Revision C
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Dynamic Systems

Blue Planet Governance

The era of global *tragedy of the commons* ends.
The new paradigm begins when Interdependent Regional Governments unite!
To form a chaordic organization called,
The **United Regions**
Where coordinated expertise in Earth Science, Human-Nature and Economics
Provide Regional Guidance to Maximize *Real* Wealth:

Real wealth is a measurement of a robust ecology
and of the general health and happiness of the people!

Indeed, I tremble for my planet, when I reflect that Nature is inflexible: that
her response to our abuse cannot sleep forever.
~ Thomas Jefferson

As indicated in the Synopsis, there are deep and incurable flaws in a few key elements of our evolved systems of independent national governance where national interest can trump any collective initiative to deal with whole-world issues than have been suggested within meetings of the United Nations.   It is the national level of a relatively few countries, such as the G8 collective, that greatly influence the socioeconomic political management of modern human civilization in general – and their guiding quest is everlasting economic growth.

Books by Jarrod Diamond and a few others illustrated collapsed societies of the past. It appears there never has been a society intentionally designed to be long-term sustainable by regulating its activities in order to sustain available resources.   If any society had established such a system, that would be classified as a basic *dynamic system*.

Today we observe The Tragedy of the Commons being played out, as humans continue harvesting the remains of the global commons on our *small blue dot* home.
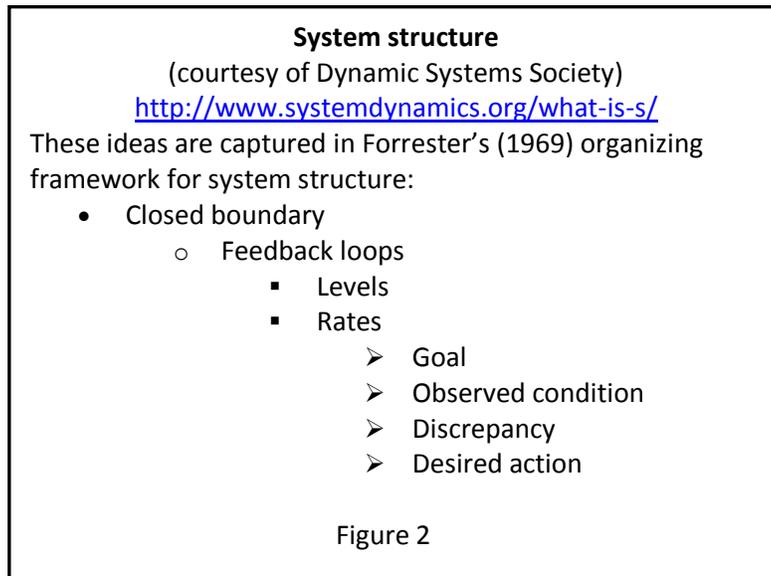
This chapter is to provide readers a common basic understanding of *dynamic systems*, and why and how systems can lead us toward balance and sustainability. This overview starts with a block diagram of system requirements and illustrates just how common systems really are; you not only use systems every day but your body is a system and is comprised of many semi-autonomous sub-systems.

The dictionary defines *dynamic* as a noun, *a dynamic – a force, or dynamic equilibrium*; or an *underlying cause of change.* It is also an adjective meaning *powerful*, and *able to make continuous and productive change*. A system is an assemblage of parts in which dynamic actions occur.   A system displays *synergy*, meaning that its usefulness, or value, of the whole is greater than the value of the sum of its parts. Systems range from very simple ones with few parts (or few people) to highly complex, such as biological systems with imbedded sub-systems, or systems of Gaia that form *Mother Nature* as we know her. A few other words commonly used when describing a system are: *regulate, feedback* (positive or negative), energy *flow, goal, quiescent point* (at rest, or having reached the desired state - goal), *range, limits, rate of change and optimum*.

Organizations and Systemic thinkers
The *Systems Dynamics Society* [R1] is an international, non-profit organization devoted to encouraging the development and use of system dynamics and systems-thinking. The organization is based on the work of Jay Forrester whose early experience with electromechanical systems led him into expand those ideas toward developing systems-thinking in many other areas, including soft systems. Forrester's work was instrumental in approaches and techniques used by the team of Donella and Denis Meadows, the researchers with MIT who were commissioned by the *Club Of Rome* [GL] to generate the graphical representations that appeared in their seminal '72 book, *Limits To Growth*. Their graphs showed what may globally unfold over time with various scenarios and events. They started with population levels and growth rates and specific resources levels from historical trends up to their present. And then they projected interactions beyond, for about 100 years. The word, cybernetics [R2] is often associated with systems-thinking because the origin of the word means, *the art of steering* – which is exactly what leaders of *Spaceship Earth* must do to as they steer us toward our goal of BDG at 3D-Optimum [GL] rate.

The web page of the *Systems Dynamics Society* makes reference to many systems thinkers, some of them referenced in this book. A few are: Denis Meadows, Gregory Bateson, Kenneth Boulding, and Stafford Beer. Their web page has an excellent section describing basic systems components, copied in Figure 2 below. All of these components are integral parts of the suggest BDG design:

System structure
(courtesy of Dynamic Systems Society)
http://www.systemdynamics.org/what-is-s/
These ideas are captured in Forrester's (1969) organizing framework for system structure:
- Closed boundary
    - Feedback loops
        - Levels
        - Rates
            - Goal
            - Observed condition
            - Discrepancy
            - Desired action

Figure 2

Systemic Structures
Like all good systemic structures, both the mechanical and soft systems, described later, all have the structural components listed here. (Your government does not.) A little discussion on each of these is in order.

- Closed Boundary

To see a picture of Earth taken from space, immediately gives the picture that spaceship Earth's boundary is our protective atmosphere. As Carl Sagan reminds us, our only home is just, *A small blue dot*. Beyond this, we appear to be hanging in space, all alone. Energy flow, in and out, seems to be our only constant cosmic visitor.

In systems-thinking, the closed-boundary idea is an important big-picture means of visualizing both systems and subsystems as relatively autonomous as far as internal functions are concerned. Many functions are performed with no external input. However, each system will have some dependence on information from another system. Its output may provide essential data to another system. Therefore, they are essentially closed, and yet interdependent with other systems in some ways. States or provinces are to a large degree autonomous. And yet, in some areas they are subordinate to the federal government, while being superior to semi-autonomous counties or large cities. Our body is to a large degree a fully autonomous system, and yet to sustain ourselves, we need the fruits of Gaia – air, food and water. And the heart and other organs operate semi-autonomously doing whatever they were groomed to do through evolution.

- Feedback Loops

Each dynamic system has a means of measuring its output, and part of that output is fed back into the input control criteria in order to increase or decrease the instantaneous output that drives toward the target level or goal.

- Level and Rates

Feedback error, or signal, is a measure of the difference between actual condition and the desired condition (goal). The feedback information must consider both the level of the corrective action needed,

and the rate at which the system is to making the corrective action. The rate of approaching target is another consideration in some systems.

> ➢ Goal

As the New York Yankee catcher Yogi Berra famously stated, *If you don't know where you are goin' that's where you'll end up!* And that is our problem today. Other than infinite growth, the corporate governance default goal, human civilization does not have a viable defined goal.   Even your home toilet has a goal, as discussed later.

3D-Optimum [GL]: The pinnacle goal of the BDG processes is to eventually reduce human activity to that which can be sustained within the Gaian renewing flows of nature.

> ➢ Observed Condition

Regarding the Gaian system that sustains us, there are very large error signals. Observed conditions indicate the planet's systems of life are significantly different now, as compared to before the human footprint grew so large over the past few centuries. Lester Brown, David Suzuki, the *Ecological Footprint* organization, and dozens of other individuals and organizations give reports on the state of the land, the water and our fellow species that now indicate our whole system of life is in a state of rapid decline. The growth paradigm of today has no means of integrating this dire information into vitally-needed sociopolitical heading change.

> ➢ Discrepancy

The amplitude of error signal determines the level of corrective feedback.

> ➢ Desired Action

Desired action is to establish feedback on elements of human activity that will dynamically guide the BDG societies on a course toward 3D-Optimum at the maximum rate of change that functioning human societies can tolerate.

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Even though the world around us functions in dynamic rhythms, relatively few people think in *systems dynamics* terms. It is not taught in high school curriculum or in college unless one specializes in an area dependent on systems analysis. Some holistic thinkers consider this void in basic learning to be a fault with our basic, silo-organized education system.

Hard System (In text below, common systems terms will be in italics for clarity)
Systems are all around us. For example we don't often think of the dynamic systemic interactions of our home toilet. It has a float to operate a water valve that *regulates* water *flow* to fill the tank to a predetermined level – the *goal* of the fill sub-system. To put this another way, the float provides informational *feedback* regarding the water level to the *regulator* (valve) which responds to this *feedback* information by *regulating* the water *inflow*. Since the water is under pressure, this represents the *system energy* source. The float and the valve are relatively autonomous *sub-systems* of the whole toilet. When you flush, gravity energizes the *flow* into the bowl up to a point when *dynamic* trip action occurs and the *kinetic energy* of water into the drain sucks out the remainder. And then the refill cycle starts and the tank fills toward the predetermined level where the float *regulator* slows the rate of flow, and finally shuts off the valve at target level - *goal*. One should never underestimate the systemic wisdom of the *closed system*

called toilet. Perhaps it is sitting in the relaxing the aura of this wisdom that cause people to often have creative ideas while using it ☺.

Another example is a home heating system. The source heat energy flow is *regulated* by a thermostat that you adjust for desired temperature. While this seems simple enough, within the overall heating system are sub-systems such as an electric motor or two, each internally *regulated* to operate at a specific speed. The thermostat is the key temperature *regulatory controller* which contains active components - a bimetal metal strip designed to bend with temperature-change in order to switch on or off an electrical controller that gates the heat energy from burning oil or gas to your home. And the temperature point between off/on can be controlled by you – the temperature that you set as the *system goal*. The thermostat, the fan motor, the fuel pump, the relays, are all relatively autonomous *sub-systems* of the overall heating systems.

Anyone living in a modern society uses a variety of systems every day. An interesting example of a fairly complex subsystem within large aircraft is the automatic pilot. It is designed to control the aircraft, often more smoothly and efficiently that the pilot. An aircraft autopilot deals with pitch, yaw, roll and height. The aircraft has sensors that provide the autopilot these data, and also the rate of change of these data. The autopilot computer deals with this information to operate the aircraft ailerons, rudder and elevator in ways that produce acceptable coordinated corrective action of the aircraft position in space using all these data categories. Control surfaces are usually activated by hydraulic or electric actuators. The engines are energized by fossil fuel. The engine-driven generators energize the aircraft electrical system, which is the energy source for the autopilot.

Here we have a large number of semi-autonomous sub-systems working together so that the pilot is able to direct the aircraft from A to B. When a pilot reports to ground crew that the autopilot system has a problem, it can be quite challenging to troubleshoot because of the high degree of interactivity of components that cannot be replicated on the ground.

Gaian Biological Systems
We marvel at the reproducing capability of nature, from microbes to flowers or us. These are Gaian systems. This is a large topic outside of the scope of PJ.

Soft Systems
A few examples of the abstract-realities described in The Triad section were banks, money, corporations or governments. These are soft-systems. For example, a bank will have a system in place to control (regulate) interest rates paid on invested money, and also a system to *regulate* interest charges on loans. These banking systems are designed to be responsive to feedback from the Federal Bank's prime rate and many other data. Governments still regulate many elements of society but have relinquished a significant level of corporate regulation, as described later. But these examples fail to meet the definition of systems for a variety of reasons including that they have no viable long term goal. This makes stability temporary at best.

An evolutionary improvement in manufacturing product quality was made in the 1950s, when Edwards Deming introduced Quality Assurance (QA) concepts to Japanese car manufacturers. Deming is an American professor and statistician. Deming's secret ingredient was *systems-thinking* applied to manufacturing processes. One change was to enable maximum local autonomy of the assembly line worker groups by inviting them to participate in producing the step-by-step written manufacturing instructions that they follow (greater autonomy). Quite often their hands-on experience gave insightful, time-saving steps that gave *feedback* to the engineers of the *Production Control* department. Also, instead

of having someone from the *Inspection Department* verify product quality at certain stages, every assembly worker was given greater responsibility for the quality output of their section. Daily statistical data of product quality data was posted in all assembly stage areas as *feedback*, so that all workers could view the results. This influenced worker pride and satisfaction within their increasingly *autonomous* group. Similar systems approaches were developed in all stages of the manufacturing processes.   Manufacturing companies using these techniques change from having just a *Quality Control* department, to being a *Quality Assurance* based company. Because local inspection was done at each stage by fellow assembly workers; and their work ethics improved because greater *autonomy* gave each section a sense of pride and responsibility. Human nature was considered as part of the overall system to reach the *goal* of a quality product.

The results were spectacular. Japanese manufactured products after WWII were considered poor quality imitations. After Deming's new *dynamic systems* approaches, the quality improved rapidly, and soon Japanese cars and other products were considered among the world's best. The principles Deming introduced are now used throughout the progressive industrial world. The techniques have been enshrined in the *International Standards Organization* (ISO) [R3]. When a company has received an ISO9000 approval, they are recognized has having adopted the ISO standards of quality-*regulated* manufacturing. If you buy their product, it will be of good quality.

The reason for elaborating on corporate quality assurance system is that the envisioned *Blue Dot Governance* (BDG) system of governance will use all of these concepts. One principal ingredient, *maximum autonomy and responsibility at the lowest practical level,* is reflected within the Regional governments who will form a chaordic type of organization to manage global affairs. We'll call this organization, the United Regions (UR), perhaps to be seen as the Wheelhouse of Spaceship Earth, a small blue dot when seen from afar.

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[R1]
The *System Dynamics Society* has an excellent description of dynamics systems and *systems thinking* at their web page: http://www.systemdynamics.org/what_is_system_dynamics.html
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Cybernetics and Systems Thinkers
http://pespmc1.vub.ac.be/csthink.html
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Who was Jay Forrester?
[http://en.wikipedia.org/wiki/Jay_Wright_Forrester]
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Stafford Beer http://www.metaphorum.org/

[R2]
"Cybernetics" comes from a Greek word meaning "the art of steering".
Cybernetics is about having a goal and taking action to achieve that goal.

Knowing whether you have reached your goal (or at least are getting closer to it) requires "feedback",
a concept that comes from cybernetics.
http://www.pangaro.com/published/cyber-macmillan.html
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[R3]
ISO 9001:2008 is the standard that provides **a set of standardized requirements for a quality management system**, regardless of what the user organization does, its size, or whether it is in the private, or public sector. It is the only standard in the family against which organizations can be certified – although **certification is not a compulsory requirement** of the standard.
http://www.iso.org/iso/iso_9000_essentials

<<End of section on dynamics>>