Anti-terror Meta-systems Engineering

Pre-emptively using holonomics and deviant logics to think through the vulnerabilites of the technological meta-systemic infrastructure

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Abstract: The major terrorist incident of 2001 in the USA is used as an example of the relationship between the *system* schema and the *meta-system* schema to show why understanding Meta-systems Engineering beyond conventional Systems Engineering is, now more than ever, a necessity.

FROM SYSTEMS ENGINEERING TO META-SYSTEMS ENGINEERING

In earlier papers[1] I have tried to explain a new paradigm and perhaps a new episteme, if not a new ontology, for Systems Engineering practice. One way of understanding this new approach is to use the extreme nihilism of terrorism as an example. In order to illustrate this approach it is necessary to move from what is known as Systems Engineering to something I call 'Meta-systems Engineering.' Meta-systems engineering is the complementary inverse-dual of Systems Engineering. It not only looks at the system as a social gestalt, "a whole greater than the sum of its parts," but also examines the environment, or an ecosystem of that system which is full of *other* systems that often interact in unexpected ways through the medium of the meta-system. That inverse-dual is what appears to us as a *whole* <u>less than</u> the sum of its *parts*. It is a whole filled with holes[2], or niches, that systems fit into. Sometimes, we attempt to talk about this using the phrase "system of systems". But, in effect, this merely posits the same schema, the "system", at another level of abstraction which hides the meta-system. Meta-systems are very different from systems. They are essentially different ontological schemas that can be used for looking at things around us. Systems are unified syntheses while Meta-systems are deconstructed fields that are the background to systems which remain both perceptually and conceptually invisible for the most part, until the system breaks down. When the system does break down, then as Heidegger says, this background becomes highlighted. That is what has happened in the wake of the terrorist attacks. This invisible background, where safety and security are achieved or lost, has come to the fore as an all-important issue.

TOWARD UNDERSTANDING NIHILISM IMPLICIT IN THE TECHNOLOGICAL SYSTEM

Meta-systems are disunited, detotalized totalities[3]. They are fields within which systems take shape and interact. One kind of system is the air travel system. Another kind of system is urban high-rise office complexes. We know that a plane might accidentally fly off course and hit a high building so we control traffic routes and place lights on the buildings to make them, in effect, light houses in the sky. Yet in all our safety and security planning we did not think of the diabolical connection between a car bomb and a high-jacking, two anti-technologies that, when put together by the hands of terrorists, who realized an undesired side-effect of our own designs, made possible a catastrophe of gigantic and horrible proportions. We merely failed to think broadly enough when we created our designs of these technological systems. We could have installed reinforced secure cockpit doors from the beginning but it did not occur to us. Until this happened, even if such reinforcements had existed, the crew would have opened those doors in order to deal with the terrorists, because the pilots would have assumed that the terrorists would not be able to pilot an aircraft themselves, and that they would ultimately want to live. When we design systems we do not tend to think about the environments or eco-systems that those systems will inhabit; especially extended environments like the entire technological infrastructure of our society and the

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[1] See http://archonic.net

[2] like a sponge in the most simple case

[3] See Sartre's <u>Critique of Dialectical Reason</u> (London ; New York : Verso, 1991) for the use of this phrase "detotalized totality" to mean the deconstruction of the project of totalization.

geo-politics of the world. Also we don't effectively plan how we deal with the side effects of our technological system. Thus the side effects come back many times to haunt us, causing problems that are deep and difficult to resolve, like the problem of global warming for instance. Unforeseen side-effects from an interaction of multiple systems that were all designed independently are also a large source of problems in our society, such as the catastrophe we have just experienced. Thus, Systems Engineers are called upon to make our systems more difficult to infiltrate, and more inter-operational, with better security and fewer safety gaps. Because there are probably so many possible ways of using the technological infrastructure against itself, we realize that it is impossible to plan for or to design around them all. And this brings us to the deeper problem, the problem of nihilism which is at the heart of technology itself. This was observed by several different philosophers such as Nietzsche and Heidegger as summarized by P. Fandozzi, in his book Nihilism and Technology[4]. The myriad views of the technological system and infrastructure that could expose all these vulnerabilities demonstrate a need for a much more sophisticated level of Systems Engineering that I will define as Meta-systems Engineering. We have had Specialty Engineering before, but now that part of our discipline needs to increase its vigilance a hundred fold in order to produce the kinds of robust systems that can reduce our vulnerabilities. As these systems are being designed, what is called for is a further splintering of viewpoints and an intensification of the gaze from those viewpoints on the technological system itself as well as its infrastructure. That in itself could be seen from a philosophical viewpoint as an intensification of nihilism. The nihilism of our enemy works on us because it causes an intensification of the very splintering that we need to do in order to produce the systems themselves. In other words the terrorism is a latent possibility within the technological society. *In fact, it comes from the technological society.* Historically, terrorism was first used in Europe against other Europeans in the same manner that it is still being used today. Terrorism is defined as a leveraged use of technology that will produce death and destruction by so called 'illegitimate forces' rather than by state institutions. These illegitimate forces believe they have nothing to lose in their fight against state institutions or the societies that support these state institutions.[5] This

misuse of the power of technology is an inherent possibility in the proliferation of the technological system. *The technological system works on the basis of the fragmentation of viewpoints. The extreme of terrorism merely intensifies this fragmentation by creating yet more viewpoints from which we must consider our designs in order to fend off the misuse of the technological system. There is an endless escalation in that splintering of viewpoints and that is the inherently nihilistic aspect of technology itself.* The system as social gestalt is the focus of the myriad viewpoints, while the meta-system is the fragmented origin of those viewpoints. Increased intensification of the gaze and the multiplication of the viewpoints causes us to shift our interest from focusing on the *system*, to focusing on the *source* of the splintered viewpoints, which make up the meta-systemic fabric that encompasses the various viewpoints within the environment of the system. We are ultimately forced to wonder if intense vigilance from a myriad of disciplined points of view is sustainable. We cannot watch everything all the time. We cannot consider all the possible misuses of technology. We are ultimately going to have to accept some level of risk. The question is how much risk will that be in an environment where diabolical illegitimate forces are running amok[6].

SCHEMA THEORY AND SCHEMA ENGINEERING

One way to approach this effort is to change our understanding of Systems Engineering and to attempt to increase our sensitivity to the environments and the ecologies *surrounding* our systems, which are fundamentally different from the systems themselves. I will refer to these surrounding environments and ecologies as "meta-systems[7]." We need to do this anyway because of global environmental concerns. Now we have a new reason to consider the hidden interstices between our designed systems, which are built to promote safety, and security, and we need to make our systems more robust in the face of threats from terrorists. 'Meta-systems Engineering[8]' leads us

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[4] (Washington, D.C. : University Press of America, c1982)

[5] The use of terror by states will not be considered here, but this is perhaps the most controversial aspect of the subject, because in that case the 'illegitimate forces' become, in the eyes of some, 'freedom fighters'. This poses a question of the definition of 'terrorism' and the ethics of revolt against oppression which, for the purposes of this paper, is not considered because it leads directly into paradox, vicious circles and absurdity if not insanity. However, it should be noted that

the label 'terrorist' can, in the wrong hands, be the excuse for prosecuting a campaign of terror. This should lead ultimately to a discussion of fascism in the sense that this word was used by Foucault in his introduction to Deleuze and Guattari's Anti-Oedipus.

[6] Legitimate forces for the purposes here are those who declare in the name "We the people . . ." and so constitute themselves as a nation through constitution and law. Legitimate forces seek to impose order within their domain and only use the means of police action or war when that order that serves the greater good is threatened.

[7] Here the META means **_beyond_** the boundaries of the system rather than a logically higher type of system. It is another schema at the same level of logical typing which is the inverse-dual of the system.

[8] See INCOSE 2000 paper by the same author of that title.

beyond the schema of the 'system' into a hierarchy of several different schemas that are all different and unique ways of organizing and understanding what we find in nature.

In general this calls for the development of what I have called Schema Theory, and its practical application, which can be called Schema Engineering. In this case the set of schemas are ontological levels of order that we project onto the ontic[9] world beyond ourselves. The schemas I have in mind are as follows:

Pluriverse[10]
Kosmos[11]
World[12]
Domain[13]
Meta-system[14]
System[15]
Form[16]
Pattern[17]
Monad[18]

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[9] The word "ontic" means: at the level of things or beings, rather than at the abstract level of Being, which is "ontological."

[10] See David Deutsch's The Fabric of Reality (Allen Lane, The Penguin Press. 1997). The pluriverse is the intersection of all existent universes. This schema is beyond our experience.

[11] The Kosmos or Universe is the subject of scientific exploration. This began at the dawn of the Metaphysical era with the work of Thales and Anaxamander. Anaximander was the first to write prose, the first to create a model of the cosmos and a map of the earth. This schema is beyond our direct experience.

[12] The world has been defined by Heidegger as the furthest horizon of our direct experience. Husserl called that the lifeworld. The world is the coherence of everything that we experience.

[13] The world that encompasses everything is splintered into domains or disciplines that have different perspectives on phenomena.

[14] Also this schema might be called the "archon" because we have no appropriate term for it. It is comprised of contexts, situations, milieus, environments, ecosystems, etc. They are fields within which systems arise and interact.

[15] Perceptually this is the level of the social gestalt characterized as a whole that is greater than the sum of its parts composed of figure and ground. Usually it is defined as a set of things and their interrelations or interactions. But this definition is analytical and does not account for the wholeness of the system. See N. Rescher in Cognitive Systematization (1979, Oxford Basil Blackwell / USA Rowman & Littlefield), who considers the organic metaphor that grounds our idea of systems.

[16] External shape of an object. This level includes not just the external shape but also its behavior as in Object Oriented design. A good example of work done to define this schema is G. Spencer-Brown Laws of Form (1969; Allen and Unwin, London)

[17] Value, Sign, Flux and Structure are various kinds of patterning of content. This is the lowest level of our experience and is dependent on the lowest level of articulation by our instrumentation. Both G. Klir in Architecture of Systems Problem Solving (ASPS) (1985, Plenum Press, New York) and U. Grenander Elements of Pattern Theory (Baltimore: John Hopkins, 1996) have done work to define this schema.

Facet[19]

This hierarchy of schemas illustrates the various *models of order, or organizations,* that we project into the phenomena we apprehend. The phenomena in itself has various levels of emergent ordering which we discover through the projection of these schemas. I am not saying that these are the only schemas, or that the schema hierarchy is exactly ordered in this way. This series is an example, a trial model that shows how the nesting of schemas could be ordered. What we really need to do is to research this inward horizon and attempt to determine the nature of these schemas and how they differ from the ontic ordering of the phenomena that is discovered by science. *Science discovers the emergent ontic hierarchy in Nature through a rebound from the projection of our schemas*, i.e. through the anomalies that show up in the aftermath of the projection of the schemas onto phenomena. For the most part we tend to mix up our schemas with the actual *discovered ordering* of the phenomena. We assume that systems are "out there" in nature and we forget that they are *imposed organizations.* In other words, our minds and perceptual organs have a natural harmonic inbuilt ordering that is projected on all phenomena. We normally think that our seeing and understanding is neutral so that the projected order becomes hidden in the midst of the different discovered order, when in actuality we need to separate the projected order from the mix of orderings so that we get a view of things that does not have an anthropocentric bias. Schema theory is a way for us to make that separation while it can also serve as a theoretical guide for Systems Engineers to design systems, meta-systems, domains, and worlds. Our designs are based on the schemas we project as the context and content of whatever we are focused on creating. At its core our design is a system of embodied projections, thus the schemas are the basis of our Engineering work. Therefore, to understand our own design processes it is important for us to understand these schemas that are the basis of our projections that give coherence to our designs.

We tend to think of mathematical categories as the basis of our designs and as the basis of our perceptions of order in nature. But in the last fifty years or so a new kind of Mathematics called Model theory has shown us the important relation between universal algebra and

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[18] The datum of the content itself at whatever level of resolution. This is the limit of our direct experience.

[19] The facet is beyond our direct experience. It is an inner determination of difference within the phenomena itself, seen within itself without the projection of our schemas. Thus this is the null schema. It is the difference beyond the resolution of our instruments.

logic. This allows us to begin to mathematically model the models and theories that underlie our mathematical understanding. Schema's theory is something of a higher order beyond the models and theories of mathematical categories. In fact, schemas inhabit a middle ground *between* these theories and philosophical categories. Aristotle and Kant developed the most famous tables of philosophical categories. As a starting point, I prefer the modern category theory of Ingvar Johansson articulated in his book <u>Ontological Investigations</u>[20] which is based on the <u>Logical Investigations</u>[21] of Edmund Husserl. It is an attempt to articulate the highest concepts and their differences and interrelations. Schemas are particular constellations of these highest concepts, such as the difference between quality and quantity, unity and totality, etc. existing in fundamentally different emergent orders. Beneath the level of the schemas are the concrete theories that we produce in science based on the implicit ordering of the schemas that we project onto nature and ourselves. Philosophical categories and Schemas are important to understand in order for us to comprehend the relation between our *theories* of phenomena and the phenomena itself. Now, the phenomena always goes beyond our schemas, but the schemas are the basis for our understanding the phenomena. It is in the difference between the implicit schemas and the anomalous violation of their categories that cause our theories to actually reflect the world. But, on the other hand, our design work is directly founded on the assumption of the schemas and, ultimately, the philosophical categories. What we want to do is to expunge all anomalies from our systems designs and their interaction with the real world. If we did not have the schemas behind our designs we would falter because our designs would fail to have inner coherence. We might have multiple theories or designs from various perspectives, but the schemas provide a bridge between the various theories and the designs by providing an underlying unity of understanding, which is, in turn, based on fundamental concepts created by the mind. If it were not for the schemas and categories implicit in our conceptualization of the designs and theories of phenomena, we would not be able to communicate rationally with each other. Understanding the foundations of rationality is the first step in comprehending the irrational.

THE TECHNOLOGICAL SYSTEMS AND THE TECHNOLOGICAL INFRASTRUCTURE

Systems Engineering needs to disentangle its projected schemas from the phenomena; for example, projections such as our assumption that no one would want to hijack a plane and commit suicide by intentionally flying it into a tall building. We unknowingly built this assumption of basic humanity and rationality into the designs of our technological infrastructure. In each case our view of what we were building stopped at the aviation system and at the urban building system. We did not think of the *system of systems* that included **both** views. We need to include a view of our vulnerabilities with respect to those others who do not share our fundamental assumption that life is preferable to death, and our assumption that intentional mass murder is unthinkable. Now we have to rethink all our systems in terms of the "system of systems" to which they belong. When we say "system of systems" we are actually projecting a *nesting of systems within systems.* However, by doing that we must also consider something implicit -- another schema that lies above that of the system in the ontological hierarchy. Just as there is a form represented as a figure on the background in the whole of the gestalt, there is a deeper background on which the gestalt of the system is seen. That deeper background is called the *proto-gestalt* when viewed perceptually, and it is called the meta-system when thought about conceptually. The meta-system is what comes from thinking of the notion "system of systems," not in terms of the nesting of the same schema inside itself, but in terms of taking the system to its meta-level, i.e. beyond itself to a new level of emergent organization that is different from the system. "Meta" can mean either above or beyond. Here we use it in the sense of beyond, but beyond to something different, a different level of theoretical organization that lies outside the system, as it becomes the complimentary inverse-dual of the system. This, 'taking of the system to its meta-level,' where we are talking about an essentially different structure, needs to be further explored in terms of its significance to Systems Engineering.

If we merely look at the nesting of the systems within the higher order system, for example the air transportation system and the high-rise office buildings of the urban system within the greater technological infra-structure, then we are going to miss the essential features of the landscape of the infra-structure that only theories based on meta-systems can comprehend. Meta-systems do not work like Systems. We know this as a result of our development of computer software systems, because there we explicitly developed meta-systems called "operating systems[22]" within which the various lower level systems we call "applications"

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[20] (Routledge, 1989) See http://hem.passagen.se/ijohansson
[21] (Routledge 1970)

[22] perhaps meaning "systems that operate systems." i.e. meta-systems.

inhabit. The infrastructure is not merely a passive landscape that holds the various large scale technological systems. Rather, the infrastructure is more like an 'operating system' that provides resources and an arena within which these other large scale technological systems interoperate. *The paradigm shift that we saw in the terrorist attack of September 11th 2001 is a result of the realization that certain people understood the interdependency of technological systems in a way that the designers never dreamed of.* They saw that they could easily introduce an anti-technology into the vulnerabilities of the designs of the technological systems, *because the meta-system was left undesigned.* This is a general problem within the entire technological infrastructure of the world. The technological infrastructure, understood and defined in terms of a meta-system, was left undesigned. Why? Because we cannot see it with our theoretical or design gaze. This is because we have no general theory of meta-systems other than that which are given by the discipline of ecology. And, in that case, we are talking about the *meta-system of nature* and **not designed meta-systems** such as we see in the "operating systems" for computer software applications. The term "operating system" is unfortunate because it suggests that its object is a system schema, when in fact it is another kind of schema all together. And that schema is the complementary inverse-dual of the system schema, i.e. the meta-system. The relation between the system and meta-system is precisely the same as the relation between the Turing machine and the Universal Turing machine. A Universal Turing machine is an "operating system" for Turing machines. Universal Turing machines make it possible to read Turing machines from the tape of a Turing machine while instantiating them one after another. In this sense there is a Turing machine inside another Turing machine. This nesting is not just a system inside another system but has another 'implicit sense' in which the coherence of the *nested schema* inside itself has a different essence from the *un-nested schema*. Saying the word "system" twice in "system of system" actually produces something quite different from the system not involved in such a nesting. This is what Godel discovered in his famous "incompleteness proof." His proof counts mathematical elements, meaning that it turns the counting system against itself and shows that systems are intrinsically incomplete, and that there are undecidable statements that cannot be placed definitely inside or outside the system. Some statements of a formalism stand undecideably right on the boundary of the system. This is seen in the foundations of the formal system itself where different variations of a single axiom produce complementary formalisms. Incompleteness at the boundaries, and the complementarity of the axioms of these formal systems hints that meta-systems do exist

where we try to bend back the system on itself, either at the level of axiomatic origins or at the level of the boundaries of the system.

Think of it this way. A system has an inside and an outside. The inside of the system is in effect the complementary inverse-dual of the outside of the system. When you place a system inside another system, then the outside of the system has a very different relation to the inside of the encompassing system. Suddenly when the system is within an environment of the encompassing system it is experienced as a meta-system. *Meta-systems are like the turning of the system inside out, or better yet like the deconstruction of the system into a field.* Nietzsche posited that Subjects are Objects turned inside out. Similarly, at a different schematic level, meta-systems are systems turned inside out. We refer to the discipline that looks at the duality of systems and meta-systems as *holonomics*, after the *holon* of Koestler which is both a part and whole at the same time. The system within the meta-system is a whole greater than the sum of its parts situated within a whole less than the sum of its parts[23].

We have not made a significant paradigm shift in our perceptions or conceptions that would allow us to view the complementary inverse-dual of the "system" schema. Yet, terrorists have managed to do that. *The unimaginable quality of their deed comes precisely from making that shift.* So now we need to make that shift ourselves, in order to counter their intent as best we can. We need to begin to design *the meta-system of the technological infrastructure*, rather than merely considering it a 'system of systems,' which means considering it in terms of the outward aspects of one system within the outward aspects of another system. When we do that we miss the field-like qualities of the meta-system that flows in between the two nested systems. Rather, when we look at our own technological infrastructure we need to explicitly concentrate on those features of the meta-system that are normally hidden from our design or theoretical gaze. We need to understand the essence of *meta-systems* and how they are different from *systems*. Until we understand this difference and use it to see the vulnerabilities that are normally hidden to us, then we will remain vulnerable. The technological infrastructure needs to be redesigned as an "operating system" for the various technological systems that it comprises rather than remaining a passive undesigned landscape which is merely the hinterlands between the various designed systems. *It is in these hinterlands and in these interstices that the terrorist has learned to strike.* We

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[23] See the paper 'Meta-systems Engineering Futures' for more information on holonomics at http://archonic.net

must learn from our experience in designing space-worthy environments, where every gap is seen as a possible weakness for the breach of the atmosphere of the spaceship or space station. In other words, when we design for space-travel we consider all the contingencies within the integration of the various technological systems that make up the entire architecture of the space environment. We need to begin to design earth systems the same way, including an understanding of the various ways that the technological systems within the technological infrastructure can be used against one another to produce gaping vulnerabilities that might be exploited by others. We have already learned this lesson with our computer systems which are violated and compromised by hackers. However, up to this point, hackers seem to operate, for the most part, as malevolent pranksters exploiting the meta-systemic qualities of the internet. They seem to be content with merely stealing or destroying data. And although this behavior is destructive and criminal, it is less repugnant than the committing of mass murder. But, theoretically mass murder could be committed by hackers if the security of the control system of some dangerous resource capable of mass destruction were to be breached, like a nuclear plant, for example.

We have said that the system and the meta-system are essentially different. It behooves us to mention some of those differences. However, when we do that we are entering an ill understood territory where much work needs to be done in order to firm up these hints in order to produce a robust theory of meta-systems to complement the general systems theory that has been created over the years[24]. One of the basic aspects of meta-systems, as pointed out by Arkady Plotnitski in his book Complementarities[25], is that Meta-systems are made up of "complementarities of complementarities." Notice that here again is a doubling like that of the "system of systems." This shows that we are again in the *beyond* of the meta-system where there is an intensification that goes beyond the mere doubling of the concept. In the English language prior to the seventeenth century, it was meaningful to repeat negations, superlatives and other constructions that grammarians eventually decided were not meaningful. Now we say that two negatives make a positive because that became the conventional rule in the restricted economy of classical logic. But prior to this, the repetition was considered meaningful and there are examples of up to four negatives in a sentence written by Chaucer[26]. This phenomena where repetition produces intensification, not cancellation, is something that is operative in the *meta-systems* way of thinking as opposed to the *systematic* way of thinking. We talk about the logical system in which two negatives make a positive. But on the other hand there is the moral compass in which it is said that two wrongs don't make a right. We recognize that morality is a meta-system where there is intensification flowing from repetition. So when we talk about the "complementarities of complementarities" that appear in the meta-system much like the way that they appear in the scientific philosophy of Bohr, there is a sense that this intensification of complementarity is something different from a particular complementarity nested in another. In fact, the intensification leads us to the nature of the field that allows itself to be folded back on itself in the nesting process. That field has the properties that Bohr posited in which there is a sustained superficiality that indicates there is nothing behind the complementarities themselves. Bohr posited that there was nothing like Bohm's[27] 'pilot waves' beyond the tissue of complementarities themselves, and he was vindicated by the tests of Bell's Theorem in which there is action at a distance between complementary particles without any medium producing the action at a distance that may be discerned. This strange characteristic of nature that quantum mechanics puzzles over, but finds substantiated in physical experiments, makes clear that we can either look at the thing (particle) or the field (wave) effects of any particular entity[28]. When we move from the system to the meta-system we are making a similar complementary transformation of our theoretical vision. The field of meta-systems is a superficial tissue of *complementarities of complementarities* with indefinite nesting and nothing grounding its phenomenality. In fact, we know our system has reached and interacted with a meta-systemic field when that field has demanded a complementary action. For instance, we can see this inherent complementarity in the *read* and *write* operations when software interacts with the operating system. A meta-system always demands that an embedded system perform to a specific protocol[29]. The designs of our

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[24] Op cit G. Klir, ASPS

[25] (Duke U. Press. 1994)

[26] "He nevere yet no vileynye ne sayde / In al his lyf unto no maner wight" (General Prologue, The Canterbury Tales, ca. 1387)

[27] David Bohm, Wholeness and the Implicate Order, (Routledge & Kegan Paul, London, Boston, 1980)

[28] Another way of looking at this grammatically is in terms of Count and Non-count (Mass) nouns.

[29] In this way a system level Highly Optimized Tolerant (HOT) system may become part of a meta-system level Self-Organizing Critical (SOC) system through the interface of a simple protocol. Bob Cummings pointed out that this is the essence of the signaling protocol which governs traffic interaction. The Highly Optimized

systems are constrained by these implicate complementarities of the meta-systems that they inhabit.

The meta-system acts as a filter on the systems that inhabit it. Just as it is difficult for a program to run under different operating systems the same can be said for general meta-systems. They exclude systems that are not tailor-made to operate in their environment. We see the meta-system as having four complementary aspects: origin, arena, source, and boundary. Origin and Arena are complementarities as well as Source and Boundary **and** the two pairs form a higher-level complementarity. Systems that appear within the meta-system all have points of origins within the medium of the field. Until they reach their destinations, which are called sinks, and they interact within the arena of the meta-system. During this interaction meta-systems provide resources for the systems that inhabit them and they impose constraints on them. These constraints are a sort of testing regime that will reject systems from niches within the meta-system that do not conform to the interfaces of the meta-system. All meta-systems have boundaries beyond which other meta-systems exist. They also have sources, like template objects, from which the systems inside them are derived, prior to instantiation. Understanding the complex interplay of complementarities that make up a meta-system out of the facets of origin, arena, boundary and source is the key to explaining how systems interact within the meta-system. When we double the meta-system, i.e. look for the *meta-system of meta-systems,* then we discover the domain. Doubling the domain gives us a world and this series of doublings reaches up through the ontological hierarchy of schemas.

GENERAL AND RESTRICTED ECONOMIES

Plotnitsky[31] brilliantly connects the concepts of Bohr concerning complementarity with those of Bataille[32] concerning the difference between General and Restricted economies. Meta-systems are *General Economies* as opposed to the *Restricted Economies* of Systems. By applying an anthropological perspective, Bataille attempted to rethink political economy on the basis of the anomalous political organizations found around the world. He realized that what we normally think of as the "rational economy" is extremely limited and that it was many times embedded in a greater economy which was not rational. When Aristotle called us rational animals, he defined us in terms of an ideal. But much of what human beings do is utterly irrational, a fact that the terrorist attacks have clearly shown us. The general economy is irrational rather than rational. Rational means that reasons are given for action. Reason is to action what Logical proof is to thought. We deem suicide bombing as irrational. When the suicide bomber wears a whole airplane instead of merely some packs of explosives (and aims at large buildings) we think of it as a monstrous irrationality. This is a characteristic of the negative use of the general economic way of looking at things. Bataille gives the example of the potlatch of the Northwestern Native American Indians where social value was gained by the destruction of wealth as an example of this "negative use". Bataille also uses the example of the Aztec Indians who killed myriad people in succession by tearing out their hearts in order to give life to their gods. *Irrationality moves very quickly from the gross destruction of commodities to the gross destruction of human life* and we must remember that these irrational transformations are ways of producing transcendental value in those societies. Honor goes to those who can destroy the most wealth. *The eternal life of the gods is made possible by the continual sacrifice of human beings.* In the case of the terrorists, personal entry into paradise[33] as well as generating change in the world is produced by their act of supposed altruism[34]. However,

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Tolerant system of car and driver become part of the wider Self-Organizing Critical System of highway traffic.

[30] All these statements are very controversial and merely made to draw our attention to how natural it is to think about meta-systems once the system vanishes as it did in this case. This is why the example of these terrorist attacks is worth pursuing here in order to understand meta-systems better. Meta-systems are not just ecologies and environments. If they were then we would not be saying anything new. Rather, Meta-systems are also like fields, markets, media, in other words they have their own active organizing principle different from that of the system which is efficacious in its own right. When we talk about terrorism we have to wonder what role is played by the entire global field of mutual interaction, our own actions included.

[31] Complementarity (Durham : Duke University Press, 1994)

[32] Accursed Share, Volumes 1 and 2 (NY: Zone Books 1991)

[33] Paradoxically this is false from the point of view of their own religion. The fundamental precepts of Islam forbids suicide. Its reward in terms of the law of Islam is endless repetition of the suicide. Also forbidden is the killing of innocents. In fact, it is the passengers and other victims that become "shaheeds" or martyrs. The Prophet Muhammad said Muslims should not use the punishment of God as a means of killing, i.e. fire and burning. Those caught in calamities such as earth quake, flood, or firestorm become shaheeds. Even Pharaoh becomes a shaheed when he is drowned in the Red Sea after pursuing Moses. By a strange absurd logic the violators go to hell and their victims go paradise by the rules of their own religion which they have defamed in attributing their action to it.

[34] What is amazing is that they truly did change the world. But instead of America collapsing it was strengthened and became determined to rout out global terrorism. This was an unintended side effect of their action that they did not foresee. They did change the world, but not in the way they had hoped. However, the unintended side effects of their actions and our response to them, which have their own unintended consequences, are the perfect example of the meta-system in action. The field of things is connected in ways we do not always understand,

we have the sense that these irrational ways of acting are at the same time utterly chaotic or completely incomprehensible when we look at them from within the restricted economies set up by Reason. *Rather, the meta-system has its own essential structure that is fundamentally different from the reason and logic that we normally appeal to.* In order to understand meta-system schema, we must produce a concept akin to Mathematical Model Theory, although this concept must be different and encompass a higher level of generality. Mathematical Model Theory is the combination of universal algebra and classical first order logic. What we need instead, is a kind of theory that combines meta-systems theory, which is rooted in universal algebra, and a kind of non-classical logic that comprehends the structure of paradox and absurdity. In this case a good logic for us to use in this case is that of N. Hellerstein called Diamond[35]. What we want to do is to consider universal algebra as generally including all the hyper-imaginaries and the various levels of algebraic ordering including the real, complex, quaternion, octonion, sedenion and infinite degrees of non-division algebras. It is these algebraic structures that determine the inherent ordering of meta-systems theory, and it is these differences in algebras that produce the Special Systems[36] that are embedded in meta-systems. The algebras relate to reason through countability. Counting is a fundamental perceptual and motor action, which gives us the basic sub-structures for the differentiation of our concepts. But we go beyond counting when we use language based on the structures of logic[37] to manipulate these distinguished concepts.. Traditionally we have not accepted logics that comprehend paradox and contradiction, so called "para-consistent logics." But in order to understand things like the absurdity of terrorism we must admit that such deviant logics do exist. By opening up the grounds of the restricted economy of their Model Theory and by combining universal algebra with paradoxical logic, we get something that might be called Meta-model Theory, i.e. a theory that goes beyond the restricted economy of traditional model theory developed by mathematicians. We do that by not only including models of mathematical categories, but also by including the implicit schemas and categories that underlie those models as well as deviant logics.

Meta-model theory can be called a theory of the nesting of the "model of models" or it can be called a schema theory. The "schema of schemas" is, in turn, a philosophical category theory with one additional step that leads us to the level of ontology. Ontology supplies us with an understanding of the various kinds and aspects of *Being* as an ultimate foundation for our understanding of the various kinds of schemas.

Here we would like to pause and point out that at the ontological level there are both different *kinds* of Being and different *aspects* of Being. The kinds of Being come from the intensification of Being itself through the process of repeated interfolding to produce *Pure*[38], *Process*[39], *Hyper*[40] and *Wild*[41] *Being*. Each level of intensification has different emergent characteristics[42]. But also at the level of Being are the aspects[43]: *truth* (x is y), *reality* (x is), *identity* (x is x) and *presence* (this is x). As I have shown in previous papers, the pairwise relations between these aspects have properties such as consistency, completeness, well-formedness (clarity), coherence, verifiability, and validity. Normally, formal systems only deal with consistency, completeness, and clarity. But when we add the aspect of reality, then these new properties that we know so well in Systems Engineering, i.e. coherence, verifiability and validity, become important. Model theory connects validity and consistency. A valid statement is deemed true. A model is specifically the target of a consistent and true set of statements in first order classical logic. This is, of course, incomplete according to Godel when a model is considered as a system. At infinity coherence is achieved at the semantic level and this is called a theory. This suggests that there is a similar connection

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the mutual unintended consequences of their acts and our acts drives us down historical paths that are unexpected giving us an excellent example of the meta-system as a global general economy at work.

[35] Hellerstein, N.S.; Diamond: A Paradox Logic (Singapore, World Scientific 1997)

[36] See 'Meta-system Engineering Futures' by the author at http://archonic.net/

[37] We include here not just syllogistic but also pervasion logics developed in India and China which are the dual of the classical Western logic.

[38] Called present-at-hand by Heidegger in Being and Time (New York, Harper; 1962)

[39] Called Ready-to-hand by Heidegger in Being and Time.

[40] Called the Hyper-dialectic of Process Being of Heidegger and the Nothingness of Sartre in Being and Nothingness (New York : Washington Square Press 1992) by Merleau-Ponty in The Visible and the Invisible (Evanston [Ill.] Northwestern University Press, 1968). Called ~~Being~~ (crossed out) by Heidegger. Called Differance by Derrida in Of Grammatology (Baltimore : Johns Hopkins University Press, 1976).

[41] Called Wild Being by Merleau-Ponty in The Visible and the Invisible. Dealt with by Deleuze and Guattari in Anti-Oedipus (Minneapolis : University of Minnesota Press, c1983) and Thousand Plateaus (London : Athlone Press, 1988, c1987). Discussed by John S. Hans in The Play of the World (Amherst : University of Massachusetts Press, 1981).

[42] These were explained in the INCOSE 2000 paper called "Meta-Systems Engineering" by the author. See also "Software Ontology" in Wild Software Meta-systems by the author at http://archonic.net/apeiron.htm

[43] These are the grammatical uses of the word "Being" in the Greek philosophical language that persist today in most Indo-European languages. These are the only languages that include the concept of "being" in their grammars.

between completeness and coherence, and between clarity and verification in relation to theories. In other words, we extend model theory, which attempts to model semantics in parallel to the syntactic level, by applying the interjection of reality as a test. Injection of reality has, as its opposite, the achievement of coherence at infinity. Instead of focusing on just three aspects of Being as normal model theory does, we interject the fourth aspect which is normally forgotten. That interjection causes our logic to be fundamentally different because now it is necessary to extend our truth values beyond the traditional *true* and *false* as well as the *both* and *neither* of deviant logics. Now we also need to consider the values real/illusory, identical/different and present/absent as well. Ultimately, the <u>Diamond</u> logic of Hellerstein, based on G. Spencer-Brown's <u>Laws of Form</u>, will have to be extended into what I call a '**Vajra** logic' which includes all the aspects of Being beyond just truth and falsehood[44].

Diamond Logic comprehends the paradoxicality and absurdity of terrorism. It posits that there are two fixed points, identified by Spencer-Brown, as '**i**' and '**j**'. Hellerstein interprets them as *true, but false* and *false, but true* in a dynamic system where there are repeating truth values. **True** in this scheme means *true but true* and **false** means *false but false*. Hellerstien gives the example of the circuit that produces the buzzer. The twin paradoxes **i** and **j** are like two buzzers. When these are interleaved as inverses of each other they either produce an illusory continuity which is the equivalent of absurdity or cancellation. The illusory continuity of the idea has as its implicit infra-structure an absurdity that bifurcates into paradoxical duals. Paradox raised to the power of paradox can be seen as an oscillation or circulation among paradoxes. So for terrorism this is the paradox *alive but dead* which is transformed into the paradox *dead but alive*. In other words the terrorists enter a liminal state where they are socially considered already dead *before* they have actually committed suicide, and this is what allows them to carry out the destructive acts that will produce transcendental value in the meta-system. There, within the meta-system, they will be transformed into *dead but alive* in a deviant paradise of their own which we consider hell[45]. Liminal states are not comprehended by normal classical logic, nor does classical logic comprehend an absurdity which is a combination of liminal states or a transformation

from one liminal state to another. *However, it is precisely this "deviant logic" that comprehends the thinking of the terrorists as they consider the meta-system of the technological infrastructure that shows through the interstices between the various technological systems.* In order to apprehend the world as the terrorists do, we need to understand and apply paradoxical and absurd logics as a means of preempting their strikes from the shadowy realm of our own blind spots.

When we look into this meta-system we can see that it is filled with monsters, as in antique maps where monsters lurk at the ends of the earth. There we see black holes, or paradoxical energy sinks, and miracles, or paradoxical energy sources, which go off the scale exponentially when given positive feed back. Aboard the boats of our restricted economies, we assiduously avoid these monsters when we sail these stormy seas. The combination of blackhole paradoxes and miraculous paradoxes together produce the absurdities that we call singularities. The singularities create catastrophes like those characterized by Rene Thom[46] where the field of the meta-system folds through itself to produce anomalous discontinuous points of transformation in the seascape[47]. *All of these effects of the meta-system can take situations completely out of our control.* In fact we see a progression toward this in the various kinds of Being which have the modalities of being-in-the-world called present-at-hand[48], ready-to-hand[49], in-hand[50] and out-of-hand[51]. In other words,

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[44] See "Vajra Logics and Mathematical Meta-models for Meta-systems Engineering" by the author at http:\\archonic.net where the concept of Vajra Logics is explained in more detail. See also INCOSE 2002 proceedings.

[45] This is also considered a hell of endless suicide in their own religion.

[46] See Rene Thom <u>Structural Stability and Morphogenesis an Outline of a General Theory of Models</u> (Perseus Pr 1989)

[47] Systems Dynamics simulations can effectively model both the system and the meta-system at a high level of abstraction through the interaction of negative and positive feedback.

[48] This is a term for a mode of "being-in-the-world" used by Heidegger in <u>Being and Time</u>. It is a mode in which the world is static and objective. Merleau-Ponty in <u>The Phenomenology of Perception</u> associated it with "pointing." It is called by the author Pure Being.

[49] This is a term for a mode of being-in-the-world used by Heidegger in <u>Being and Time</u>. It is a mode in which the world is dynamic and embedded in the technological infrastructure supporting action. Merleau-Ponty in <u>The Phenomenology of Perception</u> associated it with "grasping." It is called by the author Process Being.

[50] This is a term for a mode of "being-in-the-world" coined by the author which is associated with what Heidegger calls "~~Being~~" (crossed out) and what Derrida calls "differ**a**nce." It is called by the author Hyper Being after Merleau-Ponty's term "hyper-dialectic of Being and Nothingness" used in <u>The Visible and the Invisible</u> (Evanston [Ill.] Northwestern University Press, 1968).

[51] This is a term for a mode of being-in-the-world coined by the author which is associated with what Merleau-Ponty calls Wild Being in <u>The Visible and the Invisible</u>. John S. Hans talks about it as the nature of "Play" in <u>The Play of the World</u> (Amherst : University of Massachusetts Press, 1981). Deleuze and Guattari call it the "Rhizome" in <u>Anti-Oedipus</u> (Minneapolis : University of Minnesota

when we combine the concept of the meta-system with the Diamond or **Vajra** logics, we are inadvertently defining the necessity of stepping through the various meta-levels of Being. Normal static entities with illusory continuity have Pure Being and our modality in the world when we relate to them is the "present-at-hand." When entities become dynamic, we then enter Process Being and our modality in the world becomes "ready-to-hand." This is the modality where the Technological system supports us without our being aware of it. As we know from Zeno, contradictions appear at this level. Motion in the world results in contradictions. Interfering paradoxes produce vicious circles. When these contradictions interfere with each other then we have a paradox that places us in Hyper Being and our modality of being-in-the-world becomes "in-hand." This is the modality where the technological system transforms within our hands, producing emergent events and genuinely new phenomena like the surprise of the terrorist event on September 11th 2001. This modality describes how this event fundamentally changed our focus and attention to the meta-system in a way that was recognized by everyone. This new focus is called a "war" – but not a war against a conventional enemy, but rather a war against the terrorist networks that are the source of the atrocities that occurred: a war against Terrorism. "World War Three" is not like anyone had previously imagined, with Russia and the USA now linked as temporary partners rather than as enemies. Finally when we begin to cycle between the twin paradoxes of **i** and **j** as fixed points, then things truly get "out-of-hand" as we confront absurdity. This is what Merleau-Ponty called Wild Being. Beyond that is only madness.[52]

We see this clearly when we apply the **Vajra logic,** that allows paradox in the dimensions of truth as well as in reality, as well as the expanded algebraic models of order, and the implicit schemas and categories[53]. This

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Press, c1983) and Thousand Plateaus (London : Athlone Press, 1988, c1987). It is what Cornelius Castoriadis in The World in Fragments (Stanford, Calif. : Stanford University Press, 1997) calls the "magma".

[52] This paragraph is attempting to describe the following configuration of emergent levels:

doxa
Pure Being
paradox
Process Being
vicious circles
Hyper Being
absurdity
Wild Being
Madness, insanity

[53] A basis for the combination of the four "Vajra Logics" has already been created by August Stern in his books Matrix Logic (Amsterdam ; New York : North-Holland ; New York, N.Y., U.S.A., 1988) and

produces a realm in which it is necessary to distinguish right from wrong, i.e. correctness, within in a realm of multifarious variety[54]. In other words, the various combinations of the technological systems within the technological infrastructure as meta-system are almost infinite. Thus all the vulnerabilities are impossible to foresee! We must design the meta-system of the technological infrastructure itself so that the technological systems become orthogonal to each other as much as possible. Thus we will reduce the amount of paradox and absurdity where the various technological systems intersect in ways that can produce unwanted side effects in the hands of those who are prepared to think in ways that are profoundly anti-humanitarian and anti-technological as well. We must come to terms with those who are in the grips of the irrational and whose thoughts and actions are not merely mad but diabolical in the grip of the paradoxicality and absurdity of the deviant logics. Unwanted side-effects obey the higher meta-level of the Diamond or **Vajra** Logics. Ultimately the only way to counter terrorism is to learn and to think and reason in this mode as well, i.e. the mode that recognizes the meta-system under the influence of deviant logics. We must use our knowledge of the meta-system and the deviant logics to straighten up and correct the multifarious overlapping patches of the environment so that various things in the environment cannot be used against each other to produce catastrophe so easily.

Thus it becomes an essential, and not merely a luxury, to consider the meta-systemic view of our technological infrastructure and to consider ways of thinking about them in terms of logics that go beyond our classical logical formal system or restricted economy of thought. Some people talk about the need for thinking out of the box[55]. The tragedy of September 11th 2001 has shown us that this is a critical need when considering the meta-system of the technological infrastructure, that is, the environment of the various technological systems that support our way of life. But this thinking outside of the box has a specific theoretical basis, it is not just random flailing or miraculous inspiration. It combines a meta-systemic view of our systems with an appreciation for

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Matrix Logic and the Mind (Amsterdam ; New York : North-Holland/Elsevier ; New York, 1992). The difference is that Stern has not yet realized that all the aspects of Being need to be considered valences of the logic, not just truth and falsehood: i.e. identity/difference, real/illusory and presence/absence. A combination of "Vajra Logics" would merely be a matrix logic using all four valences. It is a natural extension of "Diamond Logic" to the next higher meta-level.

[54] Ultimately this is based on fate and arises from sources that in turn arise from a single root. In general we are talking here about the various levels of non-duals at the core of the Western worldview.

[55] I.e. out of the restricted economy and into the general economy.

the power of deviant paradoxical and absurd logics. We need to take up these tools ourselves and develop them so that we can counter the terrorist threat within the discipline of Systems Engineering which is now, by necessity, transformed into Meta-systems Engineering.

ABOUT THE AUTHOR

Kent Palmer[56] is a Principal Systems Engineer at a major Aerospace Systems Company. He has a Ph.D. in Sociology concentrating on the Philosophy of Science from the London School of Economics and a B.A. in Sociology from the University of Kansas. His dissertation on The Structure of Theoretical Systems in Relation to Emergence[57] focused on how new things come into existence within the Western Philosophical and Scientific worldview. He has written extensively on the roots of the Western Worldview in his electronic book The Fragmentation of Being and the Path Beyond the Void[58]. He has had nearly twenty years experience[59] in Software Engineering and Systems Engineering disciplines at major aerospace companies based in Orange County, CA. He served several years as the chairman of a Software Engineering Process Group and is now engaged in Systems Engineering Process improvement based on EIA 731 and CMMI. He has presented a tutorial on "Advanced Process Architectures[60]" which concerned engineering wide process improvements both in software and systems engineering. Besides process experience, he has recently been the software team lead on a Satellite Payload project and a systems engineer on a Satellite Ground System project. He has also engaged in independent research in Systems Theory which has resulted in a book of working papers called Reflexive Autopoietic Systems Theory[61]. A new introduction to this work now exists. It is called *Reflexive Autopoietic Dissipative Special Systems Theory*[62]. He has given a tutorial[63] on "Meta-systems Engineering" to the INCOSE Principles working group. A paper with this title was also published in the INCOSE 2000 proceedings. He has written a series of papers on *Software Engineering Foundations* which are contained in the book Wild Software Meta-systems[64]. He has

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[57] http://dialog.net:85/homepage/disab.html You man also try http://dialog.net or http://think.net or http://archonic.net for any of the web related material.

[58] http://dialog.net:85/homepage/fbpath.htm

[59] http://dialog.net:85/homepage/resume.html

[60] http://dialog.net:85/homepage/advanced.htm

[61] http://dialog.net:85/homepage/refauto2.htm

[62] http://dialog.net:85/homepage/autopoiesis.html

[63] http://dialog.net:85/homepage/incosewg/index.htm

[64] http://dialog.net:85/homepage/wsms.htm