CHAPTER22

THE CYBERNETICS OF SUSTAINABILITY: DEFINITION AND UNDERLYING PRINCIPLES

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Sustainability: Has the true meaning been lost?

For decades now, increasing numbers of thoughtful observers have called attention to disturbing patterns in the current trajectory of human affairs. Accelerating dramatically since the early days of the industrial revolution, powerful forces in development and technology have brought new promises and opened so many new possibilities for humankind. At the same time, driven largely by the impact of human activities, serious threats have emerged to the integrity of whole ecosystems, to other forms of life and to the future well-being of humanity itself.

In response, a growing number of individuals, communities, governments, academic institutions, businesses, faith-based organizations, and others have begun to join forces in actively seeking more harmonious, inclusive, peaceful, and sustainable forms of development. Ensuring a conscious transition of society and the world's economy to a sustainable basis has emerged as the most significant challenge of our time.

The broad-based, worldwide, growing awareness of the sustainability issue is surely a most welcomed development. Popular acceptance, however, seems to have its price. The word sustainability, which was introduced only relatively recently, has quickly become the current buzzword, politically correct and to be used everywhere and in any context. With popularity it seems to have lost some of its essential meaning. In economic development circles, for example, one can hear references made to sustainable projects, the reference is to whether a development project would outlast the period of subsidies. In financial circles, one often hears talk about sustainable financing usually related to the question of whether loans would be profitable in the conventional sense. In business circles, the concept of corporate sustainability consistently puts the well-being of a particular corporation at the fore. Similarly, analysts proclaim that this or that company still has to show sustainable profits, and one hears commentators ask whether the stock market bubble is sustainable, whether a particular domestic or international

government policy is sustainable, and so on. All these uses are grammatically correct, implying a sense of continuity, but all miss the essence of our looming global crisis, the crisis of destabilizing the very systems upon which life depends.

Even the prevailing definition of sustainability, the one advanced by the United Nations Commission on Environment and Development, does not help much. This definition, which emphasizes cross generation equity, is vague and deeply flawed on at least three accounts. It is conceptually weak by making one aspect of a desirable end result – the well-being of future generations – the primary condition for attaining itself without specifying what this requirement would actually entail. If instead, for example, we were able to establish the underlying parameters of sustainability as a state and ensure that the values of such parameters were actually secured, vibrant prospects for future generations would follow. Furthermore, the definition is operationally weak since it is difficult to establish economic utility values for future generations, thus allowing for many different interpretations and encouraging the avoidance of clear commitments. Finally, it is flawed with respect to process since no representatives of future generations can participate in critical decisions made on their behalf. Few of us would be happy, I suspect, if Neanderthal humans in their caves had been making decisions on our own behalf, decisions, which would affect directly our lives today.

The seemingly attractive concept of the triple bottom line has its problems as well. It is essentially fragmented and it allows companies who do very well financially, who claim social concerns and donate to environmental causes, claim themselves to be green even when the very essence of their operations – current practices and the depletion of finite resources in the fossil fuels sector, for example – could not be termed sustainable under any stretch of the imagination.

In this chapter the term sustainability will be used in the broad context of our whole planet, the integrity and health of its biosphere and the future well-being of humanity. In addition, a cybernetics perspective on the concept of sustainability will be explored. This particular perspective throws a uniquely useful light, which could bestow rigor and bring operational precision to a term whose meaning has been watered down to the point of trivialization.

Taking the cybernetics perspective

In the broader context of general system theory, cybernetics puts a specific focus on a consistent theme: the questions of how systems regulate themselves, how do they adapt and evolve, how do they self-organize and, in particular, what are the structures and specific mechanisms which mediate their underlying dynamics. The emphasis is on understanding cause and

effect relationships between key variables, or system's components, and how such relationships produce particular outcomes.

The emphasis on underlying system structure is central to the significance of the cybernetic perspective – in our case, related to better understanding the concept of sustainability – since it exposes the very constraints that ultimately shape manifest outcomes. This, in turn, opens the door to a proactive design approach, which involves specification of the particular structures that are most likely to bring about desired results. In other words, taking the cybernetic perspective gives us a direct handle on the operating prerequisites, the essential conditions, the design parameters, the principles, if you will, that cannot be compromised if we are serious about obtaining a particular system state.

The idea, incidentally, goes back to a now classical paper from1943, *Behavior Purpose and Teleology*, in which Norbert Wiener, the father of *cybernetics* and his colleagues, established the essential connection between a system's output, its observed behavior, and its internal structure. This idea sounds simple and obvious now, but think about how often, in attempting to change a situation, reform an institution, an individual, a country, or the world, efforts are focused on manipulating the outcomes rather than on reconfiguring the structure that is responsible for bringing these about.

The structures in question, it turned out, take the form of networks, in which the now familiar feedback loops, that amplify or dampen conditions, interact to form a recognizable 'something', a particular organization, a system, or a system's state. Invariably, the crux of any organization, any system, is stability of some characteristics, which is preserved intact. That which remains stable can be the system itself or some particular relation of parameters, an equilibrium point that is essential to its existence in the first place.

From this point of view, sustainability can be regarded as a specific system's state, distinct from a wishful goal or an adjective-like attribute. As such, we would expect for it to be mediated by an internal structure – internal wiring of a particular configuration – anchored in specific variables that can be defined, recognized, destroyed or preserved, even enhanced, by intervention. In this lies the power of the cybernetic perspective. It allows us to operationalize the concept of sustainability. Two points, then, are crucial to this perspective: first, that sustainability is seen as a particular system state born by a particular underlying structure and second, that sustainability can be regarded as a type of stability characterized by some quantity that remains invariant.

A definition of sustainability

What then is the essence, the quantity to be preserved intact, if the condition of sustainability is to hold? The answer is simple: it is a particular kind of equilibrium in the interaction between a population and the carrying capacity of its environment. It could be any population and any environment. It could be amoeba in a Petri dish, algae in a lake, elephants in their habitat, or humans on the planet. As simple as this idea is, it is rarely allowed to drive the sustainability agenda. Both sides of the equation, population on one hand and carrying capacity on the other, are often seen as too sensitive to be tackled head on. Perhaps because they require addressing issues of population dynamics along with issues of consumption patterns and waste, all unpopular subjects requiring a close look at how we humans behave. This would, of course, be uncomfortable since it might throw our whole way of life, our whole civilization into question.

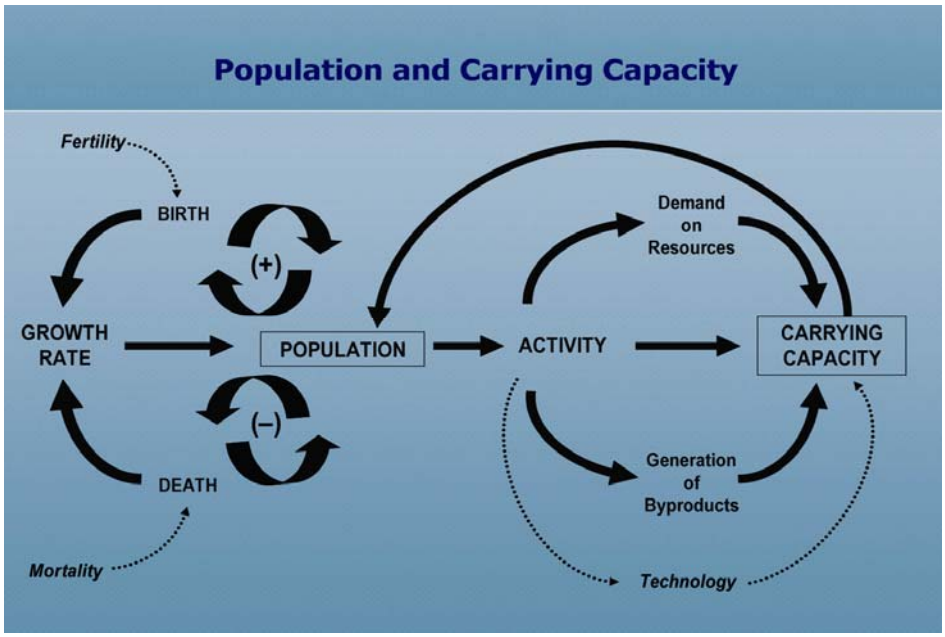
The particular kind of equilibrium referred to earlier as an essential characteristic of the state of sustainability is well familiar to cybernetics. It is embodied in a two-way circular structure, a loop, in which key variables, population and carrying capacity in this case, continuously affect one another. In this kind of circular interaction the two sides of the equation actually define one another; they are involved in a process of co-creation producing a state of dynamic equilibrium whereby, at least for a time, they hold each other in check. A particular environment defines what kind of population is possible in the first place and populations, in turn, modify and remake the environment itself. The long history of the biosphere bears witness to this kind of interaction.

In fact, living organisms and the large complex dynamic systems that comprise the major components of the biosphere, including atmospheric cycles and ecosystems, rain forests, coral reefs, societies, economies, institutions, urban areas, and whole civilizations alike, all display similar characteristics inherent to circular interdependencies. All such systems consist of networks of multiple variables, myriad multi-loops and multiple interactions, all co-accommodating to produce a state of dynamic equilibrium for the whole. It is such equilibrium that makes the recognition of a particular system, a specific identity, possible and it endures largely due to the enormous redundancy of its underlying network. Pathologies in such systems arise when one cluster of loops, one species, begins to aggressively dominate its surroundings destroying the very fabric upon which it depends.

The simple two-way loop of population and carrying capacity is depicted at a higher level of resolution below. Population is indicated at the left of the diagram and carrying capacity at the right. At any given time, population size is determined by net growth rate which is driven, in turn, by a complex interaction of factors including birth and death rates and other variables not all

of which is entirely understood today. The carrying capacity exerts its own shaping pressure as can be demonstrated in laboratory experiments with simple organisms in closed environments where the number of individuals in a population and even the actual physical size of individual organisms vary with food distribution patterns.

A population exerts its impact on the carrying capacity of its environment as a function of the rate and intensity of its activity and this impact is driven by two main channels: the demand on resources and the generation of by-products. In a very real sense, populations consume their environments and their activities generate by-products that the environment, in turn, needs to be able to absorb. Sustainability in this context requires that the rates of consumption and generation of resources as well as the rates of generation and absorption of by-products are at equilibrium. This state of equilibrium is dynamic in that it represents a moving target depending on the relative values of the underlying variables at each given time.



Note, incidentally, that in the case of human society, technology, which can be regarded as an externalized extension of basic metabolic functions, can have a considerable impact on the carrying capacity of an environment. It can expand and deepen it by opening up new and previously entirely unforeseen possibilities. For example, some five hundred years ago, ship building and navigation technologies extended the range and speed of exploration, opening up vast new territories virtually overnight. The discovery of the full range of possible chemical elements –only nine were known in 1250 AD – extended tremendously life support possibilities. Agricultural technologies increase effective yields from given plots of land, other technologies increase

the performance obtainable from each pound of resource, and the vast potentials inherent in space exploration are still to be glimpsed, let alone fully realized.

Anchoring the concept of sustainability to the interaction of population and carrying capacity and the state of equilibrium which requires unhampered regeneration capacity leads to a rigorous definition of sustainability that contains a number of key variables, all potentially measurable. For example: population size, rate of consumption of resources, impacts on absorption capacity of sinks such as forests oceans and soil, rates of regeneration capacities, a measure of well-being, and the like. I would thus like to offer the following definition:

Sustainability: A dynamic equilibrium in the processes of interaction between a population and the carrying capacity of its environment such, that the population develops to express its full potential without producing irreversible adverse effects on the carrying capacity of the environment upon which it depends.

It is this equilibrium that has been compromised in our time with the unprecedented explosion of human population and the related rapid intensification in levels of development activities that currently overwhelm the capacity of the planet's sources and sinks. The system is out of balance at present with many components of the biosphere showing relentless signs of severe stress. The list is familiar. It includes ozone depletion; climate change; loss of biodiversity; soil erosion and desertification; diminishing fresh water resources; shrinkage of forest cover; and the growing income disparity between and within nations. This pattern needs to be reversed if systemic collapses of increasing severity are to be averted.

What is going on?

Systemic patterns of stress that characterize our planetary reality can be interpreted by three essentially different perspectives. The first would be largely dismissive. It would argue that all the reported signs of stress might be annoying but they are secondary issues at best. It would insist that things could be fixed as we go along. It would claim that there is no convincing proof to show that circumstances are as bad, that the underlying science is incomplete and that those who sound the alarm have a vested interest at stake. This perspective, which advocates business as usual, still dominates mainstream leadership in business and government and is held by a majority of the general public.

The second perspective, suggested by many thoughtful commentators, concerned scientists, environmentalists and others, holds that humanity has reached absolute limits; that we need to restrain future growth or face major cataclysm. According to this perspective, human activity throughout history

was insignificant relative to the size of the planet. It has now grown to dominate the biosphere and the rapidly expanding demand on resources will require more than one planet in order to be satisfied. The advocated response, which inevitably follows, calls for limiting current growth and retreating to a less intensive, perhaps more pastoral way. Except that the genie is well out of the bottle and there seems to be little prospect for peacefully arresting development, especially in all the many parts of the world were the majority of humans are still deprived of the most basic of prospects.

The third perspective is the most intriguing. It would argue that the prevailing signs of stress are real enough but that they largely represent a failure of currently dominant concepts, beliefs and practices to adapt to new possibilities and changing demands. According to this view, prevalent signs of planetary stress are the symptoms of an ongoing conflict between the prerogatives of new possibilities immanent in a next evolutionary step beckoning humanity, and the old ways of perceiving and doing things. They are a result of a tension between a new reality struggling to be born and stubborn, conservative constraints that are blocking its way. This last perspective is compelling because of its proactive, forward-looking characteristics. It lays credence in an evolutionary outlook and puts confidence in the latent potential of life – never completely guaranteed in advance, to be sure – to reconfigure its very structure when the conditions of its context change. This perspective requires that humanity now steps up deliberately, consciously and collectively to shape the next chapter in its own evolution.

One thing is clear. Even by virtue of its numbers alone, humanity has entered a whole new relationship with its home planet. This is well evident even from a quick glance at the exponential curves depicting the growing numbers of the human population. There is no precedence to the current numbers. For thousands of years, humanity fluctuated on both sides of the one billion mark. Within the relatively short period of recent times the number shot up to seven billion and two billion people more are expected to be added by the year 2050. Scientists who study demographic scenarios still argue about the ultimate number but they are really addressing the slope at the very tip of the curve. The big, unprecedented bulge has already occurred. It brings with it entirely new kinds of challenges for which there is no ready-made prescription available. There is simply no experience of managing the world's resources and nine billion people in harmony and in peace.

"Rethink everything!" ought to be the central mantra of our time. Nothing less will suffice. Most existing tools, concepts, institutions, frameworks and mechanisms with which we address the new realities are not going to be adequate to the task. They evolved in the past in a different context and for issues of entirely different nature and magnitude. Most stand now in the way

of the necessary change, looming obstacles in the process of reconfiguring our collective reality. The possibility of realizing a sustainable economy of peace and abundance for all, calls for a complete reorientation in human affairs. This will require a deep change in our world-view; in the values we hold dear; in the structure of our economy; in our ways of allocating the world's resources; in our priorities for the use of technology; and in our modes of governance. The need is for a second order change, change that will not only affect this or that aspect of our ways of dealing with the world, but will also fundamentally transform the whole underlying system itself. Anyone who has experienced the difficulties of managing major transformation, in personal, institutional or national life, will appreciate the enormity of the challenge.

The dimensions of sustainability

A number of key factors shape the equilibrium condition in the interaction of a population with the carrying capacity of its environment. As already suggested, these include population size, volume and intensity of activity, composition of the environment, available technology, and all the physical quantities that define the channels of metabolic exchanges. As distinct from other living creatures, human society has evolved to the point whereby a number of important non-physical factors weigh heavily as well, including the manifested level of consciousness, the prevailing view of the world and the abstract framework of explicit assumptions, values and principles by which society organizes its activities.

Together, all these factors represent the constituent components of the vector of a population's interaction with its environment. In this sense, they shape the conditions upon which a state of sustainability ultimately depends and provide a framework for deriving the principles that define it as a state. As a system, this framework can be expressed in relation to five essential dimensions representing logically distinct but co-dependent, interacting domains. They include the following:

- ***The material domain,*** which constitutes the basis for regulating the flow of materials and energy that underlie existence.

- ***The economic domain,*** which provides a guiding framework for creating and managing wealth.

- ***The domain of life,*** which provides the basis for appropriate behavior in the biosphere.

- ***The social domain,*** which provides the basis for social interactions, and

- ***The spiritual domain,*** which identifies the necessary attitudinal, value orientation and provides the basis for a universal code of ethics.

From each domain a single sustainability principle is derived, each, with its own policy and operational implications. The result is a set of five core principles, a set that is fundamentally systemic in nature since each domain affects all the others and is affected by each in return. This systemic aspect is fundamental. It reflects the interdependent nature of reality itself. It has far reaching implications for policy and for any competent attempt at bringing about change. It implies that in seeking a transition to sustainability as a predominant planetary state, no piece-meal approach – emphasizing some aspects while neglecting others – is likely to yield the desired end state.

The five core principles

The ultimate objective of establishing the concept of sustainability as an organizing principle is to foster a well-functioning alignment between individuals, society, the economy and the regenerative capacity of the planet's life-supporting ecosystems. The five core principles that follow prescribe the necessary conditions for attaining this state.

I. The material domain

All the physical processes that provide the basis for human existence are subject to the primary laws of physics, for example: Einstein's law of the inter-changeability of energy and matter; the first law of thermodynamics which addresses the fundamental conservation of energy in universe; and, the second law, which stipulates the direction of energy events. These laws prescribe the ultimate limits of possibilities in physical systems and, therefore, underlie the productive potential in the use of resources.

The Second Law underscores the ultimate increase of entropy, diffusion and disorderliness in all physical systems. At the same time, it does not rule out the possibility of local order increase, at least temporarily, as manifest in the formation of complex organic molecules, organisms, whole eco-systems and at least one currently known whole planet – our own – a precious cosmic region in which energy is compounded to create order of increasing complexity, a prime characteristic of life.

Consciousness itself may turn out to be the ultimate anti-entropic enabler. Consciously disciplined intelligence, applied to the design of universally advantageous configurations of energy and matter – arranging and

rearranging components of the physical domain – provides the essential tool for creating the wealth infrastructure of lasting abundance.

The crucial point is that our current industrial infrastructure is highly entropic. It is wasteful, destructive, fragmented and grossly inefficient. Entropy cannot be eliminated entirely, of course, but it can be reduced and managed by superior design employed to deliver lasting, regenerative advantage for all. Hence,

The first principle: *Contain entropy and ensure that the flow of resources, through and within the economy, is as nearly non-declining as is permitted by physical laws.*

II. The economic domain

Economies consist of markets where transactions occur and guiding frameworks by which transactions are evaluated and decisions about commitments are made. Often treated as though they reflect an independent, objective reality, such frameworks ultimately represent human constructs, rooted in values, biases and dominant interests and concerns. These latter factors determine adoption of the underlying economic perspective: short-term, narrow, linear focus, or long-term, comprehensive, eco-sensitive cycles of return.

The accounting framework used at present to guide our economy grossly distorts values. It systematically ignores important cost-components, for example, depletion of resources and impacts of pollution and waste. Economists are beginning to reflect on the inadequacies inherent in the narrow concept of growth that dominates measurement of national economies, and some even highlight the basic absurdity of counting consumption as if it were income, a common practice in the way we treat natural resources.

Inadequate measurements, with regulations and subsidies, which often accompany them, drive markets and continue to fuel the destructive effects of the economy as a whole. The prevailing conventions of our accounting framework exacerbate such effects and limit the scope of individual initiatives seeking better practices. This self-reinforcing pattern is clearly one key dimension requiring radical change.

The second principle: *Adopt an appropriate accounting system, fully aligned with the planet's ecological processes and reflecting true, comprehensive biospheric pricing to guide the economy.*

III. The domain of life

The adaptive success of the human species and its quick propagation almost everywhere on planet earth comes at the continuous expense of many other forms of life. The destruction of individual animals, species, habitats and whole ecosystems, a trend now reaching ominous proportions, is a deep cause for concern.

Complex, self-organizing, living systems – brains, societies, ecosystems, and industrial economies alike – depend on their very complexity, their internal variety, for long term viability. Lasting stability in all such systems is in fact, science tells us, a direct function of their very complexity, of inherent redundancy, which allows for emergence and re-emergence of different configurations in response to changing context events. Monocultures are brittle in principle, the antithesis, in this context, of vibrant life. With our current practices we are striping biospheric variety away.

On this point contemporary science seems to be joining with many of the world's ancient traditions, which insist on the uniqueness and fundamental sacredness of all forms of life.

The third principle: *Ensure that the essential diversity of all forms of life in the biosphere is maintained.*

IV. The social domain

Work of early 20th century scientists and philosophers of science brought to the fore the fundamental fallibility of human knowledge pointing out that, with regard to *knowing*, complete certainty is in principle all but impossible. This suggests that, in a true ecological fashion, myriad expressions and species of truth should be allowed to coexist without any particular one seeking to aggressively dominate others.

Societies, like ecologies, depend on diversity and internal redundancy for robustness, long-term viability and health. This alone underscores the importance of encouraging variety and plurality in social forms. At the same time, modern genetics and the sequencing of the human genome indicate that the underlying genetic differences between the many ethnic groups on the planet are insignificantly small, rendering arguments for an inherent superiority of any group, baseless.

All these thoughts reinforce the still fragile idea that open processes, responsive structures, plurality of expression and the equality of all individuals ought to constitute the corner-stones of social life. As we enter the twenty first century however, society continues to operate predominantly by the worn-out assumptions, concepts and structures of yesterday.

The fourth principle: *Maximize degrees of freedom and potential self-realization of all humans without any individual or group, adversely affecting others.*

V. The spiritual domain

The human spirit has consistently sought to transcend material, biological, physiological, psychological, conceptual, and technological limitations. This constant drive for touching a 'beyond', for taking progressively more into the field of vision and integrating an increasingly broader 'reality', has a huge practical significance. With its intuitive reach for wholeness and completion, it fuels the development and evolution of individuals and societies alike.

The extent to which this deeply rooted drive is actually allowed to manifest in the daily affairs of society, affects the choices we make and the quality of our actions in the world. Ultimately, it underscores the difference between a greedy, egocentric, predatory orientation and a nurturing, self-restrained, inclusive approach, which honours the larger system of which we are a part and on which we depend for our very existence.

The essential quality of the spiritual domain, recognized, as it is, by all known wisdom traditions, is not easy to pin down. In the English language, the term spiritual carries opposing connotations: sacred, exalted, virtuous, divine, but also, insubstantial and occult. It is meant here to evoke a sense of a deep, underlying essence **--** a combination of inspiration, meaning, purpose, and a motivating, all-encompassing value. The fundamental imprecision that is involved is manifest in the more elaborate way in which the fifth principle is expressed.

The fifth principle:

Recognize the seamless, dynamic continuum

Of mystery, wisdom, love, energy, and matter

That links the outer reaches of the cosmos

With our solar system, our planet and its biosphere

Including all humans, with our internal metabolic systems

And their externalized technology extensions –

Embody this recognition in a universal ethics

For guiding human actions

The five core principle can be summarized in a few simple words: contain entropy; account for externalities; maintain diversity; self-actualize benignly; and, acknowledge the mystery.

The five sustainability principles[1] as an integrated whole

Deeper reflection on the concept of sustainability and the five core principles, which together prescribe it, reveals that the spiritual dimension, the spiritual principle, is fundamental to the quality and coherence of the whole. It is rarely incorporated however, in the conventional calculus of practical affairs.

As a guiding principle the spiritual dimension does not carry the connotation of conventional religion. Rather, it evokes the soul-focused integration of mind and heart in realization of the essential oneness at the center of being.

By anchoring the essence of human motivation and intention, the spiritual principle acts as the causal root that sets the tone for the whole. It drives the integration of the other four principles, those related to the material, economic, life, and social domains. If integrated in a balanced way, it can infuse a common purpose, provide a common foundation and stimulate common resolve. Lacking the ethical commitment implied by the spiritual principle, considerations of questions related to the four other domains, no matter how elaborately expressed, are reduced to mere technicalities.

By their very nature language, logic and action force separation, discrimination and choice. A balanced, simultaneous and full integration of all five principles is essential however, for conceptualizing and realizing sustainability as a state. The whole set has to be integrated into a single unity in which the five principles come together as one.

As already suggested, the five domains underlying the principles interact and co-define one another. Further, as in a holographic image, each embodies the whole general scheme in its own sphere. When the principles are thus integrated and seamlessly inform choices and actions, a state of sustainability, which otherwise appears as a difficult, distant goal, can be realized spontaneously and completely.

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[1] The Five Sustainability Principles were first published by Michael Ben-Eli in 2006, on the web site of the Buckminster Fuller Institute, in New York. The principles are being used as a basis for the work of the Sustainability Laboratory, established in order to develop and demonstrate breakthrough approaches to sustainability practices.

Application of the principles as an integrated, whole framework is demonstrated in the Lab's current flagship project – Project Wadi Attir – an initiative with a Bedouin community in the Negev desert, designed to showcase a model for sustainable agriculture in an arid zone (see www.sustainabilitylabs.org).

Policy and Operational Implications

For each domain and from each principle, a few primary policy and operational implications follow. Taken together, these combine to sketch out key elements for a comprehensive blue print for the future. Briefly, they include the following, primary demands:

In relation to the physical domain: Strive for highest resource productivity; Amplify performance with each cycle of use of resource; Employ *income* rather than *capital* sources for energy and continuously recycle non-regenerative resources; Affect an unbroken, closed-loop flow of matter and energy in a planetary industrial infrastructure conceived as a whole; Control leakages and avoid stagnation, misplaced concentrations or random diffusion of chemical elements during any cycle of use; Establish a predominantly service, performance leasing, rather than ownership orientation for managing durable goods.

In relation to the economic domain: Employ a comprehensive concept of wealth related to the simultaneous enhancement of five key forms of capital: natural, human, social, manufactured and financial; Align the world's economy with nature's regeneration capacity and incorporate critical externalities in all cost and benefit accounts; Embody a measure of well-being and human development in economic calculations; Design regulation and taxation policies to accentuate desirable and eliminate adverse outcomes, optimizing the whole; Rely on market mechanisms, calibrated to reflect true costs, for allocation of capital assets.

In relation to the domain of life: Assume a responsible stewardship for our planet's web of biological diversity; Harvest species only to regeneration capacity; Conserve the variety of existing gene pool; Shape land use patterns to reduce human encroachment on other forms of life and enhance biological diversity in areas of human habitat.

In relation to the social domain: Foster tolerance as a cornerstone of social interactions; Enshrine universal rights within a framework of planetary citizenship; Provide for inclusion and effective democracy in governance; Ensure equitable access to life nurturing resources; Establish cooperation as a basis for managing global issues and planetary commons; Outlaw war and trade in weapon technologies; Promote sustainability literacy through education at all levels; Embody sustainability enhancing measures in an effective planetary framework of legislation.

In relation to the spiritual domain: Acknowledge the transcendent mystery that underlies existence; Seek to understand and fulfil humanity's unique function in Universe; Honour the Earth with its intricate ecology of which humans are an integral part; Foster compassion and an inclusive, comprehensive perspective in the underlying intention, motivation and actual

implementation of human endeavours; Link inner transformation of individuals to transformations in the social collective, laying foundations for emergence of a new planetary consciousness

Even a casual review will suggest that every one of the conditions referred to above is being ignored or worse, violated, everyday and everywhere. This is why our current path is not sustainable, why it must be changed. With a long evolutionary process behind it civilization seems now to be poised on the threshold of a possible future of abundance, peace and creative well-being. Will it be wise enough to secure such a future? It could – by employing a higher, more inclusive level of consciousness and by addressing the challenge purposefully, decisively and collectively, with sensitivity, thoughtfulness, and deliberate, comprehensive design.

It can be argued that many of our current global predicaments are the direct results of a fragmented, reductionist view of the world and the associated overspecialization in education and the professions. Systems thinking and cybernetics can provide the conceptual framework and some of the particular tools that are essential for ensuring the required transformation.