Introduction

The Foundations of General Schemas Theory

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Background

Systems Engineering is a new discipline which is attempting to gain academic respectability. Systems Engineering has grown up in Industry and like Software Engineering before it now is attempting to establish itself as a legitimate discipline of study. For the most part Software Engineering was co-opted by the already existing discipline of Computer Science and the number of degree programs specifically in Software Engineering have remained few. In other words against the hopes of the Software Engineering Institute it has turned out that Software Engineering could not establish its own base in academia but instead became just another part of the already established discipline of Computer Science in the academy.

It is a question of the difference between education and job training. The Software Engineering Institute believed that there was in Industrial Production of Software a very different and quite extensive research domain to be exploited by the new discipline of Software Engineering so that it could establish itself independently of Computer Science. But the response of Computer Science departments was to add a single course in group production of software as a final course in the Computer Science curriculum, and thus by this addressed the issue, rather than developing a whole new curriculum in Software Engineering. Thus Computer Science embraced the subject of software engineering in a half hearted way and effectively prevented it's domain from being split by the institution of a new and rival discipline for the most part. This means that the discipline of Computer Science has extended its reach but at the same time it means that Software Engineering training and academic research remains weaker than it might be otherwise if it were its own discipline recognized as such universally.

Now if we turn to Systems Engineering we see that it is in a different sort of situation. There is no natural discipline on the academic side to coop this new industrially oriented discipline. On the academic side is Systems Theory which itself never made it as a respected and universal discipline despite the hopes of its founders. There are very few departments of Systems Theory in the United States. So this natural connection between an academic discipline that already exists and the associated industrial discipline cannot form a rivalry as occurred between Computer Science and Software Engineering.

Unfortunately most Systems Engineers as trained specialty engineers (Hardware, Software) know little about Systems Theory and generally do not see Systems Theory as their natural Academic counterpart as yet. And of course Systems Theory as a discipline can offer little support because of the fact that it has not established itself as an academic discipline that is separate from specialized disciplines. Therefore, it is more likely that Systems Engineering will be able to establish itself as a separate discipline in the academy because it has no natural rival there, if it can show it has a research domain that is independent of other existing disciplines that already exist. If Systems Engineering were to embrace Systems Theory as its basis then it

would at least have a wedge into the academic arena. But it is necessary to show that there is a *sui generis* research horizon that is independent and fertile for future research beyond that of Systems Engineering in order to establish itself as a discipline.

In this thesis I hope to show that there is such a research horizon which stretches out before the nascent discipline of Systems Engineering.

Research Domain

Systems Engineering is a new discipline with its own research horizon. That horizon stretches out in one direction toward the practice of Systems Engineering itself within industry. But on the other hand that horizon stretches toward the foundations of the discipline in Systems Theory and beyond. Most of the research that is being carried out at this time is toward the direction of the augmentation of the practice of Systems Engineering itself within its industrial setting. Very little research is directed at the mathematical and philosophical foundations of the discipline. But I would argue that if Systems Engineering is to establish itself as a discipline within Academia which holds the respect of other disciplines then it must establish its mathematical and philosophical foundations much as computer science has attempted to do over the years. Computer Science has recognized that beyond mathematics there are certain algorithmic and data structures that are unique to its discipline that its students must understand in order to write software programs. Thus it prides itself on the extension of general mathematical foundations with specific computational structures that also have the same sort of precision as do the mathematical structures that lay below the computational structures. At its basis it can claim the Turing Machine as its own fundamental basis which is different from any mathematical structure. Because it has found its own *sui generis* basis it can adopt the general positivism of the sciences in general as its philosophical perspective.

Systems Engineering on the other hand does not at this time either have a mathematical basis nor does it have a philosophical basis to which it can appeal for legitimacy in academia. Rather it appears as a new industrial training program only without any clearly established research horizon with its own unique foundation. Even if it claims decent from Systems Theory then it is still in a weak position because Systems Theory itself never gained universal legitimacy. And the research horizon of Systems Theory itself has been co-opted by other disciplines such that it has been absorbed into other new sub-disciplines such as complex systems science and adaptive systems theory. These are mostly pursued as part of other disciplines but are cross-disciplinary themes which have drawn much attention lately. They gain their legitimacy from such things as the Feigenbaum Constant and the discovery by Mandelbrot of Fractals. This work is mostly brought into focus by institutes rather than as a separate academic department. However, what is interesting is that these new developments in Systems Theory do not associate themselves with the discipline of Systems Theory and the societies that were already in existence to advance systems theory such as the International Society for Systems Science, but rather these new frontiers of systems science have founded their own societies and institutes to advance their research agendas and have left General Systems Theory behind. Thus in some sense Systems Science or Systems Theory is a very weak academic basis.

Of course, Systems Engineering will just be added as another department within the school of Engineering. But because it does not have a concrete basis in a particular phenomena like electronics, mechanics, chemistry it will have a difficult time establishing its own unique contribution to the engineering curriculum and its own unique research horizon. It may in fact go the way of Systems Theory and eventually merely be under the auspices of institutes and centers rather than becoming a separate department. Fundamentally we can expect that if it can be co-opted by other disciplines then it

will be as established disciplines do not want to give up any of their territory. Existing Systems Engineering programs like that at Missouri Rolla, USC, and Stevens are experiments which we will watch with interest as we wait to see if other Engineering schools develop independent Systems Engineering programs.

When we ask about the Research Domain of Systems Engineering then there are two horizons to consider. One is toward the practical problems of the discipline itself within Industry. The other is toward its own Mathematical and Philosophical foundations. If it cannot establish some unique basis in this later direction it will be difficult for Systems Engineering to sustain itself as a separate department within the academic fields of endeavor. Ideally what we want is something like the Turing machine which gives us a specific basis like that of computer science which is different from the basis of any of the other engineering disciplines. A specific basis that has not been exploited by any other engineering discipline up to the present time yet which is recognized as being a just as firm a foundation as they have achieved in their history as they have developed as separate engineering disciplines. In a sense such a basis is what defines a discipline, more than the practical problems which it might address within industry. This is because practical problems and the situation within industry change over time, but the foundations of the discipline do not change. If Systems Engineering does not discover its own *sui generis* foundations then it is liable to be swept into other disciplines over time and not achieve universal recognition. So the domain of this research project is Systems Engineering Foundations which we believe are rooted in Systems Theory, but we believe that it is necessary to extend systems theory in order to provide proper foundations for the new discipline of Systems Engineering. It is believed that the extensions we will propose are fundamental and will establish Systems Engineering as a universally recognized discipline. In order to this to occur the subject matter of Systems Engineering must itself be Emergent, and in fact change the relations between the other disciplines which it must join in academia. It will be argued in this paper that the arising of Systems Engineering is an emergent event within the academic field and as such it fundamentally restructures that field giving rise to its own research horizon and subtly changing the research horizons of the other engineering disciplines.

This sets the stage for the establishment of the research domain for this thesis which is the mathematical and philosophical Foundations of Systems Engineering as a discipline.

Research Issue

The specific direction toward which we will look in order to find the mathematical and philosophical foundations of Systems Engineering will be toward General Schemas Theory. We will attempt to extend General Systems Theory which already exists and show that this extension is necessary in order to create the foundations of Systems Engineering as a new discipline. General Schemas Theory has both mathematical and philosophical import, and it causes us to rethink the nature of Systems Engineering itself under the rubric of Schemas Engineering once it has been articulated. We may not change the name of our discipline but we will need to rethink its dependence on a single schema out of the set of possible schemas and extend its use of the various available schemas in practice. General Schemas Theory addresses a fundamental problem with “Systems” Engineering, which is that the word “System” has become meaningless by overuse. Rather in order to invest the schema “System” with meaning we must compare it to the other possible schemas and understand their interrelations. Interestingly this has to my knowledge never been done before. In other words, our tradition has used schemas since the very beginning when we see them appearing 30,0000 years ago in the caves of France, but it has never

explicitly studied the set of schemas and their relations to each other. Rather the schemas are normally submerged in various disciplines as ways of describing specific phenomena. Only occasionally do the schemas become separated out from their contexts within disciplines to become generalized, as has happened with General Systems Theory. But even then such a study, which is interdisciplinary and transdisciplinary never managed to establish its own universally accepted discipline. Rather it is the work of various practitioners within various disciplines who tried to work with others across disciplines to see the ways in which the System schema appeared within various contexts. What we are proposing here is that what is necessary is to extend to other schemas the same sort of transdisciplinary and interdisciplinary focus that General Systems Theory has provide the system schema, but to go beyond that and establish a General Theory of Schemas which looks at the interrelations between all the schemas. Thus we are proposing that we go beyond General Systems Theory as the foundation of Systems Engineering, and in fact establish a new theoretical perspective that covers all the schemas, including pattern, form and others as well, so that we make it possible for Systems Theory to draw on all the schemas as its basis. And ultimately although Systems Engineering may not change its name to Schemas Engineering, the goal is to facilitate a transformation of both Systems Theory and Systems Engineering into General Schemas Theory and Schemas Engineering.

The research issue which has been at the center of this project has been a concern with the foundations of General Schemas Theory both in Mathematics and in Philosophy. Once we produce General Schemas Theory as a new theoretical perspective and relate it to engineering and other disciplines then as an emergent event it changes the relations between the traditional disciplines in academia, and it is this emergent change that we believe will serve as a new foundation for Systems Engineering practice and also the basis for the research horizons of this new discipline which no other discipline can claim because the other disciplines never recognized the need for an overarching transdisciplinary or interdisciplinary study of schemas previously. In fact, we claim that the emergence of General Schemas Theory as a subject in its own right not only effects the disciplines within engineering but all the disciplines in the university. Every discipline that uses schemas, which means all disciplines are effected by the emergence of general theory of schemas. All disciplines can contribute their own adumbration of schemas within their realm as the part of the knowledge of how schemas are articulated and used. All disciplines can contribute to a general knowledge of the various schemas. Of course, General Systems Theory is far ahead in this regard, but there is no reason to restrict ourselves to the system schema and we can do to the other schemas what has been done to the system schema taking General Systems Theory as an example that shows how a specific schema can be generalized across disciplines. We will make the argument that it was the failure of Systems Science to become Schemas Science that caused them to loose the new sub-disciplines of Complex Systems and Adaptive Systems which have tried to establish themselves independently of the older Systems Science community. Because of this the Systems Science community has become more fragmented and have lost even more momentum within the academic community which is riven by specialization and has difficulty recognizing the worth of interdisciplinary and transdisciplinary enterprises. Complex Systems and Adaptive Systems Theories are at once bound to the Systems Schema and also attempt to go beyond it. And to the extent that they attempt to go beyond the old disciplines of cybernetics and deterministic systems theory of the past they do not feel at home in the same domain with the previous generation of systems scientists. Also because that previous generation failed to produce systems sciences departments they had nothing to offer in terms of institutional legitimization to the new generation of systems scientists. But if we take

both generations of systems scientists together we see that General Schemas Theory goes beyond the horizons set by both generations. But General Schemas Theory addresses some of the problems of understanding the various contributions of complex systems theory and adaptive systems theory. The extension of General Schemas theory goes beyond both generations of systems science and encompasses them into a single discipline which then goes beyond what they have to offer by articulating the whole hierarchy of possible schemas beyond the system schema.

Contribution

The fundamental contribution of this thesis toward the development of a mathematical and philosophical foundation for Systems Engineering lies in the development of a General Schemas Theory. This contribution has been the result of a very long research project which grew out of the author's previous Ph.D. dissertation at the University of London in 1982 called "The Structure of Theoretical Systems in Relation to Emergence." This thesis was done in the Faculty of Economics and the Department of Sociology in the London School of Economics. It's focus was Philosophy of Science and considered the ontological foundations of the phenomena of emergence within the Western Philosophical and Scientific tradition. It used the Theory of Higher Logical Types of Russell to understand the various forms of Being found by the Continental Philosophers. And it used those various forms of Being to understand the stages of Emergence of new phenomena and new theories within our scientific tradition. After finishing that Dissertation I returned to the United States to pursue a career in Systems Engineering and Software Engineering in Industry. However, I continued my research agenda while working and eventually wrote a series of working papers called Wild Software Meta-systems in which I applied my research in Philosophy of Science to the question of the basis of Software Engineering Methods. Sometime later I wrote a book called Fragmentation of Being and the Path beyond the Void which was about the structure of the Western worldview based on the recognition of the various kinds of Being that appear in the process of Emergence. In the process of writing that book I discovered the Special Systems and the relation between the System and Meta-system. These were discovered by a close study of the Cities in Plato's various dialogues. These cities had some strange oddities and when they were studied systematically they revealed an interesting pattern. Once I understood the outlines of that pattern I began searching for a mathematical basis of that pattern, and found it in various mathematical categories. This allowed me to articulate Meta-systems Theory and Special Systems Theory and finally Emergent Meta-systems Theory in another series of working papers called Reflexive Autopoietic Systems Theory. The entire series of working papers was summarized in the first chapter called "Reflexive Dissipative Autopoietic Special Systems Theory." Once the theory was discovered I spent about ten years looking for historical examples of the theory making other elaborations to the theory. I also started to present the theory at conferences in order to let others know of the existence of the theory. However, a question remained which I took as the central question for this second Ph.D. research degree which was concerning the nature of the system, meta-system, and special systems. I began to explore the concept of the schema and began attempting to understand the extent of the schemas hierarchy and the interrelation between the various schemas within that hierarchy. In my research I had hoped to recapitulate at a deeper level the discovery of the meta-system, special systems and the emergent meta-system as an extension of Klir's Advanced General Systems Theory. However, this question of the nature of the schemas themselves arrested my attention, and the further I went into it the more interesting things I discovered. Therefore I decided that I should change my title of my dissertation from "The Foundations of Emergent Meta-systems Theory and Practice" to "The Foundations of

General Schemas Theory" in some ways a narrower topic but in another way a more general topic, as Emergent Meta-systems is merely a particular combination of schemas. We must understand what schemas are in general before we can understand the true import of these very strange schemas uncovered by Special Systems Theory, or Emergent Meta-systems Theory. And General Schemas Theory underlies all of Systems Engineering, in fact it underlies all of Science and Engineering, and thus is very general in its application. It appears to be the sort of foundation that Systems Engineering needs which will establish it within the academic realm as well as helping practitioners who are struggling with real problems with very little help from the research community. So I decided to forego the full depth of the research I had hoped to do with respect to the Emergent Meta-system and its mathematical basis and concentrate on this more foundational issue of the nature of the schema.

The contribution that is hoped for here is the establishment of a new theoretical enterprise called General Schemas Theory which will serve as a basis of Systems Engineering but has ramifications for all disciplines that use schemas. It is an extension of Advanced General Systems Theory of George Klir and goes beyond the identifications of a few new schemas like the Special Systems and the Emergent Meta-system, to consider the whole realm of schemas as such. We consider their tie to the mathematical foundations and their appearance within the Western Philosophical tradition.

Method

This thesis is philosophical, mathematical and theoretical. It attempts to open up a new research horizon by creating an episteme or paradigm shift within systems engineering in particular, engineering in general and within science universally. Like much research serendipity played an important role. The expected direction outlined in my research proposal was overcome by events when I found that the problem of schemas was much deeper than I had imagined. The principle method was one of thinking very hard about very difficult problems and this led to unexpected results. But this of course leads to a consideration of the role of method in science in general. I personally follow Feyerabend in his book Against Method where he boldly claims that Anything Goes as far as methods of discovery are concerned. Method means *meta-hodos* the way after, and thus are constructed not for discovery but to bring others along to the same palace that the researcher reached by unexpected realization or serendipity. Of course, as I set out I tried just to extend the general systems theory of George Klir. He ends his book Architecture of Systems Problem Solving by talking about Autopoietic Systems which was a theory developed by Maturana and Varella. I attempted to apply what I knew about emergence to the question of how you move from a theory at the autopoietic level, i.e. the level of the individual viable organism, to the social level. Most theorists wanted to repeat the same theory at the next level, like Luhmann, but I was sure that the theory at the next level must be emergent with its own properties. Eventually I discovered the Special Systems which needed emergent levels both above and below the Autopoietic level, i.e. one at the level of Dissipative Structures that had already been developed by Prigogine, and another at the Reflexive Social level which had been explored by John O'Malley and Barry Sandywell. But this articulation of the special systems that corresponded with the oddities of the cities of Plato had to be placed within a context of the formalization of the understanding of the relation between the system and meta-system. The meta-system is the categorical reversal of the arrows of the system, i.e. it is the inverse dual of the system. It is only when this inverse dual of the system is determined and defined clearly that the special systems can be seen as existing between the system and the meta-system. Once the meta-system and special systems have been defined then it is possible to define the Emergent Meta-system which is a dynamic

structure that conjuncts the normal system and the special systems to create a higher level organization called the Emergent Meta-system which produces the Meta-system as an emergent level by the conjunction of the lower level adjacent schema and the intermediary partial schemas called the special systems.

But ultimately once we have all these various new schemas then the question becomes "What is a schema, more generally?" and that can only be answered by developing the hierarchy of the schemas and attempting to understand its mathematical and philosophical basis. This was done by searching in mathematics for something that could allow for the understanding of the articulation of the schemas, and also by looking in philosophy for how the term schema came into use in the tradition and developed over time. This more general study of the nature of the schema led to some interesting results which this thesis will endeavor to present.

The research was undertaken in phases with each phase giving rise to a series of working papers. Thus research progress was recorded assiduously. Various of these papers were given at different conferences on Systems Engineering and Systems Theory. The Research working papers and Conference papers are available at http://holonomic.net.

Principal Discipline

The principal discipline of this thesis will be General Schemas Theory itself. However since we are establishing a new discipline other principal disciplines invoked in this thesis will be Mathematics, Logic, Systems Theory, Systems Engineering and what we will be calling Schemas Theory which at this point does not exist but we hope to show that it should exist and could form the foundation of Systems Engineering, Systems Theory, Engineering and Science in general. By discovering a new deeper foundation for science and engineering we propose that this changes the nature of these traditional disciplines considerably. In order to show this a framework has been developed that allows us to see the relation between Schemas with more traditional disciplines such as Logic and Mathesis which is active mathematical thinking that results in Mathematical categories. The major point is that Schemas were introduced early in the Western tradition but did not get developed as a separate discipline and so this imbalance has been having a detrimental effect from the beginning of the tradition on the relation between science, engineering and practical live supported by technology. There is a fundamental chasm between theory and practice that is created by not having a theory of schemas which is as well developed as our theories of math and logic. Once we understand that Schemas Theory should be a discipline every bit as precise and well articulated as Math and Logic then we can see that Schemas theory itself becomes our principal discipline which we are developing in this thesis. However, we cannot develop it without recourse to the other disciplines because we must first situate it within the tradition and in relation to other disciplines before we have anchored it, so that it may then be fully developed itself.

Another point that is important is that General Schemas Theory cannot be divorced from our understanding of Systems Theory, Meta-systems Theory, or Special Systems Theory because the more general theory displays many of the hallmarks of these other more specialized theories. Thus we have continued to learn about the Special Systems and the Emergent Meta-system as we have developed the General Theory of Schemas.

Context within a Lifelong Research Program

This research project in General Schemas Theory is a culmination of a lifelong research program. It needs to be seen in the context of the overall development within the larger research program. I began at the University of Kansas doing a double major in Sociology and East Asian Studies. Then I went to the London

School of Economics to continue my studies in Sociology. But while at the University of Kansas I took East Asian Philosophy and also courses in Phenomenology (Heidegger and Husserl) from Alfonso Verdu. So when I began my doctorate at LSE I was drawn both to Continental Philosophy, many of the works of which were just being translated, and also to Philosophy of Science which was a hot topic at LSE which had both Popper and Laktos among its teachers. The famous seminar of Laktos and Feyerabend had happened at the school just before my arrival. But I ended up auditing several courses in philosophy of science at the school and at Kings College. I focused on the concept of G.H. Mead of Emergence as a rubric under which to understand various phenomena of discontinuous change within the Scientific tradition, such as paradigm and episteme changes. I wanted to understand how the tradition produced these discontinuous changes spontaneously. It took me eight years to get through this Ph.D. program because of my fascination with the subject.

This research program that I started at London School of Economics set the stage for a lifelong research project in which I have been engaged as the fascination with the subject has never wained. The subject of this lifelong research program has been the structure of the Western Worldview and the relation of that to the phenomena of Emergence and Nihilism. This work has been predicated on an interest in East Asian Studies and the philosophical and religious systems of India and China. By comparing the Western worldview with other worldviews we get a unique view of it that is not possible if we do not compare it to other worldviews. The phenomena of emergence and the problem of nihilism are something unique to the Western worldview and it is because I have approached the Western worldview from the point of view of Eastern Philosophies and Religious systems (such as Advaita Vedanta, Taoism, Buddhism, and Islamic Sufism) that certain aspects of our worldview became clear that would not have been clear from any other vantage point. The overall thrust of the research program has been understanding the structure and uniqueness of the Western worldview in the light of other worldviews which are expressed as nondual in relation to the dualism of the Western worldview. Gregory Bateson in Mind and Nature talks about how if you study two subjects at once you get a higher order of information from their dialogue than you would get from studying each one separately and serially. This is precisely what I have found in my own research. Starting off knowing about Eastern Nondual Philosophical Systems and then studying the Dualistic Philosophical Systems of the Western Worldview has led to may interesting insights into our own tradition that would not be apparent to someone who only knew about Western Philosophy and Science. These insights have provided leverage in my attempt to make clear the structure of the Western worldview and that has led to an appreciation of aspects of it that have not been made apparent in the Western Tradition itself. I feel it is of paramount importance to understand anew the Western Tradition because of its global impact on the rest of the earth and its peoples and species. So the long term research project has been to attempt to understand the structure of the Western worldview as expressed in its ontology and see how that is related to the twin problems of emergence (discontinuous sudden change in the tradition) and nihilism (destruction of meaning in the tradition).

Relation to the Prior Ph.D. Research

In my dissertation the main thrust of the research was to take the theory of Higher Logical Types of Russell, and apply them to understanding the various kinds of Being discovered in Continental Philosophy. This means using an aspect of Analytical Philosophy to understand certain crucial parts of Continental Philosophy. In the process I identified a hierarchy of meta-levels of Being and then showed how any genuine emergence must go though all these layers of Being in order to re-pattern the world. Thus the structure of emergence is related directly to the

structure of the Western worldview from an ontological point of view. Emergences can either be artificial in which case they do not pass though all four layers and thus only contribute to nihilism within the worldview, but if the emergences, either from inside as a new theory or from the outside as a new phenomenon, traverse all four kinds of Being then a genuine emergence occurs and there is produced an utter discontinuity in the tradition like that separating Newtonian from Einsteinian science. A genuine emergent event fulfills the criteria for emergence of G.H. Mead in his book The Philosophy of the Present. In the course of my studies for my dissertation at L.S.E. I wrote about a thousand pages of working papers which I summarized into my dissertation. My dissertation was heavily influenced by my study of Sufism and especially the work of Sidi Ali al-Jamal called The Meaning of Man which I played a small role in helping to interpret. The bulk of my working papers for my first Ph.D. were only ever reviewed by my advisors and did not play a large role in my dissertation and were not included in it but only summarized at a very high level. But they had to do with the working out in detail of the implications of the structure of the Western worldview based on the meta-levels of Being. My dissertation called "The Structure of Theoretical Systems in relation to Emergence" was a high level summary of what I learned from writing these working papers.

That research set the stage for the research I have carried on that has led to this thesis on the Foundations of General Schemas Theory. Without understanding the structure of the Meta-levels of Being it would have been impossible to recognize later the reciprocal relation between these meta-levels and the hierarchy of the special systems. And thus it would have been impossible to generalize this to the entire structure of the hierarchy of the schemas. Understanding the ontological context into which the schemas are embedded within our tradition is crucial to understanding the schemas themselves. What I realized part way though the research for this second Ph.D. dissertation is that Emergence and the Schemas are complementary opposites of each other. And thus the work on the Schemas although perhaps not as exciting as the work on Emergence is a necessary completion to understading emergence as a whole. Things only emerge within the schemas. There is nothing that emerges that is not schematized. So schematization is part of emergence itself at a fundamental level. Emergences are discontinuous but not utterly free to come into existence in any form (schema) or free of schematization. Rather emergences always respect the constraint of the schemas. So schematization is an important aspect of Emergence that make it non-nihilistic when it surpasses the fourth meta-level of Being.

Relation to Other Previous Research Works

After finishing my previous Ph.D. in Sociology I discovered that there were no academic jobs to be had but I had already become interested in software and systems engineering while in England where I ran a Word Processing business and were we sold some of the first microcomputers if a brand called Jacquard. I had taught myself to program in Basic and began creating models and simulations on those first microcomputers to which I had access. I was intrigued by the idea of creating dynamic simulations of my theoretical models. So being interested in Software and Systems Engineering I found work in those fields at a time when they were just forming. My extensive study of Systems Theory during my Postgraduate work served me well in my new profession. Also my ability to do research made it possible for me learn the rudiments of the nascent professions in very short order. But as I worked I considered my work as field work and continued to study of the subject which had fascinated me as I during my postgraduate studies.

Eventually I realized the relation between the ontologies that I studied and the Software Engineering Methodologies which I was researching. I wrote a series of working papers called Wild Software Meta-systems in which I tried to capture these relations. The goal was to

place software methods on a more secure philosophical ground. My major thesis was that Software was an artifact at the third meta-level of Being and that is the reason it is so strange. Eventually I published my results in an invited article in the International Journal of Systems Science. After coming to terms with Software methods I broadened my research to look at the entire Western Worldview again as it is written in Mythology and developed a method called ontomythology that looks for the structures of the kinds of Being in Indo-European mythology. I wrote a series of working papers called The Fragmentation of Being and the Path Beyond the Void. This book took me four years to write and I was engaged in it from 1990 to 1994. In it I look at the structure of the Western worldview and its encoding in myth of the four kinds of Being as a structuring motif. It was in the process of writing this book that I discovered the first hints of the Special Systems as I engaged in a partial commentary on the Laws of Plato. All the cities of Plato in his dialogues have odd properties and as a Sociologist I was drawn to study them systematically. I discovered that they had a very peculiar and unique pattern when taken as a whole, and so once I saw what this pattern was I began searching for mathematical patterns that looked similar. I found those eventually and this led to my writing a second series of working papers called Autopoietic Reflexive Systems Theory which was written as I pursued this discovery process, and which I summarized finally in the first chapter called "Reflexive Autopoietic Dissipative Special Systems Theory". All of these books were copyrighted and published on the internet as non-printable electronic books.

After the discovery of the Special Systems and the Emergent Meta-system in about 1994, with their multiple mathematical isomorphisms and analogies to physical phenomena which made them fully scientific in my estimation, I began giving papers at conferences and exploring the historical precedents of these special systems throughout world cultures. I found many images of these systems that could be compared to the mathematical models that I had discovered. I continue to try to find new ways of understanding the nature of the special systems and the emergent meta-system. However, with all these research results they merely begged the question as to what is a schema. It is this question I set out to try to answer in the current research project that has led to this thesis. However, all this prior research is important to the understanding and assessment of this thesis. The question of the nature of the schema arises within this overall intense research project which has discovered new schemas and thus raises the question of the nature of the schema to a higher pitch than it has normally had in our tradition that does not question its schemas.

Relation to Work Experience

On returning to the United States from England I had decided to enter industry rather than academia but this decision was helped along mightily by the fact that at that time there were no academic jobs available in my subject that I could discover. So I first became a Systems Engineer and then entered the profession of Real-time Software Engineering. I acted as a technologist for a large Aerospace organization introducing new tools, technologies, methods, and processes. Through that work I became involved in the SEI's CMM initiative and spent several five years or so raising an organization from level zero to level three in software engineering. I was on the board and one of the founding members of the UCI Software Process Improvement Network (SPIN) which later moved to Long Beach State before it dissolved. I moved from Software Process Improvement to Systems Engineering Process Improvement at another Company and helped then achieve CMMI levels Two and then Three (we came within two practices of achieving CMMI level 5). Now I work at another company and have the goal of raising them from SE CMMI level one to level three. A concentration on SE Process Improvement allows me some degree of freedom to understand the whole of Systems Engineering as it is now practiced. When I am

not engaged in Systems Engineering Improvement or Technology work I engage in Systems Engineering Practice itself in various roles as necessary within the organization. After we had achieved SE CMMI Three I spent a year working on various projects and proposals before leaving for my new Process Improvement job. My resume is available at http://kent.palmer.name. The point is that I am familiar with the day to day practical problems of Systems Engineering and Software Engineering and the whole gambit of process improvement initiatives that attempts to address those problems such as CMMI and Six Sigma. I have written a complete Systems Engineering process myself, as well of being involved in writing Software Engineering processes. In that process I have become familiar not only with the literature in Systems Engineering, such as it is, from an academic perspective as well as the myriad handbooks of systems engineering practice that are produced by several companies for internal use, not to mention the Systems Engineering handbook produced by INCOSE.

In this thesis the goal is to overturn the current paradigm in Systems Engineering. As such all these materials, and even the materials that are presented at the INCOSE and CSER conferences are more or less irrelevant. Thus we will not be reviewing this literature here, because it has no bearing on the foundations we will attempt to lay. It is for the most part completely ignorant of the state of the art in Systems Theory, and it is that state of the art that our extensions into Meta-systems theory and Special Systems Theory stretch. Eventually the threshold of Schemas theory is breached by the work of discovering new schemas, until the question of the nature schemas themselves becomes apparent. Once we have breached the question of the schema itself, and its nature then we have entered a completely different epistemic or paradigmatic realm. In that realm the old ways of conceiving Systems Engineering vanish and instead we conceive it as Emergence Engineering as I noted in my presentation to CSER 2004 and 2005 which I called "The Foundations of General Schemas Theory" and in which I breached the results that I present here for the first time. If I am right and the foundations of General Schemas Theory actually begins to inform the research and practice of Systems Engineers then this whole discipline will look very different in the future and the current works on Systems Engineering will merely be of historical interest. The key to a new paradigm is to step into it and to embody and dwell in it, and then to explain the old paradigm in terms of the new. It is impossible to step directly from the old paradigm into the new paradigm as Kuhn has taught us. So we will not dwell on these now outmoded ways of thinking or working as systems engineers as a launch pad for understanding the new paradigm proposed here. Rather we hope that in the future Systems Engineers have better methods, tools, techniques and processes which makes their work more efficacious.

Intellectual Context within the Tradition

Because we are really starting with Mathematics and Philosophy rather than existing state of the art Systems Engineering in order to produce our new episteme or new paradigm for Systems Engineering, and because our emphasis is on Advanced Systems Theory as a basis of understanding Systems Engineering practice we need to get our bearings because this thesis will be quite different from others presented in Systems Engineering Departments. First of all we begin by assuming that Systems Engineering as a discipline does not exist unless it has some foundations within the tradition. Establishing that place in the tradition is the focus of this dissertation. So in a sense everything that has hither to been written about Systems Engineering is irrelevant, except perhaps as a prologue to the possibility of a discipline. What is important to us instead is the history of the Western Philosophical, Scientific, and Engineering tradition itself and its internal structure. That internal structure is lopsided because it did not develop the concept of the schema beyond a few hints here and there. And it is our hypothesis that if the theory of the

schema were developed it would not only serve as a bridge between Philosophy and Science but between Science and Engineering as well. And it would serve as a basis for the practice of Systems Engineering as it goes forward into the future building more and more complex systems. In fact the complexity of systems are so great that we have exceeded already the capacity of the system schema to hold them together and we need the higher level schemas as a basis for the global systems of systems and even more complex arrays of elements of the future.

When one has been working in the fields of Systems Theory, Mathematics and Philosophy for some time at a sophisticated level it is difficult to try to position oneself in relation to a nascent discipline that one is attempting to give foundation to. Systems Engineering is peopled by those who have avoided the interaction with these other disciplines. So one is not going to be readily appreciated by the practitioners that one is attempting to help by providing foundations for their practice. Many of them do not know their discipline is without foundation, and as a rule they are unlikely to care, rather they are engaged in day to day problems of creating large scale systems and really only care about incremental improvements in their ways of working that will help them deal with the information overload, the constant change, and the other problems that they are attempting to deal with on a daily basis. Our heart goes out to the Systems Engineer because he is the one who is finally responsible for the system working, i.e. having all of its intended emergent properties. And we understand that many systems fail or do not fulfill their full promise. The sources of these problems are myriad, and having foundations for the discipline is not likely to solve any of these problems soon. But the reason we need to attempt to provide those foundations is it is because that research based on the foundations will eventually lead, hopefully, to answers to some of the many problems that Systems Engineers face. This help will only come in the future, after the foundations have been explored, and been used to produce new methods and tools, and have utterly changed the face of the discipline. But we predict that Systems Engineering is a discipline ripe for paradigm and episteme if not ontological level changes. What is about to happen to Systems Engineering will be more profound that the change from functional to object oriented design in Software Engineering. That was a relatively surface level change based on the deep structure of the software methods. Rather here we are talking about Systems Engineering moving from being unable to build the more complex systems continually demanded of it, to being able to at least conceive of being able to build those systems based on the use of the other schemas than the systems schema which are available beyond the systems schema.

The case study of Systems Engineering is informative for other disciplines as well. It is the case of a nascent discipline without much promise but which in fact holds deep implications for all the disciplines that are probably unforeseen by those other disciplines. For Systems Engineering to succeed as an academic discipline it needs to establish its own research horizon, and to do that it must find its own phenomena that has not been exploited by other disciplines. Since Systems Theory never established itself as a discipline this looks unpromising. But what is not realized is that there is a hidden resource within the tradition that is yet untapped which is the idea of the schema itself. When we recognize the roots of that idea within the tradition and we make use of it then we find not only is Systems Engineering provided a foundation, but that a completely new theoretical subject comes into view which is in fact foundational for all the Sciences and Disciplines that use schemas, not just General Systems Theory. So we posit that Systems Engineering which seems so unpromising as a discipline in fact by giving systems theory a practical region for expression, goes further and calls into question the whole hierarch of schemas, which are needed to produce the very complex global arrays of elements that are necessary, and which the system schema

cannot handle on its own. Even when we add to that the *system of systems* concept it is not enough. When we have the full panoply of Schemas to draw from our understanding of our world becomes so much more precise and detailed. And it is on this basis of the whole hierarchy of the schemas that we come to understand the basis for systems design and architecting much better. But for other disciplines what we see in Systems Engineering is an emergent event in which a neglected part of our worldview suddenly becomes important in an unforeseen way. In this way the thesis itself is a trace of an emergent event, in which the fundamental assumptions of science and technological engineering are transformed in a fundamental way. The schemas have always been there, and have always been used, but have never been seen as important until now. Suddenly they are discovered to be the foundations of a whole discipline and to change the understanding of science and technology itself in the process.

We approach the problem of founding Systems Engineering not from Systems Engineering itself with its reduced horizons, but from the point of view of postmodern philosophy, modern mathematics and logic, and from advanced systems theory. In a way Systems Engineering itself is peripheral to our immediate concerns which are predominantly based on philosophy of science, postmodern philosophy, advanced mathematics, logic and systems theory. Something is wrong at the heart of our tradition, and we need to right that wrong, and as a side effect Systems Engineering gains the foundation it so deeply desires. The lack of foundations for Systems Engineering is just a symptom of a much deeper problem. But if it had not been for the problem at the surface we might never have realized the deeper problem which needs to be solved for the tradition as a whole. But because we are coming at Systems Engineering and its problem from a very wide perspective that looks across the whole tradition and with a mind to the fundamental problems of philosophy of Science in general it is going to be difficult for many to see the connection between General Schemas Theory and Systems Engineering, from the vantage point of Advanced Systems Theory, Engineering in general, Science in general and Philosophy in general. It goes against the whole drift of specialization that is so endemic in our tradition. This thesis is non-specialist oriented but speaks to something very general in the tradition that is lacking, which is a full blown theory of schemas. This only comes to our attention when we indeed discover that there are new schemas that no one ever knew existed before. When we discover new schemas like the special systems and the meta-system then we begin to ask what are these things called schemas and why have they not been discovered long ago. But then when we look back into history we find the signature of these schemas in forgotten images and lost sciences and so we realize that we are remembering as Plato says something that we knew before but forgot. So in a way we are not discovering anything new but something very old which was lost.

So in order to get our bearings in the Western Scientific and Philosophical tradition we need to take a very broad contemporary view that takes into account progress in Philosophy, in Mathematics, in Logic, in various disciplines that has only happened in the last century. In a way Systems Engineering is still a very Newtonian discipline in spite of the effects of quantum mechanics with respect to electronics incorporated into systems. But the thrust of philosophy and science in the last century has been to go beyond Newtonian models. However if we viewed the work of systems engineers we would not see the any difference that would suggest how different our science, mathematics, and logic has become in the last century. The systems engineers that oversaw the building of the great pyramid probably worked in similar ways to the systems engineers of today. They saw themselves as building a monolith is whole of perfect form. Current systems engineers today have a similar view even though in many cases they are dealing with high technologies. There has been little advance in the human side of the

construction of technological systems. Even process improvement seeks only incremental change to existing ways of doing things. So we can see that there is plenty of room for change in the way things are done when we are producing systems with respect to how we as humans operate within the technological environment. This is dependent on the changes in science and philosophy and other disciplines filtering down to the level of practice in engineering the most conservative of disciplines. So in this dissertation we begin not with the discipline at it stands as our starting point but the tradition as it appears at its cutting edge, and then we attempt to extrapolate from that the necessary elements of a foundation that will not only serve systems engineering but also transform the whole of the tradition based on its own inner resources. This is our challenge.

So we will assume some familiarity with the Continental Philosophical Tradition, with progress in Mathematics, in Logic, in other disciplines in the last century, and we will be actively referring to these other disciplines throughout our attempt to develop a General Schemas Theory. We will attempt to explain the background information as much as is feasible, but tutorials in depth about the supporting subjects will not be possible. Fortunately this thesis is supported by working papers and so we will draw on the working papers as much as possible to fill in background information. Since we are assuming a philosophical basis that most systems theorists let alone systems engineers have never heard of before we are from the beginning jumping off into the deep end in our study. We are assuming the background of Continental Philosophy in the form of the work of Husserl, Heidegger, Merleau-Ponty, Derrida, Deleuze, Henry, Baudrillard, Batille and others as the touch stone of our approach to the problem of the development of General Schemas Theory. We will especially be using the work of Gilles Deleuze as a basis of the work on this thesis. His is the most advanced and far reaching of the continental philosophers with which we have some recourse in this work. However, besides the modern continental philosophers we will have some reason to talk about other philosophers such as Nietzsche, Kant, Descartes, Aristotle, and Plato as well as the Pre-Socratics. Science and Technological Engineering functions within an envelope produced by Philosophy. If we do not understand the horizons set out for us by Philosophy we will never understand its implications for Technological Engineering. It is Heidegger who pointed out that the Essence of Technology is Nihilism in the last century and from that point forward the fundamental relation between technological innovation and emergence on the one hand and nihilism on the other hand has been a hot issue in Philosophy. We will not take up this issue directly but it stands behind our search for a foundation for Systems Engineering, seen ultimately as Emergence Engineering. If Systems Engineering is Emergence Engineering then it must have a fundamental relation with the opposite of emergence which is nihilism and thus a fundamental relation with the essence of technology. Now we would expect engineering to have a fundamental relation with the essence of technology. So it is no surprise that this question comes to a head in Systems Engineering and its search for its foundations. We know from Postmodern philosophy that the search for foundations in general is futile. There are no first principles on which to found out science or our philosophy. This is a hard lesson that philosophy has finally learned for the most part, and we have now foundationless philosophies being proposed. But when we talk about the foundation of Systems Engineering in General Schemas Theory we are not talking about the same kind of foundation that Science in general or Philosophy in General seek in vain. Rather we are talking about a structural analysis of the Philosophical and Scientific tradition itself and the realization of some hidden possibilities within that tradition that may be used to help Systems Engineer achieve a partial foundation for its own endeavors that may assist it in being more efficacious. It is internal structural asymmetries in the tradition that need to be corrected that can give help to Systems

Engineering as a discipline, and transform other disciplines as well, which can offer this partial respite from the reality of the foundationlessness of the entire enterprise of Science and Philosophy. Our understanding of the relation between the System and Meta-system as articulated by Arkady Plotnitsky in the book Complementarities in forms our understanding of the relation between the discipline of Systems Engineering as a restricted economy and the rest of the disciplines the club of which it seeks to gain entry which is a general economy in Bataille's terms. All the disciplines are attempts to produce restricted economies in the face of the general economy of nature and the general economy of human artifacts that are embedded in nature. So ultimately there is only the foundationlessness of the general economy, but each discipline is a ship sailing on that turbulent ocean. We can see General Schemas Theory as providing an anchor in that seascape even if there is no landfall in sight. Like the building that they build in Mexico city which have as much weight below ground as above ground in order to have ballast in a foundationless ground, we can build disciplines that have an equal depth as they have height above ground level. Here we seek only to fill in that ballast based on the state of the art in Philosophy, Systems Theory, Mathematics and Logic so that the Systems Engineering discipline can at least float with the rest of the buildings that make up Mexico city which are all foundationless, given they are built on an ancient lake. We come to this job not so much for the sake of Systems Engineering itself, but for the sake of the whole tradition which has an unknown warpage only made apparent when we unfurl general schemas theory. What appears as an attempt to ground Systems Engineering is really only a side effect of untwisting a fundamental warpage in the whole tradition that has failed to develop general schemas theory from the beginning, although it was present very early in the tradition and merely remained an incipient ingredient of the philosophical and scientific tradition until now. Finding the possibility of General Schemas theory is like finding a hidden treasure that lay about for anyone to discover from the very beginnings of the tradition. That treasure is transformative of the whole tradition and by the way provides Systems Engineering with a partial, although not absolute foundation. But we believe that a partial foundation is good enough to remain afloat in the sea of the general economy for the restricted economy of the discipline.

Structure of the Working Papers

This dissertation is supported by several series of working papers. They record the progress in research toward the end of this dissertation which is a summary of part of this work. The first series that was undertaken was called the anti-thesis which considered each separate schema by itself and in the context of the entire series of schemas. It is these working papers that will serve as our in-depth definition of the schemas and their interrelation. Then I produced a series of working papers on the foundations of Schemas Theory which was related to their mathematical roots. It is these papers that will be the focus of this thesis and it was these papers that were presented at the CSER conference and were the emphasis of my talks at CSER 2004 and 2005. The fundamental work at the basis of this thesis was accomplished in those papers. These papers culminated in two papers in another series called the Meta-physics of Emergence. In those papers I revised my fundamental theory of the kinds of being and the structure of the Western worldview by adding a fifth meta-level of Being. Those papers opened a new horizon of ontological research which has not been fully explored and may not come into play within this thesis except peripherally. After that I started another series of working papers that were a genealogy of the concept of the Schema in the Western Tradition. That quickly became a commentary on the Cratylus by Plato. At this point that commentary is not complete but I intend to pursue that genealogy in parallel with writing the thesis itself. What has been uncovered so far, which is probably

enough for present purposes is the entry of the concept of the schema into the western tradition in the work of Protagoras and Plato. That genealogy ideally would continue to encompass the use of schema in Aristotle De Anima, the fact it is missing in Descartes, and its eventual canonical definition in Kant and the use it is made of in Heidegger. However, these later steps are better known to me already so that the writing of them as working papers would just be an exercise in which I strive for completion. The key point is to identify the entry point into the tradition which I have done in the papers I have written in this series. Finally I have written another series of papers on Nondual Science which has taken the place of the Thesis in the original structure of the research project that I envisaged. In those papers I project the concept of the creation of a new kind of science which is nondual rather than dualistic in the West and how Special Systems Theory, Meta-systems Theory and Emergent Meta-systems theory would fit into that greater project. The thesis is an all encompassing look at the impact of the discovery of the Special Systems, Meta-system, and Emergent Meta-system schemas on Western Science as a whole. But in it begs the question as to what is a schema. This is answered by the anti-thesis in its specifics as it considers all the schemas and their relation to each other. But then that draws us down into the foundations where we must consider the mathematical foundations of schemas theory, and then the genealogy of the concept of schema within the tradition. The one part of the series of working papers that is still unwritten is that which I called the synthesis which was meant to be a further exploration of the mathematical basis of the Emergent Meta-system. Hopefully I can manage to purse that in the future, but in doing this research I have been sidetracked by the whole question of the foundations of general schemas theory within the tradition. And I discovered that this is a more profound question and a more necessary question in many ways that the exploration of any one schema. However, certain elements of this answer has appeared in other papers along the way and so this section was not completely neglected even though the series of working papers on it has not been written as yet.

In the process of writing the series of papers on nondual science, I realized that if we were able to create a nondual science based on special systems theory then that would react back on our theory of nonduality. This led me to write two papers in a series on the science of nonduality. The second of these papers resulted in a key synthesis of many aspects of my thinking up to this point. It is from the vantage point of that synthesis which I have refrained from publishing on my website that I will be writing this dissertation. It was a key milestone in my own intellectual development and I believe that not only does it provide the key to the science of nonduality but also it provides the key to understanding the context of schemas theory. And so we will use that synthesis as the basis for explaining the import of General Schemas Theory and its context within our tradition.

Structure of the Thesis

[The structure of the thesis will be discovered as we move though the exposition of the General Theory of Schemas. Thus this section will be rewritten after the thesis has been finished.]

Coda

One of my favorite books is Knowledge Painfully Acquired by Lo Chen Shun. In that book Lo Chen Shun explained that he spent a whole lifetime pondering the words of the sages attempting to figure out what they really meant and eventually he came up with an answer that satisfied him so he wrote his book to pass on the wisdom that he had gained from his struggles. So many books are written without sufficient time given in thought about the subject. Perhaps this book is one of them as well. But unlike many dissertations it comes at the end of a career of practice conjoined with intensive research into the foundations of science and technology and their roots in the structure of the Western worldview. Because I

was making my living in Industry where no one cares about Philosophy of Science, or theory, or anything but meeting deadlines and end products I was free to pursue my studies without having to respect the boundaries of disciplines, but rather I could do my research where ever my interest and fascination took me. I have for many years been a member of the National Association of Independent Scholars and I cherish that independence of thought. Because of this my dissertation will appear somewhat quirky compared to other dissertations by younger scholars. I spent eight years reading in the British Museum what ever caught my fancy, and that period made it possible for me to use any down time when not engaged in my career in Systems Engineering or Software Engineering to think about loftier things that I found interesting. But since finishing my Ph.D. I more that doubled my bibliography. So I have kept up continuing to do ardent research over the years in order to continue to add to my repertory of disciplines that I dabble in and some of which I actually understand to some extent. So you will find that here there will be a wide array of not just philosophers mentioned but discipline boundaries breached, all in the name of giving a nascent discipline some hope of establishing the foundation we need to be able to design and build the global systems of the future, and hopefully in some way avoid bad designs that come from only thinking of systems and never considering the meta-system environment of those systems until it is too late, as we have done in the past. And hopefully the existence of Special Systems and Emergent Meta-systems as odd and eccentric schemas will help us build a better future as we discover how to design systems based on those schemas. But I believe that ultimately it is General Schemas Theory whose foundations I attempt to lay here that will help us most to understand our own sciences as projections onto nature and help us to understand the global systems and systems of systems we build within a broader context of all possible schemas, and that will contribute hopefully to our self understanding.

Ultimately I offer this work as an example of knowledge painfully acquired by a lifetime research project which has culminated in the discovery of General Schemas Theory as the discipline we need to support our further development of global systems and arrays of elements beyond systems governed by other schemas, but also hopefully this theory will help us gain enough self understanding to forego the destruction of our planet and the fouling of our own nest in the process of the global expansion of our worldview and our technological infrastructure that supports the economic infrastructure that in turn supports the functioning of the global society and cultural diversity we are quickly losing. We cannot turn back the clock on progress – which is perhaps a regress for destroyed species – but we can perhaps limit the unintended consequences and unwanted side effects if we have broader patterns within which to understand our design than just that of the system. When systems theory and systems engineering become schemas theory and schems engineering then we can at least hope that broader concerns will be addressed in our designs than merely placing a working system out the door regardless of the consequences. Systems need to work within the guidelines of the other higher level schemas. This is an imperative for the future of engineering. We expect all of engineering to be effected by this insight, because all of engineering comes together in the systems engineering function. So if systems engineering becomes schemas engineering based on schemas theory then all of engineering will be affected. And when we pull the schemas out of the scientific disciplines as Systems Theory has been pulled out and generalized then that will have a profound effect on Science in general because our projections of the schemas will stop being largely unconscious. And in that way an obscure concept that appeared within our tradition that was never fully developed as Logic and Math has been will end up transforming our relation to the world in which we live. That is because Schemas are more basic that kinds. Our culture has been fascinated with kinds from the very beginning to the detriment of our understanding schemas

that are more basic. As we explore this more basic sort of categorization prior to the identification of kinds or individuals, or assigning significance then we reorient our entire philosophical foundation and heal to some extent the duality and the breach between the practical and the theoretical. General Schemas Theory has far reaching implications for our entire tradition. I hope that becomes clear as this thesis progresses and we ultimately end up considering the nature of the schemas more deeply in our tradition. It will not solve all the problems but it will help address some very basic ones and it will help us understand ourselves better in as much as we project order on our environment, the order we project sometimes does not fit very well what it is projected upon. General Schemas Theory is about understanding that projection process in general but it becomes more poignant when seen in the context of engineering where the projections are embodied and concretized as specific technologies and infrastructures. When we do systems design we are creating very big projections that can have a global footprint. By understanding the projection process and the structure of the projections of schemas perhaps we can walk more lightly upon the earth which is our only home in the vast reaches of the desert of endless spacetime.