Space Settlement Design and Management: Entropy, Systems and Sub-Optimization

By Bob Krone, PhD

Entropy is an important concept from the thermodynamics of physics and astrophysics to describe the degree of disorder in a closed system over time. In closed thermodynamic systems, entropy will increase, resulting in a decrease of dynamics in the system, without the application of additional energy inputs across the boundaries of the closed system. Effort or energy expended to decrease entropy decreases the amount of ordered energy available in a physical system.

When dealing with thermodynamic systems, it is important to specify whether the system in question is closed or open. Some of the consequences that apply to closed thermodynamic systems do not apply to open thermodynamic systems. The mere act of such specification of boundaries amounts to an act of distinction-making (by a human observer) and its corollary—recursive distinction-making (RD)—as part and parcel of entropy increase. But recursive distinction-making, in itself, promotes creative patterning and generally acts to counter increased disorder.[1] Do we have a paradox in the making? I argue that we can attempt to control local entropy increases and even reverse these into negative entropy, under certain conditions.

It is likely that the Cosmos as a whole is an open system, with pockets of closed systems distributed therein, such that local increases in entropy are common. The imminent distribution of human settlements across the Cosmos calls into action attempts to help control entropy increases with such relatively closed systems.

We observe analogies of entropy phenomena in complex human systems as well, although it is more difficult to measure the true energy sources than with systems occurring in nature. Poorly managed human systems move from organization to chaos; from dynamic interaction to inadequate interaction; from vision, mission and goal focus to drift with wasted energy and resources; and from productive life to energy loss and progressive decline and failure. Weeds will dominate when our gardens lack wise attention. Life in Space takes the effect of entropy to another level.

Humans living in Space currently have no control over the natural forces of entropy in the universe. According to generally accepted cosmological theory, entropy in the universe will increase over time until life, as we know it, will be impossible.[2] Since that is

[1] The scientist responsible for discovering and researching the autonomous universal function of recursive distinction-making in nature is Dr. Joel Isaacson. See his feature article, "*Nature's Cosmic Intelligence*," in *The Journal of Space Philosophy* 1, No. 1 (Fall 2012) and his "*Letter to the Editor*" in this Spring 2013 issue (11-13).

[2] Existing entropy theory has a long history, commencing with the work of German physicist Rudolf Clausius in the 1850s and 1860s. See Rudolph Clausius, "On the Motive Power of Heat, and on the laws which can be deduced from it for the Theory of Heat," *Annalen der Physick*, 79 (March-April 1850): 368, 500 (Dover Reprint).

forecast to take millions of years, odds of other humanity extinction events occurring before the expansion of the universe builds entropy to the human extinction point are much higher.[3]

Strategic Design and Management provides methods to address these issues. One way to interpret the goal of Strategic Design and Management in any organization is to consider it the macro tool for continually creating and sustaining negative entropy, within its own system, to prevent organization failure. That interpretation applies to public or private organizations, to societies, and to civilizations on Earth.

This essay proposes the application of applying entropy thinking and analysis to the planning, and later creation, of human Space settlements. For human systems, as opposed to the natural astrophysics of the Solar System and Universe, there is the capability to control the means that produce ends considered good over time.

What is the optimum set of criteria for leadership needs, and for resource management tools to include in the design of "Good" (i.e., negative entropy) Space settlements?

Answers to that research question will require multi-discipline doctoral quality study (i.e., a mix of hard and soft sciences). **The recommendation of this essay is that such study be formally established on a global scope.**

Since the essay's purpose is to be more heuristic than prescriptive, I will end with a short list of components of that optimum set stemming from my personal experience:

1. Philosophy for the future of humans in Space. The Kepler Space Institute Team has created its preferred philosophy and founded *The Journal of Space Philosophy* dedicated to documenting global philosophical knowledge for the future. See Article #8 in *The Journal of Space Philosophy*, Fall 2012 issue, for the initial philosophy of Kepler Space Institute at www.keplerspaceuniversity.com.

2. The Systems Approach. Since universal acceptance at the middle of the 20th Century, The Systems Approach to thinking, to research, to analysis and to planning "*Is not a bad idea*."[4] In reality it has been universally accepted as a research, analysis, and planning model. Systems thinking has its challenges as well as its merits, but can avoid the pitfalls of sub-optimization of a complex subject into focus areas preferred by special interest groups and those in power, which automatically leads to unintended and undesired results.

[3] A large network of global scientists shares knowledge on the spectrum of human extinction possibilities, and documents "Safeguarding Humanity" at The Lifeboat Foundation, www.lifeboat.com. Scientific research into the scenarios that could cause the extinction of humanity only began in the late 20th Century. Prior to that, historians, like Arnold J. Toynbee, with his 1948 *Civilization on Trial* (Oxford: Oxford University Press), focused on why differing social-political entities rose and fell over time.

[4] This is a quote from the end of C. West Churchman's classic work, *The Systems Approach* (New York: Dell, 1968), 232. The literature on systems thinking in 2013 fills library shelves and databases

3. The Policy Sciences and Quality Sciences. After invention of the term Policy Sciences by Professor Harold Lasswell in 1951[5] and the Founding of the Science and evolving it to high academic standards by Professor Yehezkel Dror,[6] the Policy Sciences have matured to be the best knowledge sources for implementing Space Settlement strategies. The Quality Sciences, emerging after World War II have seeped into global public and private enterprises under the founding assumption that continuous improvement is the key to sustainable success.[7]

In my 1980 book, *Systems Analysis and Policy Sciences,* I summarized a need for the merging of those two academic disciplines as follows:

> Expanding the economic and mathematics based systems analysis of the 1940s to 1970s with the qualitative macro social orientation of policy sciences makes a quantum jump in complexity for the analyst but interjects a corresponding amount of realism. The analysis becomes difficult, less precise, but much more relevant to the real social and political world of human systems. This, in turn, makes policy recommendations and alternatives more feasible and acceptable to decision-makers and clients, as well as more effective in improving or designing systems.[8]

4. The Law of Space Abundance. In 2009, the leadership of the Kepler Space University formulated this law and defined it as: "*Space offers abundant resources for human needs."* Nothing happens without resources. Earth's resources are limited. Many are non-renewable. Space discoveries over the past 50 years confirm that Earth's needs for resources can be met from Space. In fact, without mining those resources in Space, humanity's long-term survival is doubtful.[9]

5. Humankind Spiritualism. This fifth essential component is best described by Pastor (Dr.) Lawrence Downing in Article 21 of this Spring 2013 issue of the Journal of Space Philosophy. I quote him from it:

> The human spiritual component has been part of space-life since humans first were propelled into space…. What form the spiritual component will take is quite beyond our scope to predict. What we can say is that the men and women who inhabit space will take with them the values, practices

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[5] Harold Lasswell, "The Policy Orientation," in *Policy Sciences*, ed. Daniel Lerner and Harold D. Lasswell (Stanford, CA: Stanford University Press, 1951).

[6] Professor Yehezkel Dror, Hebrew University of Jerusalem, was the Scholar largely responsible for the formulation and early growth of the Policy Sciences, commencing in 1965 and continuing to today, 2013. His many books and other works can be found through the Internet.

[7] For a review of the history and major subjects of the Quality Sciences, see Robert M. Krone, *Quality Classics,* www.asq711.org.

[8] Robert M. Krone, *Systems Analysis and Policy Sciences: Theory and Practice* (New York: John Wiley & Sons, 1980), 36.

[9] See Robert M. Krone, "The Law of Space Abundance and Lunar Cratersville," *AdAstra, The magazine of the National Space Society* 24, no. 1 (Spring 2012): 46.

> and beliefs that they held on earth. Likewise, the three philosophical questions await answer: Who am I? Where did I come from? Why am I here? These timeless questions will be part of the baggage space travelers take with them. Each is a spiritual question."[10]

Readers will recognize the qualitative nature of those five components. Design and quality management begin with ideas, but are incomplete without the inputs that science, technology, mathematics and commerce add to the essential quantitative inputs.[11]

HYPOTHESIS: Those five major components of a Space Settlement Design and Management Strategy form a needed set for creating and sustaining future human Space settlements. Reader comments are encouraged.

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About the Author: Dr. Bob Krone is the Co-Founder and Provost of Kepler Space Institute and University and the Editor-in-Chief of *The Journal of Space Philosophy.* His curriculum vitae is at www.BobKrone.com/node/103.

[10] *Journal of Space Philosophy* 2 no. 1 (2013): 87.

[11] Peer reviewers Dr. Lawrence Downing and Dr. Joel Isaacson provided valuable edits to the draft of this article.