Vajra Logic and Mathematical Meta-models for Meta-systems Engineering

Notes on the Foundations of Emergent Meta-systems Theory and Practice

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Abstract: This paper explains at a high level of abstraction the meaning of the term Vajra Logic it relates to Diamond Logic and Matrix Logic. It also explains the concept of Meta-models as an extension related to the concept of Mathematical Model Theory. These ideas were mentioned in the paper "Anti-terror Meta-systems Engineering" and this paper seeks to fill in more background as to what is meant by these terms. These ideas are related to Set and Mass mathematical and logical categories and Syllogistic and Pervasion logics. Finally, there is discussion concerning the use of the Gurevich Abstract State Machine Method for the purpose of modeling Turing machines and Universal Turing machines as a way to represent Systems and Meta-systems for Engineering Design. The foundations of Systems Design Languages are briefly discussed. This is a conceptual working paper of research still in progress and does not represent final results.

A '**system**' is a particular kind of conceptual schema that we project on things related to the perceptual gestalt[1]. We need to recognize that there are other kinds of schemas such as '**pattern**' or '**form**' or '**meta-system**[2]' or '**domain**' or '**world**' that are also projected on things. The schemas form an ontological emergent hierarchy[3] that is opposite the ontic emergent hierarchy[4] discovered in things. This difference is celebrated as the dualistic distinction between logos and physus within our Western worldview. This leads us to understand that we need a General Schemas Theory[5], which explains *both* the nature of the emergent hierarchy of schemas that we project on things, *and* how it differs from the organization of the things themselves (the ontic) at the various levels of emergence. This need is particularly poignant in the case of Systems Engineering Design in which the ontological emergent schemas are used as internal archetypal blueprints which form the basis for producing the products that change our world; i.e. products that have emergent properties. The question that arises is: *How do we ground this production that we already engage in, but do not completely understand? How do we produce systems that have emergent properties? How do these systems fit into the context and content of the other schemas within the hierarchy of emergent schemas?* These questions become particularly important when we realize, to our own peril, that we have been ignoring other broader schemas such as meta-system, domain, and world. The terrorist incident of September 11th 2001 shows that others are able to do us harm[6] by intervening within our technological infrastructure at the level of the broader schemas. Suddenly it becomes important to begin to design the higher level schemas themselves, rather than just designing systems and ignoring their interactions and side-effects. We must think in terms of designing meta-systemic environments, designing domains, and designing the worlds we inhabit as well. In this way new disciplines called meta-systems engineering, domain engineering, and world engineering come to the fore as needing to be articulated. We have been

[1] The system is in effect all possible figures on all possible complementary grounds that show up as perceptual *gestalts* when looking at something. The switching from a focus on one figure to another allows us to see the different relations between the figures reified as objects which yields the normal definition of the system as objects plus relations.

[2] The conceptual meta-system is seen in the perceptual *proto-gestalt*. The proto-gestalt is all the possible paths from gestalt to gestalt in an environment across multiple systems composed of multiple objects and their relations. Thus the meta-system is all the possible sequences through all the possible gestalts in an environment considering all the systems in that environment. Proto-gestalts have what David Bohm calls *Implicate Order*, i.e. an implicit ordering that determines what will be looked at next given all the competing claims on our attention in an environment. For more about meta-systems see "Meta-systems Engineering" by the author in INCOSE 2000 proceedings.

[3] See footnote 72

[4] See footnote 69

[5] not just 'general systems theory'

[6] See "Anti-Terror Meta-systems Engineering" by the Author at http://archonic.net in INCOSE 2002 proceedings.

implicitly engaged in these broader levels of design for a long time, now we need to explicitly include them in our compass of what constitutes "systems engineering" which would be more properly thought of as Schemas Engineering.

This paper deals with the grounds of a new discipline in which we consider a *different hierarchy* that goes from the design theory to the paradigm, and as well as from the episteme to the level of ontos. Design theory uses schemas in order to achieve an internal coherence, and normally we think of this as patterned data content encapsulated by objects, or as *forms plus behavior* within a system. We design the system to produce some emergent qualities that would be useful to support our intentions within our world. Then, what we normally fail to do is to take into account the side-effects of these designed systems within the world; we fail to extend our design vision beyond the *system* into the *meta-systemic environment*, and into the *domain* and *world* levels of organization as well. Recently we have begun to speak in terms of *systems of systems* in order to indicate a broader perspective. But this term merely reiterates the schema of the system at a higher level of abstraction rather than recognizing the *fundamental difference* between the system and the meta-system[7].

When we begin to think about the differences between the system and its complementary inverse-dual[8], the meta-system[9], we suddenly find ourselves in foreign territory[10]. We tend to want to ground our systems thinking in mathematics and construct formalisms which explain the nature of the system in terms of parts and relations between these parts. This does not explain the wholeness of the system that Rescher points out in his work Cognitive Systemization[11]. If we look to systems theory, such as that of Klir in his key work Architecture of Systems Problem Solving[12], we notice that analytic definitions of the system schema prevail. Klir defines for us a 'discipline independent' model of the formal structural system, i.e. a unified approach to things that combines the schemas of pattern in terms of structure, form, and system. What is needed is a similar combination of the schemas of meta-system, domain, and world which would give us an articulation of the context within which formal structural systems arise and interact. Here, however, we will concentrate on the *grounding* of the meta-system because it is the next step in broadening our conception of the task of systems engineering.

In order to ground the meta-system we need to understand the way in which theories depend on paradigms[13] which in turn depend on epistemes[14] which finally depend on ontologies[15]. Our systems designs are theories that we test, first by bringing the systems they blueprint into existence and then by placing them into our world in order to see how they operate within that world. These design theories are based on schematic paradigms which give them internal coherence[16]. We talk about paradigm shifts when our assumptions behind our theories change, but what is not normally mentioned, is that these assumptions that produce the paradigm that our theories are based on, are related to our schemas, i.e. the inner coherence of our thoughts. However, as Foucault pointed out, at an even deeper level than the paradigms are the epistemes, i.e. the fundamental categories of our thought, which in philosophy we know as philosophical category theory[17] (like that of Aristotle and Kant). Going deeper, we reach the ontological level of our understanding of the world. In order to ground our design theories it is necessary to articulate each of these deeper levels of understanding. Each level has its own emergent qualities that need to be explored and brought to the surface for our contemplation.

When we look at the level of *ontology* we find that this level has become fragmented. *Being* itself is a paradox, and in order to make that paradox comprehensible by way of reason we apply Russell's Theory of Logical Types.[18] This produces a set of meta-levels, or kinds, of *Being* and a set of types called the aspects of *Being*. This set of meta-levels that was discovered by

[7] Systems and Meta-system interleave. Systems are surrounded by meta-systems and have them in their interior and thus mediate between super-systems and sub-systems. This is also true for forms and domains as well as patterns and worlds.

[8] Inverse-dual means that the duality is produced by inverting or reversing attributes of one thing to give properties of the other thing.

[9] See footnote 70

[10] This foreignness becomes even stranger when we discover that between the system and the meta-system there are a series of special systems called Dissipative, Autopoietic and Reflexive that are ultra-efficacious. For more on this see "Reflexive Autopoietic Dissipative Special Systems Theory" by the author at http://archonic.net/autopoiesis.html or Reflexive Autopoietic Systems Theory at http://archonic.net/refauto2.htm

[11] (Oxford : B. Blackwell, c1979)

[12] (New York : Plenum Press, c1985)

[13] Kuhn,T. The Structure of Scientific Revolutions (Chicago,: University of Chicago Press; c1962)

[14] Foucault, Michel. The Order of Things (NY: Vintage; 1970)

[15] Heidegger, Martin Being and Time (New York: Harper & Row, 1962)

[16] Each schema has a consequence for cognitive understanding. Meta-system = indication; System = description; Form = proof and Pattern = explanation.

[17] See also Ingvar Johansson's Ontological Investigations. An Inquiry into the Categories of Nature, Man and Society (Routledge 1989) [http://hem.passagen.se/ijohansson]

[18] See Copi, Irving M; The Theory of Logical Types (London, Routledge and K. Paul, 1971)

Continental Philosophers in the last century can be enumerated as *Pure Being*[19], *Process Being*[20], *Hyper Being*[21] and *Wild Being*[22]. The series of types that appear at each of these levels are called the aspects of Being which are *Reality* (x is), *Truth* (x is y), *Identity* (x is x) and *Presence* (this is x). These aspects are the grammatical uses of *Being* in our Indo-European languages. These kinds of *Being* are the levels of intensification that we witness as *Being* folds through itself while devolving into the chaos of ultimate paradox and absurdity[23]. We begin with doxa (opinion) which devolves into paradox, which then devolves into vicious circles that again devolve into absurdity, finally ending in insanity, i.e. the utterly irrational. Doxa is the obverse of reason in Plato's "divided line." Reason goes through a similar spiral but in a different direction on different grounds. There is reason which evolves into the *search for grounds*, which then evolves into *self-grounding*, which then evolves into *mutual grounding*, which ultimately evolves into the *supra-rational*. In other words, when we provide reasons for our actions we normally search for external grounds that are beyond ourselves. But eventually it is realized that the best kind of reason, i.e. the most stable kind of reason, is that which is *self grounding*, i.e. appeals only to itself. However, eventually it becomes clear that the self that it appeals to is not unified, as Nietzsche contends. So we see that there is a progressive fragmentation of the self, first into something which is the dual of itself, and then into that which is multifarious. For instance, in formal systems we know that axioms form a set and sometimes lend themselves to mutations that produce complementary formal systems that are intrinsically different. These complementary formal systems, such as in Euclidian and non-Euclidian geometry, or as in Set and Mass[24], together give each other a mutual grounding. But eventually we discover that each axiom is subject to various interpretations and we need something like Rescher's method in Cognitive Systemization to revisit the various axioms of our system. This will give us in a kind of hermeneutic circle that will help us to successively reground our enterprise. Ultimately we realize that the splits in the self, which appeals to itself as a *ground*, produce fundamental discontinuities that are ultimately supra-rational. This supra-rationality is the opposite of the insanity that doxa devolves into. In fact each stage of evolution toward supra-rationality is balanced by the opposite stage of devolution into insanity. The kinds of *Being* represent the phase transitions between these various levels of devolution and evolution.

When we ground our systems engineering practice we enter into planes of successive evolution of reason and devolution of opinion (doxa). This is what causes the frustration that we experience when we cannot find an easy access to the grounds of our discipline. All this may be summarized by an idea propounded by Nietzsche: that *groundlessness itself* is the grounds of our discipline. What we are looking at with the successive evolution and devolution of *doxa* and *reason* is the *groundlessness* of *Being* as Heidegger suggests. If we accept this then we can begin to ask our question again, how can we ground our discipline in the *groundlessness of Being*? *Grounding* in *groundlessness* in some way accepts the impossibility of producing firm and incontestable grounds and accepts that all grounds we might find are temporary and tentative. Ultimately this means that the best we can do is to project Russell's Theory of Higher Logical Types onto the grounds of insanity and supra-rationality in order to disambiguate it in progressive emergent levels. Therefore, seeing the emergent models of the *kinds of Being* and the *aspects of Being* embodied before our eyes is the best we can achieve. When we see that emergent model we have seen our own grounds to the extent that we can have temporary and fragmented grounds.

At the end of this article, as an example of mutual grounding, we will offer for examination the **set** and **mass** categories which are duals of each other and appear embodied in mini-design languages. We will use these examples of mathematical categories here as a basis for talking about model theory and its extension into meta-model theory. Set and mass define each other by their complementarity. This complementairty is a property of the meta-system of all the mathematical categories, and we can see this complementarity in Mathematical Category Theory through the reversal of arrows. These mini-languages are the primitive basis for a language of system design. It is worth concentrating on this primitive basis because of the fact that the mass category is not understood to be a dual of

[19] See Heidegger Being and Time for present-at-hand mode of being-in-the-world.

[20] See Heidegger Being and Time for ready-to-hand mode of being-in-the-world.

[21] See Merleau-Ponty The Visible and the Invisible (Evanston [Ill.] Northwestern University Press, 1968) for the hyperdialectic between Being and Nothingness also called the in-hand mode of being-in-the-world. Also called "~~Being~~" (crossed out) by Heidegger in The Question of Being (New York, Twayne Publishers 1958) and "Differ***a***nce" by Derrida in Of Grammatology (Baltimore : Johns Hopkins University Press, c1998).

[22] See Merleau-Ponty The Visible and the Invisible for this term also called by the author the "out-of-hand" mode of being-in-the-world.

[23] See the work of Don Kunze which is a nice complement to that of Hellerstein, who develops a Boundary Language for understanding the way we relate to paradoxes and absurdities. See http://art3idea.ce.psu.edu/boundaries/

[24] In mathematical category theory they talk about **anti-set** category. But it would be better to speak of the **mass** category which is the real dual of the **set** mathematical category.

set category. And it is not understood to have its own special logic called *pervasion logic*[25] which is the dual of the classical Western syllogistic logic.

Now let us return to our concern in this paper with the grounding of Meta-systems theory as the context for Systems theory. I propose that we use a modified form of Mathematical Model Theory. Mathematical Model theory attempts to work out the relation between Mathematical Categories and First Order Logic. One definition of it is the combination between universal algebra and logic. This becomes problematic because all mathematical objects are purely *present-at-hand*, i.e. they exist only in *Pure Being*. What we need is something more robust and articulated at all the various meta-levels of *Being* so that it is useful in dealing with the real world. It is also problematic that logic only deals with the values of truth and does not consider the other aspects of *Being*. It is clear that we need a theory that accepts fragmentation and ultimately accepts *groundlessness* by expanding from the restricted economy of mathematical model theory into something deeper, i.e. the general economy of Meta-model Theory which takes into account all the aspects and kinds of *Being*. In this way we will have something robust enough to guide our work of systems design within the context of the real world.

Here we can only sketch what this meta-model theory might be. Actually, developing it will have to be left to further study and fuller exposition at a later date. Meta-model theory must cover not only the mathematical categories, but also the schemas, philosophical categories and higher logical types which appear at the successive emergent levels that ground our design theories. Thus we want a considerable expansion of scope beyond the concern of mathematics per se, but at the same time, we must not limit our scope to first order classical logic. Rather, we must to consider deviant logics that comprehend paradox and absurdity as well as supra-rational states such as those indicated by the tetralemma (a, ~a, both a and ~a, neither a nor ~a) which considers para-consistency[26], para-completeness, and para-clarity.

Let us begin by considering a formal system's properties. They have consistency, completeness and well-formedness (clarity). When we produce a set of requirements or a design we would like it to have these properties. However, we recognize that if even small logical systems are incomplete, vis a vis Godel's incompleteness theorem, then our much larger systems will certainly be incomplete as well. However, in the context of our formalisms we would like to define our systems designs so that they have these properties of the formal system. But rather than just ignoring the violations of these properties, we need logics that deal with the failures to achieve these ideal properties of formal systems. And beyond this we need logics that will allow us to deal with the real world, i.e. logics that distinguish values other than truth. We need a system of logic that also distinguishes the values of reality, identity and presence aspects of Being.

In order to set our designs on a formal footing, for discussion purposes let us adopt the Gurevich Abstract State Machine Method[27] which is a particular formalism that is well suited for use by Systems Engineers for designing systems. This method was developed by Gurevich to embody Turing Machine descriptions without the cumbersomeness of the Turing machine notation. It has been used successfully to describe all manner of computer languages; and if it can describe the idiosyncrasies of computer languages, then it can certainly describe everything that is computable. It is very simply described as a method, in which one merely describes everything in rules that one would create for an expert system. The difference is that these rules stand as a static description of the design itself rather than being used as an implementation[28]. It is interesting to note that the rule, i.e. the *if…then…* statement has an amazing flexibility to describe software systems. In the rule statement, the four viewpoints one would like to represent in a real-time system, i.e. agent, function, data and event, are unified[29]. What is even more interesting is that we can use these rules to describe systems of constraint on the system or the response of the system itself. Thus, the rules may be used to describe either the system or the

[25] See Bimal K. Matilal , Logic, Language and Reality : An Introduction to Indian Philosophical Studies (Asian Humanities Press, 1985) As far as I know the only researcher into the formalization of Pervasion logics is Bricken, W. (1986). A deductive mathematics for efficient reasoning. Technical Report HITL-R-86-2, Human Interface Technology Laboratory of the Washington Technology Center, University of Washington, Seattle, WA. Also Bricken, W. (1992) "Spatial Representation of Elementary Algebra," Proceedings of the 1992 IEEE Workshop on Visual Languages, IEEE Computer Society Press, Los Alamitos, CA. 56-62. He used G. Spencer Brown's Laws of Form as the basis of his logic. See http://www.lawsofform.org/logic.html. Pervasion Logic was the logic developed in ancient India and became the logic of choice for Buddhists and is ingrained as one of the formal bases of Tibetan Buddhism.

[26] See Graham Priest et al, Paraconsistent Logic (München : Philosophia, c1989).

[27] See "Gurevich Abstract State Machines in Theory and Practice" by the author at http://archonic.net and see also http://www.eecs.umich.edu/gasm/ and http://www.uni-paderborn.de/cs/asm/

[28] In other words, this is not an Expert System. The rules are static and do not execute but are used for specification only.

[29] See "Software Ontology" in Wild Software Meta-systems by the author at http://archonic.net/wsms.htm

meta-system[30] and thus may play a pivotal role in our attempt to understand the difference between these two ways of looking at things. The meta-system is modeled as a Universal Turing machine and is described in a set of rules that provides an operating system for the rules that describe the system. Meta-systems are basically filters that operate on systems. Meta-systems are described by a series of niches to which they supply resources for the systems that inhabit those niches. The meta-systems are the origin of the systems that come to inhabit their arena. They provide a boundary within which the systems have free play to the extent they are not confined by meta-system constraints. The meta-system has templates by which it knows how to construct instantiated systems within its boundaries. These are the sources of those systems, and anti-systems that compete within its environment. A good example of a meta-system is a *market* where competition between agents occurs within a set of guidelines or rules when given certain limited resources. Another good example is *excitable media* which Brian Goodwin discusses[31]. In general, all active media are meta-systems, for instance, the media of the world wide web and the internet are meta-systems par excellence[32].

If we use the set and mass categories, as we find them represented in the mini-languages that appear in the appendix, then it is only necessary to augment these languages with logic. However, the two different categories lend themselves to two dual logics that correspond to the duality of their categories at the logical level. These logics are called syllogistic logic and pervasion logic. Syllogistic Logic is composed of familiar deduction and induction augmented by *abduction* which was recognized by Charles Peirce. Abduction is the third form of the three statements of the syllogism, other than induction and deduction, which concerns the generation of hypotheses[33]. Pervasion, on the other hand, is a boundary logic related to the participation of instances in a mass. Just like the syllogism, we believe that the statements of this logic can be permutated to give three basic configurations which we call *invasion*, *abvasion* and *devasion*. This is to maintain parallel naming conventions with those traditionally used for different permutations of the statements of the syllogism. We describe both the syllogism and pervasion in the meta-set and meta-mass reflective commentaries in the appended languages. These reflective commentaries contain what these categories would have to know about themselves in order to function. Briefly, *devasion* occurs when an instance is reasoned to be pervaded by a mass *if* it is within the boundary of the mass. In order to determine this, it is necessary to have statements about the boundary and to know whether instances are inside, outside, or on the boundary of the mass. *Invasion* is like induction. It says that when given all the instances, and when those instances are inside a given boundary, then it must be part of the mass associated with that boundary. *Abvasion* says that all the instances of a particular mass exhibit a property, and since these particular instances exhibit that property, then these instances must be from that mass which has that property.

In general the mass dual of the set and the pervasion dual of the syllogism are interesting because we think of systems and meta-systems as actually moving back and forth between mass and count ways of looking at things, as well as moving back and forth between syllogistic and pervasion ways of reasoning about things. *But because of the blindness of our tradition to the mass and pervasion ways of approaching things, we do not have words and ways of thinking about these aspects of the system and meta-systems.* This is one of the major reasons that we are blind to meta-systems, because meta-systems are more like masses than sets and their logics are more like pervasion logic than syllogistic logic. In the systems and meta-systems that we apply to our architectural design languages, we need to use these mass terms and these pervasion logics in order to clearly see the duality and complementarity between the system and the meta-system which is better thought of in terms of the *mass-set duality* as mathematical categories and *pervasion-syllogism complementarity* as forms of reasoning.

Given our ability to define meta-systems and systems with rules that amount to a Turning machine representation, in the case of a system, or of a Universal Turing machine representation of a meta-system, we can go on to look further at our meta-model theory as a means of grounding these representations. The meta-model theory needs to begin with a universal algebra that includes a kind of logic which can comprehend paradox and absurdity as well as all the aspects of Being. We can begin with the work of N. Hellerstein and his development of Diamond[34] Logic based on the work of G. Spencer-Brown's Laws of Form[35]. Diamond logic looks at truth and falsehood in terms of a dynamic system in which these values are repeated. It defines

[30] We merely use the rules to define a universal Turing machine instead of a Turing machine in order to describe the meta-system.
[31] How the Leopard Changed Its Spots:
The Evolution of Complexity (Princeton UP, 2001)
[32] See "Thinking Through Cyberspace" a presentation by the author at http://dialog.net:85/homepage/uciconf1/index.htm
[33] See http://www.artsci.wustl.edu/~philos/MindDict/abduction.html for a definition.
[34] (World Scientific 1997)
[35] (London: Allen and Unwin, 1969)

four truth values: ttttt = **True**, ffff = **False**, tftf = **i**, and ftft = **j**. These oscillating truth values (**i** and **j)** are seen as fixed points of paradox. When we combine **i** and **j** with a meta-oscillation between them, then we get a vicious circle, and when we fuse them we get absurdity. Diamond Logic comprehends all three levels of the devolution of paradox to vicious circles and absurdity. Even though Hellerstein would like to consider the interpretation of **i** and **j** in terms of *both...and...* and *neither...nor...* which would be suitable as well, here we will reserve this interpretation which gives access to supra-rationality[36] for another use and will not apply it to the Diamond Logic. The fixed points are best interpreted by Hellerstien as: *true but false* and *false but true*. Interestingly it does not matter whether **i** and **j** are assigned to the fixed points because they are indistinguishable except from each other. We may distinguish them if we use complex numbers to do so. In other words if we treat the logical values as if they were numbers, we can distinguish the **i** and **j** by treating one as real and the other as imaginary[37]. Their combination is a conjunction of the form ax+bi. Hellerstein says that he considers his logic the two dimensional extension of logical values equivalent to the complex numbers[38]. What he does not appear to consider is the possibility that the logical fixed points may be treated as numbers as well as logical values. In that case we can distinguish them by designating one as a real number and the other as imaginary. Now we would like to make a change to Diamond logic and convert it into **Vajra** Logic.[39] We can accomplish this by allowing all the aspects of Being to become values with respect to the logic. In fact there are four orthogonal values that the extended logic must deal with, which are true/false, real/illusory, present/absent, and identity/difference. These also need to be considered dynamically with each pair of the diachronic logic producing its own fixed points so that ultimately there are eight fixed points rather than just two. For instance, *rrrr* = Real, *uuuu* = unreal or illusory or imaginary, *ruru* = real but illusory = **k**, *urur* = illusory but real = **l**; *iiii* = Identity, *dddd* = Difference, *idid* = identical but different = **m**, *didi* = different but identical = **n**; *pppp* = Present, *aaaa* = Absent, *papa* = present but absent = **o**, and *apap* = absent but present = **p**. We would like to suggest that these new fixed points form sets in conjunction with the Diamond logic fixed points. *In other words, a Diamond, together with one of the other aspects, forms a higher level logic called a* ***Vajra****.* In that case the fixed points may be treated as a quaternion (x+i+j+k)[40]. Vajras are a kind of sword of discrimination that appear in Buddhist Tantric symbolism[41]. A vajra may be single ended, double ended or perhaps may be also imagined as crossed with four ends. The crossed double Vajra would be the combination of all four aspects of a single higher level logic. In that case the eight logical fixed points (i-j-k-l-m-n-o-p[42]) would be treated as if they were an octonion (x+i+j+k+E+I+J+K)[43]. This means that these logical paradoxes, vicious circles and absurdities may interact with similar conundrums of identity, presence and reality. In the interaction the fixed points are distinguished by their alternative role as hyper-complex numbers. And this interaction can produce very sophisticated combinations of these various forms of higher level paradox, vicious circles and absurdities. This variety of interacting fixed points is exactly what we are confronted with when we attempt to build real systems in the real world. The other three properties that emerge when we add reality to the "identity-presence-truth" of the formal system, are coherence, verifiability, and validity. It is precisely the latter that have become so important in Systems Engineering where we attempt to design systems to meet these requirements to function successfully in a real environment. Within Vajra logic these properties appear along with the normal properties of consistency,

[36] We use August Stearn's Matrix Logic (Amsterdam ; New York : North-Holland ; New York, N.Y., U.S.A., 1988) to address Supra-rationality.

[37] We get a glimpse of how the supra-rational haunts the paradoxical when we treat the fixed points as hyper-complex numbers.

[38] In a personal communication N. Hellerstein tells me that another way of looking at this is to see the diamond logic as analogous to the "dual numbers" rather than the complex numbers. See http://math.hyperjeff.net/hypercomplex/1st_order.html Note that the difference between complex, dual and double numbers is whether the square root is equal to -1, 0 or 1. Note that this relation to the Complex Numbers produces an image of the Dissipative Special System. See "Reflexive Autopoietic Special Systems Theory" by the author at http://archonic.net

[39] "Vajra Logic" is something that is being introduced here for the first time. It basically means using the Diamond Logic of Hellerstein for each aspect of Being as explained. A Vajra is sometimes referred to as a diamond sword of discrimination in Tibetan Buddhist iconography. Sometimes Vajra symbols have swords at both ends of the handle. So there is also the idea of the combination of diamond logics.

[40] Note that this relation to the Quaternion produces an image of the Autopoietic Special System. See "Reflexive Autopoietic Special Systems Theory" by the author at http://archonic.net. See http://mathworld.wolfram.com/Quaternion.html.

[41] For an example of a Trantric Vajra and bell iconography see the following explanatory link http://www.geocities.com/Athens/Ithaca/4886/belldorje.htm. There is no intrinsic relation between the Vajra icon and the logics we are suggesting. It is merely an interesting allusion similar to the one Hellerstein made to the diamond form.

[42] These constants for fixed points (ijklmonp) are qualitatively different from the signifiers of complex and hyper complex algebras (ijkEIJK) and should not be confused even if the same letters are being used by traditional convention in some cases.

[43] http://mathworld.wolfram.com/Octonion.html. Note that this relation to the Octonion produces an image of the Reflexive Special System. See "Reflexive Autopoietic Special Systems Theory" by the author at http://archonic.net

completeness and clarity by interacting with the various logical values. By treating fixed points as algebraic values we get a complete unification between the universal algebra and logic. This is impossible with first order logic alone.

When we use syllogistic and pervasion logics with respect to masses and sets, then we need to recognize that we could add to these languages, the macro "**if** *statements* **then** *statement* **else** *statements*" construction. This macro construction is for the type of reasoning concerned with the properties of the model different from the *if...then...else...* statements which express contingency and necessity in the Gurevich Abstract State Machine model representation. We also need the logical operators: **and**, (**nand**), **or**, (**nor)** and **not** as well as the **All Exist** (?) and **One Exists** (?). To be able to express the contradictions of Diamond Logic we need to be able add to any statement "*VALUE aspect BUT aspect*" when we are talking about the contradictory opposites of the same aspect, and "*VALUE aspect YET aspect*" when we are talking about the relations between different aspects.

It is necessary to recognize that the Vajra logic is not merely the combination of four Diamond logics aimed at the different aspects of Being. Rather the Vajra logic has its own emergent properties which can be seen in August Stern's Matrix Logic. It is in Matrix Logic that the tetralemma comes into play giving this logic a supra-rational aspect. Matrix Logic is a combination of Matrix Mathematics and Logic. In Matrix Logic the 'two by two' truth table matrices operate on truth vectors. Truth vectors may take orthogonal forms of either *bra* or *ket* and these are interpreted as having values of true, false, and *both* or *neither*. However, Stern does not interpret the fact that the *bra* and *ket*[44] truth vectors are orthogonal to each other. We can interpret this by saying that these orthogonal vectors are related to different aspects of Being, rather than the same aspect[45]. Thus we could see the matrix logic of Stern as the emergent logic of the relation between the aspects of Being. Stern shows how the matrix logic can produce scalar logic values that are equivalent to the lower level Diamond logic values; or if we reverse the operations then we get the production of truth tables. Matrix logic therefore spans the logical levels of scalar, vector and matrix where different complexities of terms appear. Matrix Logic becomes a Vajra logic merely by allowing the various orthogonal vectors to implement different distinctions between the various aspects of Being[46]. Also Stern demonstrates that this Matrix Logic, which combines mathematics and logic, allows for the computation by truth tables operating on truth tables alone to produce autopoietic structures. Matrix Logic is an emergent level above the deviant logics and it provides a clear picture of the logic of the meta-system. The meta-system is not something necessarily vague and indiscernible. It has indeed its own logic. The problem is that this logic is quite complex in the ways that Stern outlines. As we come to understand Matrix Logic in the context of all the aspects of Being, or as a Vajra Logic, dealing with each aspect separately, then a very precise picture of the operation of the Meta-system will arise. Matrix Logic introduces orthogonality and also highlights the relations between the various values of the *aspect*, *non-aspect*, *both aspect and non-aspect* and *neither aspect nor non-aspect*, and this is the means by which supra-rationality enters into the picture. It balances the paradoxicality, vicious circles, and absurdity that are articulated by means of Diamond Logic.

When taken in relation to the Vajra Logic, Meta-model theory gives us a basis on which to ground our design of real systems. Rather than producing formalisms that are divorced from the real world, Vajra Logic produces formalisms that deal with "reality as an independent aspect orthogonal to truth," and "identity as orthogonal to presence." When we combine this with the ability of the Gurevich Abstract State Machine[47] to model Turing and Universal Turing machines we suddenly have a ***systemism***[48] and an ***archonism***[49]. When we produce our rules in such a way that they are articulated not only in terms of truth and falsehood, but also in terms of reality, or perhaps in terms of success

[44] *bra* and *ket* are aspect vectors made up of two conjuncted variable cells which may have the values **10** *aspect*, **01** *anti-aspect*, **00** *neither aspect nor anti-aspect*, **11** *both aspect and anti-aspect*. For *aspect* you may substitute truth, reality, identity or presence and their respective opposites. The *bra* and *ket* aspect vectors are orthogonal meaning that one is horizontal and the other is vertical in terms of the direction of the stacking of the *aspect* variable compartments to make up the *aspect* vectors.

[45] This is like having a four dimensional "space" of aspects.

[46] These statements of the diamond logic might be nested inside statements of the Matrix Logic of the form *Both....and...* or *Neither...Nor....* which might have the form NONE value NOR value NOR value NOR value; ALL value AND value AND value AND value; SOME value NAND value NAND value NAND value; as well as SELECT value OR value OR value OR value. In other words we need versions of the tetralemma (A, ~A, Both A and ~A, Neither A nor ~A) which comprehend all four aspects at the same time rather than just two.

[47] The GAST method uses proof by existence rather than truth verification models of proof theory and thus is much more simple and straight forward than other formal methods.

[48] Rather than a formalism, because it is at the level of the system schema not the level of the form schema.

[49] Archonism is a neologism that the author uses for the meta-system schema. English has no appropriate term for this schema unlike the other schemas in the ontological hierarchy.

and failure as we see in the SNOBOL[50], ICON[51], UNICON[52] languages; then we will also be able to model in the additional situations that we encounter when we interface a system to its environment, i.e. the meta-system.

By assigning values of true and false, Model theory takes a first order logical language as its source for producing the model of a mathematical category. We wish to use Meta-model Theory to produce languages with sentences where we assign not only values of truth, but also values of reality, presence, and identity. We not only wish to describe meta-models of mathematical categories, but we also wish to describe schemas that are the core of systems designs that are inwardly dependent on philosophical categories and ontologies. These meta-models must be considered in terms of the deviant logical forms that appear with the Diamond[53], Vajra[54], and Matrix[55] Logics in order to understand more precisely the nature of the diachronic meta-models that found our formalism. A formalism for such languages has already been presented in the work Wild Software Meta-systems[56] in which the ***Integral Software Engineering Design Methodology*** was formulated. This methodology assumes that there are four fundamental viewpoints on any real-time software system. These are Agent, Data, Function and Event. Each viewpoint interacts with the other viewpoints through a bridging methodology, and for each methodology a minimal language is produced. These languages are more expressive than current graphically oriented design languages such as UML[57]. The combination of the languages that describe the minimal methods for real-time software design allows us to construct a meta-model of the system under design. It is correct to call this a meta-model because it is comprised of various models that are grounded in the various minimal methods that arise from the interaction between viewpoints. We only need to raise these models and apply them to a higher level of abstraction in order to make these methods applicable to the entire system, rather than only considering the real-time software element of a system. The meta-models of the designed system are described by sentences composed out of the minimal method languages. They encompass count (**set**) and non-count (**mass**)[58] ways of looking at things[59] as well as the application of syllogism and pervasion[60] logics. However, on the syntactic level, consistency completeness and clarity operate, and this is complemented by the semantic level where validity, verifiability and coherence operate. This is interesting because signification appears by the addition of the "aspect of reality" to the mix. In other words. a formal system already encompasses identity as tautology; and presence as the existential instantiation of variables. What is lacking is the distinction of reality. When reality is added,[61] then the semantic level is achieved where signification is produced. So the heart of model theory is the basis for the creation of meta-model theory which can be expanded to describe schemas, categories and ontological commitments.

Requirements that had once been aphoristically stated can now be converted into a Gurevich Abstract State Machine formulation that is a concrete interpretation of those requirements. In this representation there are myriad rules that embody the fusion of the data, function, agent and event viewpoints. But when we move to the area of design, then we use the languages of the minimal methods[62] to describe the

[50] See http://cs.fit.edu/~dclay/cse5040/snobol.html or http://www.engin.umd.umich.edu/CIS/course.des/cis400/snobol/snobol.html

[51] See http://www.cs.arizona.edu/icon/

[52] See http://unicon.sourceforge.net/

[53] Encompasses paradox and is para-consistent

[54] Encompasses all the aspects of Being including Reality, Identity and Presence as well as Truth

[55] Encompasses supra-rationality and gives a logic of the meta-system.

[56] See http://archonic.net/apeiron.htm

[57] Unified Modeling Language. See Object Management Group [http://www.omg.org/]

[58] Non-count or mass ways of looking at things exist in the English language but we do not use them the way that Aristotle defined them in Greek ontology which emphasised count ways of looking at things, even though the Pre-Aristotelians, including Plato, may have preferred non-count ways of looking at things. See The Discovery of Things by Wolfgang-Rainer Mann (Princeton, N.J. : Princeton University Press, c2000). Chad Hanson made a similar discovery about Chinese Philosophy. See Language and Logic in Ancient China, (University of Michigan Press 1983).

[59] One example of the kind of difference that is seen between set and mass categories is the difference between Self-Organized Criticality (SOC) of Peter Bak (see How Nature Works : The Science of Self-Organized Criticality; Copernicus Books 1996) which is a mass-like description of catastrophe which is contrast to Highly Optimized Tolerance (HOT) of John Doyle UCSB [http://www.cds.caltech.edu/~doyle/CmplxNets/] which is a set-like dual which is proposed as an alternative. However, many phenomena may be combinations of SOC and HOT like swarming animals in which the swarm may experience SOC phenomena while the individuals in the swarm may experience HOT phenomena. This theoretical example shows that the difference between set and mass ways of approaching things may be important for us to understand when we are analyzing complex systems and meta-systems and their interactions.

[60] Pervasion Logics were developed in India and China and are rooted in non-count ways of looking at things. They have not been well developed in our Western tradition of logic.

[61] Nietzsche's goal was to replace Plato's emphasis on Presence, Identity and Truth with Reality.

[62] The minimal methods are the bridges between viewpoints:

? dataflow between function and data both ways

? Gomma's darts between agent and data both ways

? worldline and scenario between agent and event both ways

? state machine between event and function one way

various meta-models encompassed by our design. Here the viewpoints are separated and their interactions specified via their interactions through the minimal methods. By giving us slices of a Turing machine, minimal methods allow this computation to be further specified. This specification of the design is then implemented with a programming language. For prototyping we might use a very high level languages such as UNICON, RUBY[63] or other lower level languages.

But we must remember that all these various transformations of the meta-model are still determinate. In order to produce a more robust modeling capability, we must also consider the other meta-levels of Being and their mathematical concomitants. Pure Being is represented by Calculus, Process Being by Probabilities, Hyper Being by Possibilities in the form of Fuzzy or Rough Math and Logic, and Wild being by the Propensities that we see in Chaos Theory, Fractals and Vagueness. This is just one way of seeing how various forms of mathematics model the kinds of Being. Another way is to look at Arithmetic as a representation of the *ontic*, Geometry as a representation of *Pure Being*, Algebra as a representation of *Process Being*, Group Theory as as a representation of *Hyper Being*, Mathematical Category Theory as as a representation of *Wild Being*, and Model Theory as as a representation of *Ultra Being*, i.e. beyond *Being*. Each of these forms of mathesis[64] has something in common with the various kinds of Being, and the sequence of their development is no accident[65]. Rather, in its own way mathematics has been exploring the kinds of Being in its development. We must be willing to increase the range of our models by adding these various forms of mathematics as a means of coming to terms with the relationship of our world and of the designs of things that we fit into our world.

But there is also a concern that our designs must now consider the diabolical use of our own technological infrastructure against us. This makes the drive to go beyond understanding systems and formalisms to meta-systems and deviant logics more pressing. As explained in the paper "Anti-Terror Meta-systems Engineering[66]," the wider view of nested emergent schema can help us look for those gaps and blindspots that an enemy might exploit. It calls us to develop our twenty-first century systems theory and systems engineering, by recognizing how they can be expanded to include meta-systems theory and meta-systems engineering as well as other schemas that fit within our philosophical categories that express our ontological commitments. This paper sought to bring some clarity to the relation of meta-mathematical meta-models and Vajra logics. Hopefully with these sophisticated tools we will be able to head off disaster before it happens as well as make our own systems more safe, secure, and robust. Safety and security are properties of systems that need to be added to those properties that already occur naturally from the interaction between the aspects of Being. The six fundamental properties are: consistency, completeness, clarity, coherence, verifiability, validity. If we want to describe other properties such as security and safety, we need to add sets of rules to our meta-models that distinguish those properties. This is what is called Aspect Oriented Requirements and Design[67]. The application of this approach addresses the fact that qualities are spread out within the designed system. Here those aspects are modeled with orthogonal rule sets added to the Gurevich Abstract State Machine Method. Basically when the rules are activated, they indicate when a property is violated. Those kinds of properties which are addressed by these added rules should call for an understanding of failure: failure to be safe and failure to be secure. Those failures occur because the meta-system is more complex than the systems that we build to inhabit them. Thus, our logics need to be robust enough to handle not just paradox, vicious circles, and absurdity, but also insanity with respect to truth and reality. It is those conundrums that we are designing against that need to be explicitly modeled and we need a logic like Vajra Logic which is built upon the foundation of Matrix Logic[68] to accomplish that. We live in a dangerous world which goes beyond our assumptions in ways that are difficult to anticipate. We need to arm ourselves against that

? petri net between function and event one way
? use cases between agent and function one way
? virtual layered machines between function and agent one way
? along with four data and event combinations.

[63] See http://rubycentral.com

[64] Mathesis here means the various forms of mathematical understanding represented by these sub-disciplines of Mathematics.

[65] A full explanation of this identification of the kinds of Being with the forms of mathesis would be too complicated to describe here. Let us just say that as we move up the scale the peculiarities of each form of mathesis tells us something about the kind of Being associated with that new level of mathematical organization. The levels are in a semi-historical sequence so that it might be said that mathematicians discovered each of these levels associated with the properties of Being one by one as they delved more and more deeply into the nature of mathematical objects.

[66] By author at http://archonic.net/

[67] See Krzysztof Czarnecki and Ulrich Eisenecker, Generative Programming: Methods, Tools, and Applications (Addison-Wesley Pub Co, 2000)

[68] Developed by August Stern in his books Matrix Logic (Amsterdam ; New York : North-Holland ; New York, N.Y., U.S.A., 1988) and Matrix Logic and the Mind (Amsterdam ; New York : North-Holland/Elsevier ; New York, 1992).

world with a kind of meta-model theory that includes deviant logics that go beyond the standard forms of logic and mathematics. We are continually projecting these schemas onto the ontic[69] in our work as systems engineers. To the extent that we can make them more prominent and conscious, the more we will reduce our blindspots and thus will make ourselves less vulnerable to attack through the gaps in our understanding of the technological infrastructure that we produce.

This brings us back to the question of grounding. In our designs we appeal to multiple reasons as a basis for our design actions. But one thing we need to understand is how much the design activity is self-grounding, i.e. self-fulfilling. When we design we continually revisit the axioms of our requirements. Many of these are mutually grounding or even grounding as a community of axioms that we treat with a kind of Cognitive Systemization described by Rescher. But ultimately the discontinuities between the axioms remain as a supra-rational ground. However, what we do not do is look at the requirements of the meta-system, the domain, and the world. This broader horizon of requirements needs to be taken into account in order to provide the basis of designing the meta-system[70], domain and world that the formal structural system is to be embedded in. These broader environments are not just systems but something very different, in the way that an 'operating system' is different from the applications that it encompasses. The broader environments have different kinds of requirements that have to do with the interoperability of the various technological systems that form part of the technological infra-structure. When we turn to these requirements and realize that they appear in a what Bataille[71] calls the *General Economy* rather than an ordered logical and rational *restricted economy*, then the real need for meta-models and deviant logics becomes clear. This is the horizon of exploration for a twenty-first century Schema Theory[72] and Schema

[69] The ontic emergent hierarchy might be:

gaia ?
social group
animal
organ
multi-cell organism
cell
macro-molecule
molecule
atom
particle
quark
string ?

There are a myriad ways of cutting up the emergent levels that appear in nature. This is just one of many given for heuristic purposes.

[70] There is no appropriate word in English for this general "meta-system" schema. A neologism that we might adopt for this term could be the term 'Archon' which signifies the functional heads of the Greek democracy after the sovereign was deposed. That act of deposing the sovereign is seen as the process of turning the city-state from a system into a meta-system. Here system is seen as analogous to the idea of sovereignty and non-representational democracy which is decentralized and seen as analogous to the meta-system in the political arena. Synonyms are ecosystem, field, mosaic, collage, market, general economy, active media, situation, context, milieu, universal Turing machine. It turns out that the prefix 'meta-' can have three different meanings signifying: ABOVE in terms of logical type; BEYOND or after in terms of sequence; and CHANGE in terms of supercession. Anthony Wilden in System and Structure (Travistock, 1980) uses the term metasystem^{A} in the sense of ABOVE to mean something that is a higher logical type than the system. The system he defines as an ecology. Thus he has reverses the use of terms from those that I have suggested. George Klir in Architecture of Systems Problem Solving uses the term metasystem^{C} in the sense of CHANGE primarily to be the dual of the structure system. I use the term metasystem^{B} in the sense of BEYOND to signify what is the complementary inverse dual of the system, i.e. what is beyond it either inside or outside. So there is terminological confusion in the use of this term among various sources. This results from the ambiguity of the prefix 'meta-' that comes down to us from the Greeks. In this paper we will stick to metasystem^{B} as the signification of choice for this term and will identify this use of the term with a hyphen as "meta-system". That means the next higher schema in the ontological emergent hierarchy from the system schema for which there is no general name. This is odd because all the other general schemas seem to have names. But this namelessness is part of the reason that it is a blindspot for us as a culture.

[71] Accursed Share (Zone Books, 1991)

[72] The ontological emergent hierarchy might be:

pluriverse *(as defined by David Deutsch in Fabric of Reality (Allen Lane, The Penguin Press. 1997))*
kosmos *(physical universe, first defined by Anaximander) opposite of chaos*
world *(lifeworld, realm of human existence defined by M. Heidegger in Being and Time (New York, Harper; 1962) and E. Husserl in Krisis in the European Sciences... (Evanston, Northwestern University Press, 1970))*
domain *(crafts, disciplines, departments of the university or as defined by M. Foucault in The Order of Things (New York, Vintage Books 1994))*
meta-system *(aka archon; mosaic, market, field, media, ecosystem, universal Turing machine, operating system, general economy, etc. as defined by A. Plotnitsky in Complementarity (Durham : Duke University Press, 1994))*
[special systems] *(dissipative, autopoietic & reflexive) A deeper level of schema that only exists between the system and the meta-system which further increase their importance. See Reflexive Autopoietic Dissipative Special Systems Theory by the author at http://archonic.net*
system *(first defined by L. von Bertalanffy in General Systems Theory (New York, G. Braziller c1968))*
form *(as defined by G. Spencer Brown in Laws of Form (Allen and Unwin, London. 1969))*
pattern *(as defined by Ulf Grendander in Elements of Pattern Theory (Baltimore: John Hopkins, 1996) and by G. Klir in Architecture of Systems Problem Solving (1985, Plenum Press, New York))*
monad *(first defined by Leibniz in Monadology)*
facet *(first defined in quantum mechanics as superposition)*

Engineering which will hopefully replace what we now call Systems Theory and Systems Engineering[73]. It is the hazards we have found in the world that drive us toward the exploration of this horizon where meta-systemic environments, domains and worlds need to be designed just as much as the systems we have learned to design in the last couple of centuries. Twenty-first century systems engineering will be much more complex and sophisticated than anything we have put into practice up to this point. But we must rise to the challenge in order to advance from systems design, to environmental meta-systems design, to cross-environmental domain design, and finally to the design of future worlds.

APPENDIX: EXAMPLE ISEM LANGUAGES

SET SUB-LANGUAGE

{DEFINE} BEGIN SET id
{DEFINE} ATTRIBUTE id HAS RANGE FROM alphanum TO alphanum.
{DEFINE} ATTRIBUTE id HAS VALUE alphanum.
{DEFINE} IDENTIFIER ids IS {NOT} PARTICULAR.
{DEFINE} IDENTIFIER ids IS {NOT} SET.
{DEFINE} PARTICULAR id HAS ATTRIBUTE ids.
{DEFINE} PARTICULAR id HAS REPRESENTATION id.
{DEFINE} PARTICULAR id IS INSTANCE id.
{DEFINE} PARTICULAR id IS MASS id.
{DEFINE} PARTICULAR ids IS OF CLASS ids.
{DEFINE} REPRESENTATION id HAS BINARY id.
{DEFINE} SET id IS INSTANCE id.
{DEFINE} SET id IS MASS id.
{DEFINE} UNIVERSAL id HAS ATTRIBUTE ids.
{DEFINE} END SET id.
{INQUIRE} INTERSECT SET id WITH SET id.
{INQUIRE} MEMBERSHIP OF SET id.
{INQUIRE} PRODUCE RANDOM PARTICULAR OF SET id.
{INQUIRE} UNION SET id WITH SET id.
{PERFORM} EXTRACT PARTICULAR ids FROM SET id.
{PERFORM} EXTRACT SET ids FROM SET id.
{PERFORM} INSERT PARTICULAR ids INTO SET id.
{PERFORM} INSERT SET ids INTO SET id.
{POSIT} PARTICULAR ids {DOESNT} BELONG TO SET id.
{POSIT} SET id HAS {NOT} PARTICULAR ids.
{POSIT} SET id HAS {NOT} SET ids.
{POSIT} SET ids {DOESNT} BELONG TO SET id.
{POSIT} SET ids {DOESNT} EXCLUDE SET ids.
{POSIT} SET id {DOESNT} HAVE SET ids.
{POSIT} SET ids {DOESNT} INCLUDE SET ids.
{POSIT} {DONT} EXCLUDE PARTICULAR ids FROM SET id.
{POSIT} {DONT} EXCLUDE SET ids FROM SET id.
{POSIT} {DONT} INCLUDE SET ids INTO SET id.
{POSIT} {DONT} INCLUDE PARTICULAR ids INTO SET id.
{POSIT} {NOT} EMPTY SET ids.
{POSIT} {NOT} OCCUPIED SET ids.

meta set ALL SET PARTICULARS DIFFERENT.
meta set IF PARTICULAR PART OF UNIVERSAL THEN IN SUPER-SET.
meta set IF PARTICULARS IN SET IDENTICAL THEN DISCARD REPLICA.
meta set META-SET IS ALL REPLICAS OF SET PARTICULARS.
meta set PARTICULAR HAS ATTRIBUTE.
meta set PARTICULAR HAS CLASS.
meta set PARTICULAR HAS REPRESENTATION.
meta set PARTICULARS CAN BE IN MULTIPLE SETS AT THE SAME TIME.
meta set PARTICULARS CAN BE MASSES.
meta set PARTICULARS MUST BE DIFFERENT IN THE SAME SET.
meta set SET CANNOT HAVE ATTRIBUTE.
meta set SET HAS PARTICULAR.
meta set SET HAS SET.
meta set SET HAS UNIVERSAL.
meta set SET REPRESENTATIONS HAVE NO IDENTICAL ATTRIBUTES FROM SAME SET.
meta set SETS CAN BE INSTANCES.

meta set **ABDUCTION**: POSIT PARTICULAR THEN HYPOTHESIZE UNIVERSAL SET AND ATTRIBUTE FROM ITS SET AND ATTRIBUTE.

meta set **DEDUCTION**: IF ATTRIBUTE SHARED BY UNIVERSAL SUPER-SET AND PARTICULAR THEN PARTICULAR INCLUDED IN UNIVERSAL SUPER-SET.

meta set **INDUCTION**: IF PARTICULAR SHARED BY SET AND UNIVERSAL SUPERSET THEN ATTRIBUTE BELONGS TO UNIVERSAL SUPERSET.

MASS SUB-LANGUAGE

{DEFINE} BEGIN MASS id
{DEFINE} ATTRIBUTE id HAS RANGE FROM alphanum TO alphanum.
{DEFINE} ATTRIBUTE id HAS VALUE alphanum.
{DEFINE} IDENTIFIER ids IS {NOT} MASS.
{DEFINE} MASS id HAS ATTRIBUTE ids.
{DEFINE} INSTANCE id.n HAS REPRESENTATION id.
{DEFINE} MASS id IS SET id.
{DEFINE} INSTANCE id.n IS SET id.
{DEFINE} MASS ids IS OF CLASS ids.
{DEFINE} REPRESENTATION id HAS BINARY id.
{DEFINE} MASS id IS PARTICULAR id.
{DEFINE} INSTANCE id IS PARTICULAR id.
{DEFINE} MASS id {NOT} INSIDE BOUNDARY id.
{DEFINE} MASS id {NOT} OUTSIDE BOUNDARY id.
{DEFINE} INSTANCE id.n {NOT} INSIDE BOUNDARY id.
{DEFINE} INSTANCE id.n {NOT} OUTSIDE BOUNDARY id.
{DEFINE} INSTANCE id.n {NOT} ON BOUNDARY id.
{DEFINE} INSTANCE id.n {NOT} OFF BOUNDARY id.
{DEFINE} END MASS id.
{INQUIRE} INTERSECT MASS ids WITH MASS ids.
{INQUIRE} MEMBERSHIP OF MASS id.
{INQUIRE} PRODUCE RANDOM INSTANCE OF MASS id.
{INQUIRE} UNION MASS id WITH MASS id.
{PERFORM} EXTRACT INSTANCE id.n FROM MASS id.
{PERFORM} EXTRACT MASS id FROM MASS id.
{PERFORM} INSERT INSTANCE id.n INTO MASS id.
{PERFORM} INSERT MASS id INTO MASS id.
{POSIT} INSTANCE id.n {DOESNT} BELONG TO MASS id.
{POSIT} MASS id HAS {NOT} INSTANCE id.n.
{POSIT} MASS ids HAS {NOT} MASS ids.
{POSIT} MASS ids{DOESNT} BELONG TO MASS id.
{POSIT} MASS ids {DOESNT} EXCLUDE MASS id.
{POSIT} MASS ids {DOESNT} HAVE MASS id.
{POSIT} MASS ids {DOESNT} INCLUDE MASS id.
{POSIT} {DONT} EXCLUDE INSTANCE id.n FROM MASS id.
{POSIT} {DONT} EXCLUDE MASS ids FROM MASS id.
{POSIT} {DONT} INCLUDE MASS ids INTO MASS id.
{POSIT} {DONT} INCLUDE INSTANCE id.n INTO MASS id.
{POSIT} {NOT} EMPTY MASS id.
{POSIT} {NOT} OCCUPIED MASS id.

For further explanation of what these levels mean see "Anti-terror Meta-systems Engineering" in INCOSE 2002 Proceedings by the author.

[73] See "Meta-sysem Engineering Futures" by the author at http://archonic.net/

meta mass ALL MASS INSTANCES IDENTICAL.
meta mass IF INSTANCE IN BOUNDARY THEN PART OF INFRA-MASS.
meta mass IF INSTANCES IN MASS DIFFERENT THEN DISCARD ODDITY.
meta mass INSTANCE CANNOT HAVE ATTRIBUTE.
meta mass INSTANCE HAS CLASS.
meta mass INSTANCE HAS REPRESENTATION.
meta mass INSTANCE REPRESENTATIONS HAVE NO DIFFERENT ATTRIBUTES FROM OTHER INSTANCES.
meta mass INSTANCES CAN BE IN MULTIPLE MASS AT THE SAME TIME.
meta mass INSTANCES CAN BE SETS.
meta mass INSTANCES MUST BE IDENTICAL IN THE SAME MASS.
meta mass MASS CAN BE PARTICULARS.
meta mass MASS HAS ATTRIBUTE.
meta mass MASS HAS BOUNDARY.
meta mass MASS HAS INSTANCE.
meta mass MASS HAS MASS.
meta mass META-MASS IS ALL ODDITIES OF MASS INSTANCES.

meta mass **ABVASION**: POSIT INSTANCE THEN HYPOTHESIZE INFRA-MASS AND BOUNDARY FROM ITS MASS AND BOUNDARY.

meta mass **INVASION**: IF INSTANCE SHARED BY MASS AND SUPER-MASS THEN INSTANCE BELONGS TO INFRA-MASS.

meta mass **DEVASION**: IF INSTANCE WITHIN BOUNDARY OF MASS AND SUPER-MASS THEN INSTANCE SHARES INFRA-MASS ATTRIBUTE.

ABOUT THE AUTHOR

Kent Palmer[74] 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[75] 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[76]. He has had nearly twenty years experience[77] 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[78]," 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[79]. A new introduction to this work now exists. It is called Reflexive Autopoietic Dissipative Special Systems Theory[80]. He has given a tutorial[81] 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[82]. He has taught a course in "Software Requirements and Design Methodologies" at the University California Irvine Extension. (*Version 0.16; 4/30/2002; vl01a16.doc final*)

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[75] 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.
[76] http://dialog.net:85/homepage/fbpath.htm
[77] http://dialog.net:85/homepage/resume.html
[78] http://dialog.net:85/homepage/advanced.htm
[79] http://dialog.net:85/homepage/refauto2.htm
[80] http://dialog.net:85/homepage/autopoiesis.html
[81] http://dialog.net:85/homepage/incosewg/index.htm
[82] http://dialog.net:85/homepage/wsms.htm