Paper #128

The Failure of Systems Engineering as an approach toward Complex Adaptive Systems in our major Customer's Eyes:

Analysis of the Capstone Concept for Joint Operations and its relation to Meta-systems Theory

Kent D. Palmer, Ph.D.

SEEC Student

Box 1632 Orange, CA 92856, USA

kent@palmer.name

Abstract

Complex Adaptive Systems has become the predominate paradigm for understanding both our own joint forces as well as our adversary. Systems Engineering, however, lacks significant acceptance as a means for providing solutions to the problems that the customer faces. This paper will examine the customer's view of Systems Engineering in the Capstone document. In addition, a discussion of how Complexity Theory relates to Meta-Systems Theory will give added depth to this analysis.

An Important Quote!

"**What this framework is not.** This paper does not argue that most systems can be understood with anything resembling *certainty* or that systems are manipulated with anything resembling *deterministic mastery* or *precision*. ***This framework is not a call for a Systems Engineering approach to the conduct of military operations.*** The conduct of war will always be as much an art as a science. Although the systems approach is helpful in understanding the complex nature of a given target, it cannot account for all variables. A detailed understanding of most systems' elements and processes cannot be accurately mapped; much of their inner dynamics are opaque to comprehension. Systems will often exhibit unpredictable, surprising, and uncontrollable behaviors. Sometimes systems will absorb outside actions with little or no change in the system state, while at other times systems will submit to outside influences although the results will rarely be exactly as expected. Unintended consequences can be commonplace. Most systems will react to actions taken upon them. While some subsystems of military interest are essentially mechanical systems and will submit to analytical methods, most systems of military interest are not amenable to analytical or engineered solutions. End states will rarely be determinable in advance of operations. Instead, the Capstone Concept calls for a significant level of

> humility in expectations of certainty, precision and control. It argues for a framework that sees operations as learning – that is, military actions themselves become an experimental means of learning about a target system. Rather than being an engineered solution, a military operation evolves as a joint force while adapting responsively to the target system.[1]"

It is very interesting that the Capstone Concept for the Joint Operations document (hereafter called the Capstone document) mentions Systems Engineering. And here is the irony. Sometimes the document applies Complex Adaptive Systems to both the Joint Forces and its enemy, yet it says that Systems Engineering is not the right approach for the military implementation of those Systems. What we are seeing is a fundamental disillusionment with Systems Engineering as a approach to implementing these Systems, which seems to be based on experience with trying that approach. Yet when we compare the Capstone document to the former Evolving Joint Perspectives[2] document we see that the image of both *self* and *other* as Complex Adaptive Systems, or at least as Systems, has solidified. Thus, we can read this disclaimer in the appendix as saying that Systems Engineering does not seem to be enough, or the right approach, to the Systems as they appear in action on the battlefield, even though it does seem to be the right approach toward the production of *procured* systems to be used in combat. In other words, Systems Engineering is applicable to technological problems and solutions *off* the battlefield, but it does not merit status as an approach to using that technology in real life situations. Now we must remember that the military probably employs more Systems Engineers than anyone else, directly or indirectly, so this disillusionment is something that Systems Engineering (as a discipline) should take into account. Our customer is placing this statement of disillusionment in its highest document describing the Joint Operations. It is clearly stating that although they think that they are dealing with Complex Adaptive Systems, or just Systems, in most cases and in practice it has found that a Systems Engineering approach to those systems is the wrong way to conduct military affairs. Rather, Systems Engineering is only useful off line as a way to develop technologies that would be used in some other fashion on the battlefield. In my opinion our major customer's disillusionment with Systems Engineering as an approach to Systems should be taken seriously, and should be a point of discussion within the profession.

Premonitions Concerning the Problem

Of course, it is difficult to avoid dwelling on the fact that I have already described this problem in two previous papers which introduced Meta-systems Theory, a theory characterized as the dual of Systems Theory and the missing element in our Military's concept of Joint Operations. When I read the Capstone document it seemed to be crying out for an understanding of Meta-Systems, in spite of the fact that they have solidified their paradigm around the concept of Complex Adaptive Systems. Yet when you arrive at the appendix this cry for help turns into a rejection of Systems Engineering as an approach to Live Complex Adaptive Systems in the field. And so it is clear to me, and I hope that the reader will concur, that something must be missing in this equation. Of course, I believe Meta-Systems Theory to be the missing element. And the irony here, as I explained in another paper called "Anti-Terror Meta-Systems Engineering" at INCOSE 2002, is that our enemy, the 'so-called' Terrorist Network, has made this paradigm shift in understanding and utilizing the Meta-System. *They demonstrated to the whole world that if they can take a Meta-Systemic view*

---

1 DOD Capstone Concept for Joint Operations v. 2 August 2005, page C2

2 DOD An Evolving Joint Perspective: US Joint Warfare and Crisis Resolution in the 21st Century 28 January 2003, Joint Staff J7, Joint Vision and Transformation Division, See http://www.dtic.mil/jointvision/

of us, then they can use our own infrastructure to strike us. They demonstrated this to all our possible enemies on 9/11. But in the intervening time we have become more and more entrenched in the accepted paradigm of Complex Adaptive Systems as an extension of the Systems paradigm, which means we are still blind to the meta-systemic threat posed by our enemy. That means that they have made a paradigmatic leap but we have failed to learn that lesson so far, rather, we have become more entrenched in the paradigm that made us vulnerable in the first place, i.e. *thinking of everything as a System, and being blind to the meta-system dual of that System.*

However, our customer, who has been experimenting with different System approaches, found that Systems Engineering does not work on the battlefield. And I think that they would probably extend that to say that it does not work as the means of design for their own Complex Adaptive System which they hope to make into a more integrated, synergistic, and intelligent organization. In other words, I think they would say that Systems Engineering is acceptable in its place as a discipline that provides technological systems, but that it must be kept away from operations, in other words: 'Don't let Systems Engineers design and operate an intelligent organization.' This flies in the face of the fact that Systems Engineers feel that they *can* ostensibly design intelligent organizations. Organizations are made of people, not technological systems, and so the question would come up as to why Systems Engineers think they might have a successful chance at re-engineering organizations in the way they re-engineer technological systems. There is definitively a dark side to Intelligent Organizations[3] and Systems Engineers do not understand that dark side any more than they understand military operations. So the upshot of all this is that our view of ourselves and our customer's view of us are at odds, and to my mind that merely *reinforces my message that something is missing from Systems Engineering which I call Meta-Systems Engineering.* This deficit is both apparent in the Military's view of itself and its enemy, and in Systems Engineering's view of itself. Yet, what is amazing is that it is clear that our enemy has already understood this paradigm change by their actions, which means we are still vulnerable at a fundamental level even though we have already been attacked, already tried to adapt, and already tried to change in many ways as we continue to try and transform the military and the government. But you can't just change incrementally when you need a paradigm or episteme shift. You need to change radically, you need to employ Radical Knowledge Discovery[4]. Just because academia tells you that Complex Adaptive Systems is the wave of the future, and that it can be used to understand ourselves and our enemy, does not mean that this is correct. Perhaps academia has not realized that the real nature of the paradigm shift still needs to happen. Perhaps they are still giving you old news when they emphasize Complex Adaptive Systems while your enemy has a new way of looking at things and is operating in a different battlespace than you are currently imagining, although we have been hit multiple times from within that battlespace.

Making the Argument Clear

Once we get over thinking that we understand things and take a second look at what we thought we understood, we will then gain an insight that helps us to really understand what is going on. So let us take this argument from the top and try to understand this problem that has been pointed out in the Capstone document.

Systems Theory is just one schema out of many. In our culture everything is perceived in terms of Systems, whereas at previous points of our tradition everything was described in terms of Form. The problem with this is that it is nihilistic, because a term loses meaning when *everything* is defined in the same way. In our case, the nihilism stems from everything being defined as a System. If you want to know what a System is you have to look at all the other kinds of things that are like a System, i.e. at all different schemas. So, in

[3] Palmer, K.D., "Exploring Intelligent Enterprise System Limitations"
[4] Palmer, K.D., "Radical Knowledge Discovery and Emergence"

response to this I have developed a General Schemas Theory. Up to now, no one seems to have thought of our tradition in this way: Find all the schemas and compare them and try to find out how they are alike and how they are different. This has been the crux of my research project for the last few years.

Once the existence of the schemas was established, I became intrigued by the fact that there is a schema that exists but is not understood or acknowledged. I found it to be conspicuous by its absence. I termed this the Meta-System, because unlike all the other schemas, I could not find a single word for it in its universal meaning. 'Meta' means beyond and so the Meta-System is what is beyond the System. The Meta-System is also the strict inverse dual of the System, so you would think that someone would have noticed it before. I could only find one book that mentioned it explicitly as a Meta-System. But as my research progressed I found that it existed under many other names in social and scientific literature and so I started collecting these examples. At first I developed it by applying the Systems Theory of George Klir[5] in order to figure out what its Categorical Dual might be. As soon as I developed a rough sketch using a 'reversal of arrows' approach, I then went on to find other people who had had similar ideas but had called it by different names in different disciplines. Eventually a much clearer picture arose in my studies and I wrote a paper on Meta-Systems Engineering for INCOSE 2000. After 9/11 I realized that Al-Qaeda had realized the nature of Meta-Systems and were operating on the basis of that realization, and so I wrote a paper suggesting that we needed to use Meta-Systems Engineering as a way to fight back against the terrorist networks. Then it occurred to me that I should look at the Military Organization of our Joint Forces and see whether the idea fit there as well. I found that it was exactly the concept that our Joint Forces needed in order to realize their Self-Transformation. I wrote two papers about that in 2004 which I have published in 2007[6]. Then, upon researching what the DOD was now doing, I found the Capstone document which had solidified the paradigm of the Complex Adaptive System as a way of conceptualizing itself as a Joint Force as well as defining the enemy. Now I have nothing against Complex Adaptive Systems Theory, as such. Complex Adaptive Systems Theory takes Systems Theory and tries to extend it into much more complex systems. It extends into intelligent, living, social systems, as well as other very complex natural systems that border on the edge of chaos. But in order to make it useful to us we would have to posit its dual, which would be a Complex Adaptive *Meta*-System. In other words, the Systems Schema cannot describe the difference in the organization of Meta-Systems. Meta-Systems, as I have shown in my various papers, is a completely different schema which is nothing like a System, it is, in fact, the inverse dual of the System. So no matter how far we extend the idea of the System, there is a fundamental barrier to achieving an understanding of a Meta-System. To understand a Meta-System we have to undergo a schema shift. And if you are assuming that everything is a System, then that schema shift is also a paradigm shift.

So the next thing that we must do is to explain why a Complex Adaptive System is not a good model of a Meta-System, and why it is not even a good model of living, conscious, and social things, even though it purports to be. When we talk about Complex Adaptive Systems we will use the work of John Holland as our touchstone. He is the one who has tried best to explain the concept and to explore its implications. Holland has the additional benefit of inventing Genetic Algorithms and so he has a deep understanding of the problems that other authors might not have. But any one of a number of authors could be used as an example. If this explanation that I am about to give loses you, then please go read Holland. Complex Adaptive Systems are an extension of Complex Systems, which is an extension of Systems. Complex Systems are ones that are so complicated that we can only treat them globally because there are just too many elements and too many diverse relationships to treat them analytically. This whole area of study took off with the discovery by M.

---

[5] Klir, G. *Architecture of Systems Problem Solving*

[6] Palmer, K.D., "The Evolving Joint Perspective and Meta-systems Theory: A Case Study based on the Joint Vision Document," and "Toward an Intelligent Military Enterprise: An Introduction to an Approach to Joint Forces based on Meta-systems Theory"

Feigenbaum that Chaos has an internal order, and that symmetry breakings conform to a constant, both in math and in physics. Discovering that there was a hidden order in Chaos, i.e. really complex things that are impossible to understand, made it look as if we could understand Complex but not Chaotic Systems. So there have been many proposed approaches in the attempt to understand Complex Systems. There is the study of cellular automata, self-organized criticality, highly optimized tolerance, and other similar approaches. But all these approaches assume that there is a set of elements with a set of relations, and that if you understand that, then you have understood what is going on in the System. Of course the most interesting Complex Systems are those that are not only supervenient but also display emergent properties, which is another domain of study which attempts to understand how emergence arises within a complex system[7]. And it is here that the Complex Adaptive Systems come into play by showing how one could produce emergent properties with a set of agents through their seemingly intelligent interaction giving the illusion of life, or the illusion of social behavior. And so there is an active research program, which attempts to understand everything we could not understand with Newtonian approaches, and Simple Systems approaches.

Unfortunately this research program has certain assumptions that is thwarting its progress. The main mis-assumption is that everything is a System. Not everything is a System, there are other schemas out there, but no one seems to be interested in identifying them and comparing them. But when you do scrutinize the spectrum of schemas we can identify readily that there is a hole, because the inverse dual of the system is missing. For some reason it seems that our culture has a blind spot regarding this schema, despite the fact that many theorists have attempted to describe what it might be like. The best example of this is Bataille and his idea of the General Economy as opposed to the Restricted Economy of the System[8]. General Economies are another name for the Meta-System in the domain of the Political-Economy. Meta-System is just the more general name in the domain of Systems Theory, or what I now call Schemas Theory. It turns out that the Meta-System is crucial because of its duality with the System Schema, and it is as if these two schemas are the heart of the hierarchy of the Schemas. So if you do not understand Meta-Systems then it is as if you are completely lopsided in your understanding. It is the duality of the System Schema and the Meta-System that gives a basis for reasoning about things that we could not think about otherwise. Once you have isolated the Meta-System and realized its inverse duality from the System Schema then you can use it to analyze all sorts of problems that seem intractable otherwise. In my papers I try to do that type of analysis in different domains to show the usefulness of the concept of the Meta-System in relation to the System and other schemas as well. If you do that you suddenly have a vantage point. Outside of our obsession with the System Schema, it is possible to understand a few more things than what is understood by those who think that all there is are Systems, whether Complex, Complex Adaptive, or Emergent, or Chaotic.

What we need to realize is that this spectrum from System to Complex System, to Adaptive Complex System, to Emergent System, and then to Chaotic System is mimicked and inverted into a dual which would be: Meta-System to Complex Meta-System, to Adaptive Complex Meta-System, to Emergent Meta-System, to the Chaotic Meta-System. Once you produce the inverse dual of each of these extensions of the System Schema, then and only then do things start to make some sense. *In other words, without the duality we are lost. But it cannot be just any duality, it has to be an inverse duality, in other words we are not just creating a self-dual, but the dual must, in fact, be a real dual, i.e. there must be 'a difference that makes a difference' as Gregory Bateson*[9] *taught us.* So if we begin again and understand that there is not only Systems Engineering but also Meta-Systems Engineering, and that once we have taken into account all the schemas, we will then have Schemas Engineering; and when we focus on producing Emergence at any level of schematization we will then have Emergent Engineering, which should help us to realize that our discipline is something much

[7] Palmer, K.D., "Emergence and Complexity in relation to General Schemas Theory"
[8] Bataille, G. *Accursed Share*
[9] Bateson, G. *Steps to an Ecology of Mind*

broader than we imagined. Furthermore, this broader discipline does not have the problem of applying the System Schema to everything, and it does not think that merely extending the idea of the System will solve all problems and explain everything.

What the U.S. Military, indeed the entire U.S. government, needs to do is take a step back and look at their problems from this broader perspective. Once they do this they will realize that Emergent Engineering can help them, because Emergent Engineering understands multiple schemas and attempts to understand how to produce an emergent or de-emergent effect at all the various schematic levels. Now this calls for a paradigm shift, although that is not enough, because we also need what Michel Foucault calls an episteme shift. In other words, we need to understand that there is a Radical Knowledge Discovery[10] that is necessary to add to our Knowledge Management and Rediscovery methods, because only Radical Knowledge Discovery can comprehend the emergence of the radically new. This concept is missing from our Military's perspective and as a result we have not been able to make the shift that the enemy has already made which is thinking in Meta-Systemic terms. And so we would still have the same blind spot in spite of the demonstration of the efficacy of Meta-Systemic thinking. This paradigm shift is needed with the utmost urgency. No matter how adaptive, agile, etc. you are, if you do not know when the whole playing field has changed, then you are in trouble.

By not only making this duality explicit in Systems and Meta-Systems, but also explicit in the duality of their extensions, then we can suddenly understand why Systems Engineering does not work in operations and organizational design as well as we might hope. The point is that the Military's focus is usually on de-emergence, taking things apart and destroying them. De-emergence is what you get when you traverse from a System to a Meta-System. Emergence is what Systems Engineering specializes in with respect to one Schema, i.e. the System. Systems Engineering tries to bring emergent properties into being by applying emergent designs to produce new technological solutions that our customer can use. Many times these are weapons systems, i.e. Systems meant to be lethal and to wreak destruction. So, in one way, the problem with Systems Engineering is that it is the dual of what the Military wishes to accomplish. Now in the Capstone document it is recognized that in the global environment the Military has new responsibilities that include more than just destroying an enemy, instead they are sometimes performing humanitarian assistance, or disaster response. Sometimes they are engaged in pacification of an area or policing which attempts to stabilize and make an environment ready to be re-systemitized, i.e. to bring about new orders that are perhaps emergent. The Military is uncomfortable with these new roles in which they need to produce emergent effects rather than de-emergent effects. Thus we can see that Systems Engineering would be no help with a de-emergence production that moves from System to Meta-System. But, on the other hand, the Military is expected to extend its services to peace keeping and missions of stabilization. Yet, Systems Engineering can learn from the Military about the process of de-emergence, because de-emergence produces a Meta-System out of a System. In a way, Systems Engineering and Military Operations are duals of each other and because they are duals they can learn from each other. The reason that Systems Engineering is not good at producing organizational re-engineering is because the organizations are both Systems and Meta-Systems intertwined. You have to understand both sides of the coin to be able to do social and organizational re-engineering, because in that work you are creating Meta-Systems for human beings to operate in, which is something the Military knows more about than Systems Engineers, whereas the Systems Engineers' expertise is in how to create the technological infrastructure for those organizations. However, we have recognized recently that social needs should be more highly emphasized in the technological systems that we create.

[10] Palmer, K.D., "Radical Knowledge Discovery and Emergence"

Systems and Meta-systems

We have mentioned that Systems and Meta-Systems are duals. A more sophisticated way of describing them is that they are nested Systems and nested Meta-Systems and the two are interleaved. Systems are the emergent wholes greater than the sum of their parts while the Meta-Systems are the de-emergent wholes less than the sum of their parts, that is to say wholes with holes, i.e. with niches into which Systems fit; so the relationship between the System and the Meta-System is like the relationship between the Turing Machine and the Universal Turing Machine, i.e. between an application and the computer operating Meta-System on which the application runs. Meta-Systems have organization like Systems, but different. Systems do not exist only in a homogeneous plenum but in fact exist in an organized environment with a particular structure that is made to accept, give resources to, and to provide a medium for Systems.

Complex Systems and Complex Meta-systems

Complex Systems are those in which the number of elements and their types and relations are so large that we must treat them as a mass in order to understand them. Normally we would treat a system as a set of objects with the set of their relations. But when the system is too complex then we must treat it instead as a mass and look for the rules that the mass follows that give it a structure that we can understand from a global perspective.

Complex Meta-Systems can also be treated from a mass perspective. In other words if the environment is too complex to understand from a set perspective then it must be treated as a mass with global synthetic approaches rather than local analysis. Environments tend to be more complex than the systems they contain due to the diversity of the number and types of Systems that exist in the environment. So there is more of a tendency to treat an environment from a mass perspective than there is to treat a System from a mass perspective. That is why the Complex Systems Theory is novel, because it treats Systems from a mass perspective rather than from a set perspective which is not the normal method of approach. But we must make it clear that Complex Systems have Meta-Systems within them as well as being immersed in Meta-Systems due to the layered nesting between Systems and Meta-Systems. So there is some confusion since Complex Systems sometimes contain complex Meta-Systems within them as an environment for their sub-systems. The same is true for the Systems of Systems, i.e. Super-Systems, they also contain Meta-Systems which may be a complex structure which forms the medium for the Systems within the Systems of Systems. Thus there is some blending of the Systems and Meta-Systems' features in what is now called Complex Systems Theory. Sometimes we might be looking at the complexity of a Meta-System contained in a System while thinking that we are actually dealing with the complexity of its Meta-System. Thus, some balance between analysis and synthesis is needed, as well as set-like and mass-like approaches in order to distinguish clearly whether we are dealing with the Complex Systems or Complex Meta-Systems which are two different things but may be intimately intertwined. However, a key point in this is that Systems of Systems are not the same as Meta-Systems. There is a nesting of Systems at different levels of abstraction and containment, and there is a separate nesting of Meta-Systems at alternate levels of encompassing media, and these appear like the difference between the Russian dolls and the spaces between the Russian dolls. The spaces between them are the metaphor for the Meta-Systems which are not part of the normal consideration if we just look at the nesting of Systems at various levels of abstraction. Meta-Systems are normally missed unless we change our lenses to one that concentrates on the Meta-System instead of the System. But, of course, Meta-Systems and Systems interact because they are intimately related to each other, and one may hear of Meta-Systems effects being talked about as if they were part of the System, because normally the analyst does not recognize the existence of the Meta-System as something different from the System. This blending makes our concepts

vague, ambiguous, amorphous and generally produces something that is less intelligible than if we would carefully distinguish between Systems and Meta-Systems as a way of approaching a phenomena.

Complex Adaptive Systems and Complex Adaptive Meta-systems

Systems, with their emergent properties, as well as Meta-Systems, with their de-emergent properties, are not only complex, but also adaptive. Adaptive is just one feature that we might want to emphasize, others might be robust, or resilient, or agile. Such systems are called "*Self-* systems*" where the *star* "*" indicates a desired property of the system[11]. The point is that Complex Systems and Meta-Systems can have properties such as adaptability that are subtle and sophisticated and these need to be studied separately. These additional properties can be singled out with respect to the System or to the Meta-System because each has different properties, although some properties, such as adaptability, are highly desirable.

In the Capstone document these properties are identified for the Joint Forces as follows: Knowledge Empowered, Networked, Interoperable, Expeditionary, Adaptable / Tailorable, Precise, Fast, Resilient, Agile and Lethal. In previous papers it has been pointed out that in order to achieve 'jointness,' the Joint Forces are Systems that need to have prepared niches in which to operate and that the medium through which that conjunction (or 'jointness') can happen is within the context of the Meta-System. In terms of its boundary, the Meta-System can then be seen as a System-of-Systems from the outside; but on the inside, that System-of-Systems must have a Meta-System that makes it possible for the conjunction of the Joint Forces to operate smoothly together. If we think that there is only a blank plenum between the System-of-Systems and the Force Systems then we have missed something essential. Simply applying a System-of-Systems approach cannot make the Joint Force Systems operate together because the medium of their conjunction has not been developed as an environment for the co-existence and co-operation needed to produce the possibility of unified action. Note that the attributes that have been specified in the Capstone document combine those that are Systemic with those that are Meta-Systemic. For instance, Networked, Interoperable, Adaptable / Tailorable, and Resilient are Meta-Systemic attributes. On the other hand, Knowledge Empowered, Expeditionary, Enduring / Persistent, Precise, Fast, Agile, and Lethal are Systemic attributes. There is a vague recognition that there is a combination of these two features, but there is no theory to further analyze how some of the attributes relate more closely to a System while others relate more closely to a Meta-System.

Emergent Systems and Emergent Meta-systems

A System is normally Emergent, in other words it has the properties and characteristics of a whole that is more than the sum of its parts, like a gestalt. Meta-Systems are normally de-emergent in as much as they are normally produced by taking apart a System, in other words if we take apart the System-of-Systems in order to see the individual Force Systems from which it is made, then we will see how the Meta-Systemic medium holds them together to make it possible for them to interoperate efficaciously. This is a spectrum because it is possible to think of de-emergent Systems and emergent Meta-Systems as anomalous cases. A de-emergent System is one that functions when taken apart, like a rocket that loses its stages on launch. On the other hand there is also the special anomalous case in which a Meta-System is emergent where the whole that is less than the sum of its parts giving it an emergent function that would not exist otherwise; an example would be a sponge which is a whole full of holes. If the holes were not there it would not be able to soak up liquid and

[11] Palmer, K.D., "Self-Adaptation, Self-Organization and Special Systems Theory"

thus would not have the property that we value in a sponge. Actual systems that we create may need to go though phases of Emergence and De-emergence in order to produce unique properties as both Systems and Meta-Systems. There is a whole range of effects that can be categorized by understanding that emergence and de-emergence can apply both to Systems and Meta-Systems, but usually it is the System that is emergent and the Meta-System that is de-emergent, although that is not necessarily always the case.

There is a particular case in which the relationship between Systems and the Meta-systems can be illustrated. This will include Special Systems[12] which are organizational thresholds between the System and the Meta-system schemas. These Special Systems are partially systemic and partially meta-systemic. When you conjunct the Special Systems with a System, then you get a model of an External Emergent Meta-System, i.e. a Meta-System with emergent properties that it would not have otherwise. It is emergent because it has properties beyond those of the System embedded in it. But the reverse is also the case. Sometimes you can take a System and de-conjunct the Special Systems and thus produce the De-emergent Meta-System that it contains. It is de-emergent because you have lost the emergent properties of the system to reveal the field within it that supports its sub-systems. The opposite of this occurs when we subtract Special Systems from a Meta-System to produce an Internal System. In this case the System is de-emergent when the characteristics of the medium in which the System is suspended are lost. Another case is where we add Special Systems to a Meta-System to produce an Emergent Super-System. These four cases show how it might be possible to produce a theory showing that when we move from Systems to Meta-Systems, or vice versa, it is possible to get either emergent or de-emergent effects. Of these cases, the possibility that is of most interest is the Emergent Meta-System, because it produces the most counter intuitive results. Moving to a Meta-System and getting emergent effects is something we do not think is currently possible, and for that reason it has been a focus of my research. Moving from a System, to an External Meta-System, to a System-of-Systems is something we might understand because we are already talking about architectural frameworks for Systems that make Product Lines possible. These architectural frameworks are our way of talking about what is between the System and the System-of-Systems. Moving from the Meta-System to see the Systems within it is also something that we can understand fairly readily, just as we see operating systems running applications. But moving from a System to a Meta-System and engendering emergent effects is something that we have not previously thought of. And that is why the focus of my work has been on the anomalous possibility of the Emergent Meta-System that comes from adding the Special Systems to the System.

This augmentation and de-augmentation of the Special Systems act like the Godelian statements. For example, when you introduce a Godelian statement to a collection of parts it becomes a System with emergent properties, but when you deduct it, it then becomes a de-emergent Meta-System. The Godelian statements cannot be proven to be a part of the system as such. They are the statements concerning the emergent properties. We speculate that there is a fine chemistry-like discipline which considers the effects of appending and removing Special Systems from Systems and Meta-Systems in order to produce both emergent and de-emergent properties in each.

Chaotic Systems and Chaotic Meta-systems

An example of where emergence is more likely to occur, and where evolution is more likely to produce interesting phenomena, is near what is called the ‘edge of chaos.’ If a System or a Meta-System goes into chaos then we have basically lost control of it. At the edge of chaos there is a fractal boundary where interesting neg-entropic organizations can occur and evolve into more and more complex Systems or Meta-

[12] Palmer, K.D., “Reflexive Autopoietic Dissipative Special Systems Theory”

Systems that have interesting properties, some of which are life, consciousness, and sociality. However, the Meta-System tends more naturally toward chaos, and the System tends more naturally toward order. So this edge of chaos really has two frontiers, the System frontier and the Meta-System frontier. Or perhaps this is the same frontier looked at from two different directions. At any rate we have not yet studied the relationship between Systems and Meta-Systems at the edge of chaos and how that leads to evolutionary development in organisms, or other types of Complex Adaptive Systems. And we have not yet studied the subtle chemistry of the combinations of the Special Systems with both Systems and Meta-Systems of various kinds. But it is interesting to speculate about how Meta-Systems and Systems interact at the edge of chaos along with the partial organizational thresholds that exist between them. Both Systems and Meta-Systems fall into chaos or arise out of chaos by losing track of that edge of chaos where the interesting things happen, i.e. where there are subtle interesting organizational possibilities created that negative entropy can exploit locally, even though positive entropy is maintained globally.

We must remember that there are four factors that interest us in both negative and positive modes. There are both positive and negative forms of information, entropy, energy and matter. Negative energy and negative matter are unstable and anomalous forms that we normally do not encounter. But positive and negative information and entropy are very fundamental to our understanding of Systems and Meta-Systems on many levels and are not scarce phenomena. So even though our physics operates mostly with positive energy and matter, there is an aspect of physics that deals with negative information and negative entropy. In fact, even though we cannot create perpetual motion machines, we can, in fact, create perpetual information machines. Those machines make use of the chaos which produces an infinite amount of slightly differing information in strange attractors which we then use to model the edge of chaos where order and disorder mix in interesting ways. We now know that negative entropy is something that can only be created locally within a globally entropic environment. All Special Systems exist in this envelope of possible neg-entropic spaces far from the equilibrium energy and matter flows that are found on the way to chaos. Organization can be thought of as an ordering of information imposed on the physical structures of energy and matter. But what is not often mentioned is the fact that information can be negative or positive. We normally talk about positive information, but negative information is more than just a lack of information, it is a sort of zero information, or an information hole, but sometimes there is negative information, such as a secret, or an anti-organization of information that corresponds to a positive organization of information. We know about these negative types of information when there is a cancellation (such as we get in algebraic equations) which is analogous to the annihilation of matter and anti-matter in physics. Our point with all this is that Systems, for the most part, are composed of positive information that is organized neg-entropically. One thing that we might posit as a speculation is that Meta-Systems are normally organized as neg-entropic negative information. That is how the System and the Meta-System can meet in a niche. The niche for the System in the Meta-System is the place where the negative information of the Meta-System cancels or matches up synergistically with the positive information of the System. Now both the System and the Meta-System will degrade over time through entropy, and that will disorganize them globally. But the Meta-System degrades by the disruption of the neg-entropy that produces its negative information, and the System degrades by the disruption of the neg-entropy of its local positive information. The reason for positing this effect is to try to explain how it is that Meta-Systems hide from us. *One way to do this is to say that both Systems and Meta-Systems may have both negative or positive information, but that positive information predominates in the System while negative information predominates in the Meta-System.* So, for instance, in a System we might add anti-tampering or anti-exploitation devices to the design to hide its secrets, but in general, the System is made up of positive information. On the other hand the amount of positive information in an environment may be low compared to its negative information. Much of this negative information is stored in traces within the medium of the Meta-System and so it is not obvious that it is there unless we look carefully for it as the complement of positive information.

Meta-Systems are composed of source, origin, boundary and arena. They contain positive feedback in both the positive and negative directions. They contain singularities, and discontinuities. All of these phenomena that exist in the Meta-System can be seen as types of negative information. When we see the Meta-System as merely a homogeneous plenum then we are blind to the traces of negative information that the Meta-System may contain. The Meta-System can be full of strange attractors so that this negative information (in tandem with some positive information) can be generated perpetually with infinite difference. The System must evolve to keep up with the generation of infinite difference in positive and negative information from the Meta-System. And this evolution does not only deal with the interaction taking place with other entities (characterized as Systems) that may inhabit the same territory, the Meta-System forms a field within which all of these various kinds of Systems interact and exchange both positive and negative information. Just as a food chain allows an energy and matter flow to occur, the evolving System will produce not only weapons of predation, it will also produce camouflage. This suggests that the Meta-System is full of negative information in the form of dissimulation, and all this takes place within the 'great' Meta-System we call *Gaia*.

Meta-Systems and Systems and their extensions are inverse duals of each other. Once that is understood it is then possible to use the Meta-System as a basis for critiquing the Capstone document. I will refrain from that critique here because it is basically the same critique already performed on the Joint Vision document. *Here I will simply try to press the point as forcefully as I can that both Systems Engineering and the Military in their Capstone document have the same problem*. Everything is seen a 'System.' And if you think of everything as a 'System,' then you miss much of the phenomena that are right in front of you. The System is a projection, but instead of projecting the System we could project the Meta-System, or many of the other schemas. They are templates of understanding. If you project a different schema then you have access to understanding the phenomena in a different way. *If you project the same schema all the time* then you are blind to the things that the phenomena could tell you through different schematic lenses. If I could rewrite the Capstone document then it would say that there are many different schemas that may be used to examine phenomena for designing battlefield operations. One should use the schema that fits the phenomena best, and occasionally try different ones even if current projections are successful just in case something is flying under the radar. Then, I think we would resolve the Capstone document's critique stating that Systems Engineering does not work for operations planning and for execution, and by implication does not work for organizational re-engineering. Systems Engineering cannot work until multiple schemas (that exist under the purview of Emergent or De-emergent Engineering) are tried and tested. In my mind, what the Capstone document is really saying is that sometimes Systems Engineering fails us, and in those cases we need to revert from science to engineering, or from craft to art, because we don't have all the conceptual tools we need to understand everything that is happening. But if we offered them the full panoply of conceptual tools from Schemas Theory and applied them to Schemas Engineering, and if we showed them how to produce emergent or de-emergent effects at the various schematic levels, then this problem would vanish and they would realize that in Emergent Engineering, there will be, hopefully, conceptual tools and a discipline that the customer could trust. That discipline has a foundation, unlike the current 'want-to-be' discipline of Systems Engineering, which puts on conferences but does no serious and ground breaking research into the problem of its own groundlessness. If you want to be accepted as an academic discipline, then you have to bring something to the university table that does not exist there already. Complex Adaptive Systems already exist in various disciplines. *We* are just discovering it, but it is not new to academia. But because Complex Adaptive *Meta*-Systems are new, and so it appears that Academia has the same problem as the Military Industrial Complex which is that they can only see 'Systems' and are blind to Meta-Systems. Thus, once Systems Engineering understands that its foundation is at least partly in General Schemas Theory, it can then introduce Meta-Systems to academia, as well as Special Systems, and Emergent Meta-Systems.

Complex Adaptive Systems cannot really model living[13], conscious[14], and social[15] creatures because it has the wrong model and neither Systems nor Meta-Systems are the correct model for that. In this case what will work is something in between them called the Special Systems[16]. If you cannot completely model living conscious social beings with Complex Adaptive Systems, then how are you going to use that as a basis for organizational engineering, or as a basis for understanding human beings that are opposed to you, who are working in social groups, who are intelligent and responsive and adaptive as you want to be, but perhaps cannot be because you are hobbled by an outmoded paradigm that your Enemy has already given up?

Resolution

I have pointed out a position in the Capstone document that I think all Systems Engineers should take seriously. In various papers I have tried to present an alternative approach that may resolve this problem. I am suggesting that we give this new paradigm a chance to work. Can we resolve this aberration in our major customer's view of us? Can we understand who we are? If we can understand who we are, i.e. not Systems Engineers, but Schemas Engineers, and ultimately Emergence Engineers, then we can help the customer understand how to fight our new Enemy, who has already made this leap into Meta-Systems thinking. And ultimately we can help the entire academic community which we want to join and be a respected member of. We need to build emergent technological artifacts, and when we test and integrate those artifacts we must recognize that we run straight into the Meta-System. But that Meta-System is not the same one that the customer sees in actual operation. The System in operation that the customer sees usually involves extracting a de-emergent effect from the emergent capability, i.e. the emergent capability of the System that we have produced. Hopefully, we can eventually show them that we understand at least part of the foundations of our own discipline, and how it will affect their understanding of their disciplines.

What I think we need to understand is that all enemies of the United States have been taught a lesson in Meta-Systems by Al-Qaeda. It is not as if we got rid of Al-Qaeda that the *war on terror* will suddenly be over. As long as we are a global power, the main global power, then others will be gunning for us. And jointness is not enough if you are on a different playing field than your opponent. They are playing on a field that includes Meta-Systems. We are playing on only half the field because we do not recognize Meta-Systems and quaintly think there are only Systems, even after an enemy used our infrastructure against us on 9/11 and showed us that we cannot protect our own Meta-System. In Iraq the insurgency has effectively prevented us from building an infrastructure there despite our spending hundreds of billions of dollars. The Meta-System is the key. If we pick up that key and use it then we will be able to understand and think like our enemy. If we do not pick it up then we will always be hit from somewhere unexpected by an enemy that understands this concept well, as they have demonstrated many times. But we continue to ignore this. It takes a schema shift to understand that our assumptions of everything as a System is wrong, and thus we need a paradigm shift, as well as an episteme shift because we need to be able to see the emergent event when it occurs. It is clear that the emergent event of 9/11 has still not been understood clearly by our Military, since they are still using the System Schema as the be all and end all of their understanding of themselves and their foes.

It is incumbent upon the System Engineering community to transform just as the Military has been trying to do, but we must do this in terms of our understanding of our own foundations so that we can help the Military understand this new world that they know they have entered, but cannot yet see clearly because they

[13] See Palmer, K.D. "Defining Life and the Living Ontologically and Holonomically"
[14] See Palmer, K.D. "Holonomic Theory of Consciousness"
[15] See Palmer, K.D. "Possible Grounds For A Reflexive Sociology"
[16] See Palmer, K.D. "Reflexive Autopoietic Dissipative Special Systems Theory"

don't have all the conceptual tools they need. We have those tools in the concept of General Schemas Theory as part of the foundation of our discipline. But we need to quickly understand the advent of this newly claimed foundation, validate it, and then use it to help our customer in his work. The customer generally uses our emergent technologies to produce de-emergent effects. But we should also be able to engineer Meta-Systems so that we can demonstrate how to use de-emergent fields to create emergent effects. If we could do both things then the customer could become more comfortable with his organization and infrastructure stabilization and building role, and we could become more comfortable with understanding the environments where our technological systems will be used. Perhaps then we might change the implied opinion that we are only useful for building technological Systems but unable to create, plan, or execute an intelligent organization.

A community that has a scientific bent is always on the outlook for new ideas, and when it finds those new ideas it examines and tests them for their strengths and weaknesses. It is a community with an active research program. It is a community with a vibrant debate. We need to become an intelligent community that recognizes a weakness when it appears in our customer's most important document, and address it by looking at ourselves carefully to find out what is lacking that would cause this perception. Could it be that we have no foundations for what we are doing, and therefore we are reduced to trial and error, and because of that we can only sit on the sidelines while the real players play the game? Now we may think of ourselves as being on the sidelines, but if our customer does not perceive us as being an important resource during the game then there is a perception problem. There is the perception that we are not part of the game, and not useful when the game is being played. What will it take to turn this perception around? I think it will take a revolution within our discipline that makes Meta-Systems Theory equal to Systems Theory in our eyes. I think it means changing the name of the discipline to recognize the importance of all the Schemas. I think it means making Emergence, and its dual, De-emergence, the *center* of the discipline.

References

Bataille, G. *Accursed Share* Zone Books Volumes 1-3, 1991, 1993.

Bateson, G. *Steps to an Ecology of Mind: Collected Essays in Anthropology, Psychiatry, Evolution, and Epistemology*. University Of Chicago Press. 2000.

DOD *Capstone Concept for Joint Operations* v. 2 August 2005

DOD *An Evolving Joint Perspective: US Joint Warfare and Crisis Resolution in the 21st Century* 28 January 2003, Joint Staff J7, Joint Vision and Transformation Division, See http://www.dtic.mil/jointvision/

Foucault, M., *The Order of Things*. Routledge. 2001.

Holland, J., *Emergence: From Chaos to Order*. Perseus. 1999.

Holland, J., *Hidden Order: How Adaptation Builds Complexity*. Addison Wesley. 1996

Klir, G. *Architecture of Systems Problem Solving.* Springer. 2003.

Palmer, K.D., "Autonomic Systems and Special Systems Theory" http://holonomic.net

Palmer, K.D., “Defining Life and the Living Ontologically and Holonomically” ISSS 2000

Palmer, K.D., “Emergence and Complexity in relation to General Schemas Theory” CSER 2008

Palmer, K.D., “Exploring Intelligent Enterprise System Limitations”, INCOSE 2007

Palmer, K.D., “From General Systems Theory to General Schemas Theory,” ISSS 2004

Palmer, K.D., “General Schemas Theory,” CSER 2004

See Palmer, K.D., “Holonomic Theory of Consciousness” http://archonic.net

Palmer, K.D., “Meta-systems Theory” http://holonomic.net

Palmer, K.D., “Meta-systems Engineering,” INCOSE 2000

Palmer, K.D., “Ontological and Knowledge Emergent Engineering of Systems and Meta-systems based on General Schemas Theory” http://holonomic.net

Palmer, K.D., “Possible Grounds For A Reflexive Sociology” Social Theory Consortium 2003 http://archonic.net

Palmer, K.D., “Quantum Games and Meta-systems Theory” http://holonomic.net

Palmer, K.D., “Radical Knowledge Discovery and Emergence” http://holonomic.net

Palmer, K.D., Reflexive Autopoietic Dissipative Special Systems Theory” http://works.bepress.com/kent_palmer

Palmer, K.D., “Self-Adaptation, Self-Organization and Special Systems Theory” http://holonomic.net

Palmer, K.D., “The Evolving Joint Perspective and Meta-systems Theory: A Case Study based on the Joint Vision Document,” INCOSE 2007

Palmer, K.D., “Toward an Intelligent Military Enterprise: An Introduction to an Approach to Joint Forces based on Meta-systems Theory,” http://holonomic.net

Biography

Kent Palmer, Ph.D. is a Systems Theorist and Systems Engineer. His Systems Theory research website is at http://archonic.net. His new Ph.D. research website in the foundations of Systems Engineering is at http://holonomic.net. He is a student at the University of South Australia System Engineering and Evaluation Center (SEEC).