decentralised networks of smaller units. They are also connected to networks of small and medium businesses that serve as their subcontractors and suppliers, and units belonging to different corporations also enter into strategic alliances and engage in joint ventures. The various parts of those corporate networks continually recombine and interlink, cooperating and competing with one another at the same time. Similar networks exist among non-profit and nongovernmental organisations (NGOs) for example the environmental movement, the human rights movement. Many of these networks transcend national boundaries. Networking has emerged as a new form of organisation of human activity.

Communities of Practice

For an organisation to be alive, however, the existence of social networks is not sufficient; they need to be networks of a special type. Living networks, as we have seen, are self-generating. Each communication creates thoughts and meaning, which give rise to further communications. In this way, the entire network generates itself, producing a common context of meaning, shared knowledge, rules of conduct, a boundary and a collective identity for its members.

Etienne Wenger has coined the term 'communities of practice' for these self-generating social networks, referring to the common context of meaning rather than to the pattern of organisation through which the meaning is generated. 'As people pursue any shared enterprise over time they develop a common practice, that is, shared ways of doing things and relating to one another that allow them to achieve their joint purpose. Over time, the resulting practice becomes a recognisable bond among those involved.' Wenger

He defines a community of practice as characterised by: mutual engagement of its members, a joint enterprise and, over time, a shared repertoire of routines, tacit rules of conduct and knowledge. In terms of Capra's conceptual framework, the mutual engagement refers to the dynamics of a self-generating network of communications, the joint enterprise to the shared purpose and meaning, and the shared repertoire to the resulting coordination of behaviour and creation of shared knowledge. This includes the creation of a boundary of meaning and hence of an identity among the members of the social network, based on a sense of belonging, which is the defining characteristic of community. According to Arie de Geus, a strong feeling among the employees of a company that they belong to the organisation and identify with its achievements – in other words, a strong sense of community – is essential for the survival of companies in today's turbulent business environment.

Communities of practice invariably arise and develop within the organisation's formal structures. These are informal networks – alliances and friendships, informal channels of communication (the 'grapevine') and other tangled webs of relationships – that continually grow, change and adapt to new situations.

> Workers organise their lives with their immediate colleagues and customers to get their jobs done. In doing so, they develop or preserve a sense of themselves they can live with, have some fun, and fulfil the requirements of their employers and clients. No matter what their official job description may be, they create a practice to do what needs to be done. Although workers may be contractually employed by a large institution, in day-to-day practice they work with – and, in a sense, for – a much smaller set of people and communities. Etienne Wenger

Within every organisation, there is a cluster of interconnected communities of practice. The more people are engaged in these informal networks, and the more developed and sophisticated the networks are the better will the organisation be able to learn, respond creatively to unexpected new circumstances, change and evolve. In other words, the organisation's aliveness resides in its communities of practice.

The Living Organisation

An organisation's formal structures are sets of rules and regulations that define relationships between people and tasks and determine the distribution of power. Boundaries are established by contractual agreements that delineate well-defined subsystems (departments) and functions. The formal structures are depicted in the organisation's official documents – the organisational charts, bylaws, manuals and budgets that describe the organisations formal policies, strategies and procedures.

The informal structures, by contrast, are fluid and fluctuating networks of communications. These communications include nonverbal forms of mutual engagement in a joint enterprise through which skills are exchanged and shared tacit knowledge is generated. The shared practice creates flexible boundaries of meaning that are often unspoken. When new people join, the entire network may reconfigure itself: when people leave, the network will change again, or may even break down. In the formal organisation, by contrast, functions and power relations are more important than people, persisting over the years while people come and go.

In every organisation, there is a continuous interplay between its informal networks and its formal structures. Formal policies and procedures are always filtered and modified by the informal networks, which allow workers to use their creativity when faced with unexpected and novel situations. The power of this interplay becomes strikingly apparent when employees engage in a work-to-rule protest. By working strictly according to the official manuals and procedures, they seriously impair the organisation's functioning. Ideally, the formal organisation recognises and supports its informal networks of relationships and incorporates their innovations into its structures.

The most effective way to enhance an organisation's potential for creativity and learning, to keep it vibrant and alive, is to support and strengthen its communities of practice. The first step is to provide the social space for informal communications to flourish. Some companies create special coffee counters to encourage informal gatherings; others may

use bulletin boards, the company newsletter, a special library, off-site retreats or online chat rooms for the same purpose. If widely publicised within the company so that support by management is evident, these measures will liberate people's energies, stimulate creativity and set processes of change in motion.

Learning from Life

The more managers know about the detailed processes involved in self-generating social networks, the more effective they will be in working with the organisation's communities of practice.

1) A living network responds to disturbances with structural changes, and it chooses both which disturbances to notice and how to respond. What people notice depends on who they are as individuals, and on the cultural characteristics of their communities of practice. A message will get through to them not only because of its volume or frequency, but because it is meaningful to them.

2) Mechanistically oriented managers tend to hold on to the belief that they can control the organisation if they understand how all it parts fit together. Even the daily experience that people's behaviour contradicts their expectations does not make them doubt their basic assumption. A machine can be controlled; a living system, according to the systemic understanding of life, can only be disturbed. In other words, organisations cannot be controlled through direct interventions, but they can be influence by giving impulses rather than instructions. Working with the processes inherent in living systems means that we do not need to spend a lot of energy to move an organisation. There is no need to push, pull or bully it to make it change. Force or energy is not the issue; the issue is meaning. Meaningful disturbances will get the organisation's attention and will trigger structural changes.

3) It is well known that intelligent, alert people rarely carry out instructions exactly to the letter. They always modify and reinterpret them, ignore some parts and add others of their own making. Sometimes, it may be merely a change of emphasis, but people always respond with new versions of the original instructions. Strict compliance can only be achieved at the expense of robbing people of their vitality and turning them into listless, disaffected robots. This consideration is especially important in today's knowledge-based organisations, in which loyalty, intelligence and creativity are the highest assets.

4) If we involve people in the change process right from the start, they will 'choose to be disturbed', because the process itself is meaningful to them.

> We have no choice but to invite people into the process of rethinking, redesigning, restructuring the organisation. We ignore people's need to participate at our own peril. If they're involved, they will create a future that already has them in it. We won't have to engage in the impossible and exhausting tasks of 'selling' them the solution, getting them 'to enrol,' or figuring out the incentives that might bribe them into compliant behaviours…..In our experience, enormous struggles with implementation are created every time we *deliver* changes to the organisation rather than figuring out how to involve people in their creation……(On the other hand,) we have seen implementation move with dramatic speed among people who have been engaged in the design of those changes. (Margaret Wheatley and Myron Kellner Rogers)

The task is to make the process of change meaningful to people right from the start, to get their participation and to provide an environment in which their creativity can flourish.

5) Offering impulses and guiding principles rather than strict instructions amounts to significant changes in power relations, from domination and control to cooperation and partnerships. This, too, is a fundamental implication of the new understanding of life. In recent years, biologists and ecologists have begun to shift their metaphors from hierarchies to networks and have come to realise that partnership – the tendency to associate, establish links, cooperate and maintain symbiotic relationships – is one of the hallmarks of life.

Organisational Learning

In a strict sense, knowledge is created only by individuals…… Organisational knowledge creation, therefore, should be understood as a process that 'organisationally' amplifies the knowledge created by individuals and crystallises it as a part of the knowledge network of the organisation. (Nonaka and Takeuchi)

Nonaka and Takeuchi argue that the knowledge created by individuals can be brought to light and expanded by the organisation through social interactions. Thus, while knowledge creation is an individual process, its amplification and expansion are social processes that take place *between* individuals. 'If we want to succeed with knowledge management, we must attend to human needs and dynamics…..Knowledge (is not) the asset or capital. People are.' (Margaret Wheatley)

The most effective way to enhance an organisation's learning potential is to support and strengthen its communities of practice. In an organisation that is alive, knowledge creation is natural and sharing what we have learned with friends and colleagues is humanly satisfying. 'Working for an organisation that is intent on creating knowledge is a wonderful motivator, not because the organisation will be more profitable, but because our lives will feel more worthwhile.' (Wheatley)

The Emergence of Novelty

The phenomenon of emergence takes place at critical points of instability that arise from fluctuations in the environment, amplified by feedback loops. Emergence results in the creation of novelty that is often qualitatively different from the phenomena out of which it emerged. The constant generation of novelty is a key property of all living systems.

In a human organisation, the event triggering the process of emergence may be an offhand comment, which may not even seem important to the person who made it but is meaningful to some people in a community of practice. Because it is meaningful to them, they choose to be disturbed and circulate the information rapidly through the organisation's networks. As it circulates through various feedback loops, the information may get amplified and expanded, even to such an extent that the organisation can no longer absorb it in its present state. When that happens, a point of instability has been reached. The system cannot integrate the new information into its existing order; it is forced to abandon some of its structures, behaviours, or beliefs. The result is a state of chaos, confusion, uncertainty and doubt; and out of that chaotic state a new form of order, organised around new meaning, emerges. The new order was not designed by any individual but emerged as a result of the organisation's collective creativity.

This process involves several distinct stages. To begin with, there must be a certain openness within the organisation, a willingness to be disturbed, in order to set the process in motion; and there has to be an active network of communications with multiple feedback loops to amplify the triggering event. The next stage is the point of instability, which may be experienced as tension, chaos, uncertainty or crisis. At this stage, the system may either break *down*, or it may break *through* to a new state of order, which is characterised by novelty and involves an experience of creativity that often feels like magic.

The initial openness to disturbances from the environment is a basic property of all life. Living organisms need to be open to a constant flow of resources (energy and matter) to stay alive; human organisations need to be open to a flow of mental resources (information and ideas), as well as to the flows of energy and materials that are part of the production of goods or services. The openness of an organisation to new concepts, new technologies and new knowledge is an indicator of its aliveness, flexibility and learning capabilities. The experience of the critical instability that leads to emergence usually involves strong emotions – fear, confusion, self-doubt or pain – and may even amount to an existential crisis.

After prolonged immersion in uncertainty, confusion and doubt, the sudden emergence of novelty is easily experienced as a magical moment. Artists and scientists have often described these moments of awe and wonder when a confused and chaotic situation crystallises miraculously to reveal a novel idea or a solution to a previously intractable problem. Since the process of emergence is thoroughly nonlinear, involving multiple feedback loops, it cannot be fully analysed with our conventional, linear ways of reasoning, and hence we tend to experience it with a sense of mystery.

In human organisations, emergent solutions are created within the context of a particular organisational culture, and generally cannot be transferred to another organisation with a different culture.

Emergence and Design

Before the evolution of humans, all living structures on the planet were emergent structures. With human evolution, language, conceptual thought and all the other characteristics of reflective consciousness came into play. This enabled us to form mental images of physical objects, to formulate goals and strategies, and thus to create structures by design.

Designed structures are always created for a purpose and embody some meaning. Human organisations always contain both designed and emergent structures. The designed structures are the formal structures of the organisation, as described in its official documents. The emergent structures are created by the organisation's informal networks and communities of practice. The two types of structures are very different, as we have seen, and every organisation needs both kinds. Designed structures provide the rules and routines that are necessary for the effective functioning of the organisation. They enable a business organisation to optimise its production processes and to sell its products through effective marketing campaigns. Designed structures provide stability.

Emergent structures, on the other hand, provide novelty, creativity and flexibility. They are adaptive, capable of changing and evolving. In today's complex business environment, purely designed structures do not have the necessary responsiveness and learning capability. They may be capable of magnificent feats, but since they are not adaptive, they are deficient when it comes to learning and changing.

The issue is not one of discarding designed structures in favour of the emergent ones. We need both. In every human organisation there is a tension between its designed structures, which embody relationships of power, and its emergent structures, which represent the organisation's aliveness and creativity. As Margaret Wheatley puts it, 'The difficulties in organisations are manifestations of life asserting itself against the powers of control. Skilful managers understand the interdependence between design and emergence. They know that in today's turbulent business environment, their challenge is to find the right balance between creativity of emergence and the stability of design."

Two Kinds of Leadership

Finding the right balance between design and emergence seems to require the blending of two different kinds of leadership. The traditional idea of a leader is that of a person who is able to hold a vision, to articulate it clearly and to communicate it with passion and charisma. It is also a person whose actions embody certain values that serve as a standard for others to strive for. The ability to hold a clear vision of an ideal form, or state of affairs, is something that traditional leaders have in common with designers.

The other kind of leadership consists in facilitating the emergence of novelty. This means creating enabling conditions rather than giving directions, and using the power of authority to empower others. Both kinds of leadership have to do with creativity. Being a leader means creating a vision; it means going where nobody has gone before. It also means enabling the community as a whole to create something new. Facilitating emergence means facilitating creativity.

Holding a vision is central to the success of any organisation, because all human beings need to feel that their actions are meaningful and geared toward specific goals. At all levels of the organisation, people need to have a sense of where they are going. A vision is a mental image of what we want to achieve, but visions are much more complex than concrete goals and tend to defy expression in ordinary, rational terms. Goals can be measured, while vision is qualitative and much more intangible. Often, the vision remains unclear as long as we try to explain it, but suddenly comes into focus when we find the right metaphor. The ability to express a vision in metaphors, to articulate it in such a way that it is understood and embraced by all, is an essential quality of leadership.

To facilitate emergence effectively, leaders of "community" need to recognise and understand the different stages of this fundamental life process. As we have seen, emergence requires an active network of communications with multiple feedback loops. Facilitating emergence means first of all building up and nurturing networks of communications in order to 'connect the system to more of itself' Wheatley.

In addition the emergence of novelty is a property of open systems, which means that the organisation needs to be open to new ideas and new knowledge. Facilitating emergence includes creating that openness – a learning culture in which continual questioning is encouraged and innovation is rewarded. Organisations with such a culture value diversity

and 'tolerate activities in the margin: experiments and eccentricities that stretch their understanding' De Geus.

Leaders often find it difficult to establish the feedback loops that increase the organisation's connectedness. They tend to turn to the same people again and again – usually the most powerful in the organisation, who often resist change.

The experience of the critical instability that precedes emergence of novelty may involve uncertainty, fear, confusion or self-doubt which may generate resistance to change. Experienced leaders recognise these emotions as integral parts of the whole dynamic and create a climate of trust and mutual support.

The problem is that people at all levels want to be told what concrete results they can expect from the change process, while managers themselves do not know what will emerge. During this chaotic phase, many managers tend to hold things back rather than communicating honestly and openly, which means that rumours fly and nobody knows what information to trust.

Good leaders will tell their employees openly and often which aspects of the change have been established and which are still uncertain. They will try to make the process transparent, even though the results cannot be known in advance.

During the change process some of the old structures may fall apart, but if the supportive climate and the feedback loops in the network of communications persist, new and more meaningful structures are likely to emerge. When that happens, people often feel a sense of wonder and elation, and now the leader's role is to acknowledge these emotions and provide opportunities for celebration.

Finally, leaders need to be able to recognise emergent novelty, articulate it and incorporate it into the organisation's design. Not all emergent solutions will be viable, however, and hence a culture fostering emergence must include the freedom to make mistakes. In such a culture, experimentation is encouraged and learning is valued as much as success.

Since power is embodied in all social structures, the emergence of new structures will always change power relations; the process of emergence in communities is also a process of collective empowerment. Leaders who facilitate emergence use their own power to empower others. The result may be an organisation in which both power and the potential for leadership are widely distributed. This does not mean that several individuals assume leadership simultaneously, but that different leaders step forward when they are needed to facilitate various stages of emergence.

It is sometimes argued that the need for coherent decisions and strategies requires an ultimate seat of power. However, many business leaders have pointed out that coherent strategy emerges when senior executives are engaged in an ongoing process of conversation. In the words of Arie de Geus, 'Decisions grow in the topsoil of formal and informal conversation – sometimes structured (as in board meetings and the budget process), sometimes technical (devoted to implementation of specific plans or practices), and sometimes ad hoc.

Different situations will require different types of leadership. Sometimes, informal networks and feedback loops will have to be established; at other times people will need

firm frameworks with definite goals and time frames within which they can organise themselves.

Bringing Life into Organisations

Bringing life into human organisations by empowering their communities of practice not only increases their flexibility, creativity and learning potential, but also enhances the dignity and humanity of the organisation's individuals, as they connect with those qualities in themselves. In other words, the focus on life and self-organisation empowers the self. It creates mentally and emotionally healthy working environments in which people feel that they are supported in striving to achieve their own goals and do not have to sacrifice their integrity to meet the goals of the organisation.

The problem is that human organisations are not only living communities but are also social institutions designed for specific purposes and functioning in a specific economic environment. Today that environment is not life-enhancing but is increasingly life-destroying. The more we understand the nature of life and become aware of how alive an organisation can be, the more painfully we notice the life draining nature of our current economic system.

When shareholders and other outside bodies assess the health of a business organisation, they generally do not inquire about the aliveness of its communities, the integrity and well-being of its employees or the ecological sustainability of its products. They ask about profits, shareholder value, market share and other economic parameters; and they will apply any pressure they can to assure quick returns on their investments, irrespective of the long-term consequences for the organisation, the well-being of its employees or of its broader social and environmental impacts.

These economic pressures are applied with the help of over more sophisticated information and communication technologies, which have created a profound conflict between biological time and computer time. New knowledge arises, as we have seen, from chaotic processes of emergence that take time. Being creative means being able to relax into uncertainty and confusion. In most organisations this is becoming increasingly difficult, because things move far too fast. People feel that they have hardly any time for quiet reflection, and since reflective consciousness is one of the defining characteristics of human nature, the results are profoundly dehumanising.

The enormous workload of today's executives is another direct consequence of the conflict between biological time and computer time. Their work is increasingly computerised, and as computer technology progresses, these machines work faster and faster and thus save more and more time. What to do with that spare time becomes a question of values. It can be distributed among the individuals in the organisation – thus creating time for them to reflect, organise themselves, network and gather for informal conversations – or the time can be extracted from the organisation and turned into profits for its top executives and shareholders by making people work more and thus increasing the company's productivity. Unfortunately, most companies in our much-acclaimed information age have chosen the second option. As a consequence, we see enormous increases in the corporate wealth at the top, while thousands of workers are fired in the continuing mania for downsizing and corporate mergers, and those remaining (including the top executives themselves) are forced to work harder and harder.

Most corporate mergers involve dramatic and rapid structural changes for which people are totally unprepared. Acquisitions and mergers are undertaken partly because large corporations want to gain entry into new markets and buy knowledge or technologies developed by smaller companies (in the mistaken belief that they can short-circuit the learning process). Increasingly, however, the main reason for a merger is to make the company bigger and thus less susceptible to being swallowed itself. In most cases, a merger involves a highly problematic fusion of two different corporate cultures, which seems to bring no advantages in terms of greater efficiency or profits, but produces protracted power struggles, enormous stress, existential fears and thus deep distrust and suspicions about structural change.

It is evident that the key characteristics of today's business environment – global competition, turbulent markets, corporate mergers with rapid structural changes, increasing work loads and demands for '24/7' accessibility through e-mail and cell phones – combine to create a situation that is highly stressful and profoundly unhealthy. In this climate it is often difficult to hold on to the vision of an organisation that is alive, creative and concerned about the well-being of its members and of the living world at large. When we are under stress, we tend to revert to old ways of acting. When things fall apart in a chaotic situation, we tend to take hold and assume control. This tendency is especially strong among managers, who are used to getting things done and are attracted to the exercise of control.

Paradoxically, the current business environment, with its turbulences and complexities and its emphasis on knowledge and learning, is also one in which the flexibility, creativity and learning capability that come with the organisation's aliveness are most needed. This is now being recognised by a growing number of visionary business leaders who are shifting their priorities toward developing the creative potential of their employees, enhancing the quality of the company's internal communities and integrating the challenges of ecological sustainability into their strategies. Because of the need for continuous change management in today's turbulent environment, the 'learning organisations' managed by this new generation of business leaders are often very successful in spite of present economic restraints.

In the long run, organisations that are truly alive will be able to flourish only when we change our economic system so that it becomes life-enhancing rather than life-destroying. This is a global issue, which I shall discuss in some detail in the following pages. We shall see that the life-draining characteristics of the economic environment in which today's organisations have to operate are not isolated, but are invariably consequences of the 'new economy' that has become the critical context of our social and organisational life.

This new economy is structured around flows of information, power and wealth in global financial networks that rely decisively on advanced information and communication technologies. It is shaped in very fundamental ways by machines, and the resulting economic, social and cultural environment is not life enhancing but life degrading. It has triggered a great deal of resistance, which may well coalesce into a worldwide movement to change the current economic system by organising its financial flows according to a different set of values and beliefs. The systemic understanding of life makes it clear that

in the coming years such a change will be imperative not only for the well-being of human organisations, but also for the survival and sustainability of humanity as a whole.