Janie Chroust, 2010

International Federation For Systems Research

"Systems and Science at Crossroads"

Proceedings of the
Sixteenth IFSR Conversation

G. Chroust, G. Metcalf (eds.)

April 14 - April 19, 2012
St. Magdalena / Linz (Austria)

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Looking back at St. Magdalena 2012

Gary Metcalf , Gerhard Chroust

Conversations were introduced by Bela H. Banathy around 1980 as an alternative to the classical conferences which usually consist only of presentation of streamlined papers and short question slots. In a Conversation a small group of systems scientists and practitioners meets for several days to discuss in a self-guided way a topic of scientific and social importance. A Conversations is preceded by an intensive off-line preparation phase (including exchanges of ‘input papers’), followed by the face-to-face discussion at the Conversation and followed by a post-conversation consolidation period. No papers are presented during the conversation, the participants discuss face-to-face their topic, often modifying it in the course of the conversation (IFSR, 2010).

Since 1981 the IFSR has organized one IFSR Conversation every other year, originally in a hotel in Fuschl, near Salzburg (hence they were known as “Fuschl Conversations”). In 2010 we moved the Conversation to Pernegg, a small village nearer to Vienna in order to improve the ambiente. In 2012 we chose the Seminar Hotel St. Magdalena in the outskirts of Linz, Austria, resulting in an even better enviroment for the conversation. Additional Conversations were organized by IFSR’s member organisations in many locations around the world. In total approx. 50 Conversations were held up to now.

These proceedings include reports from the four teams which participated in the 2012 IFSR Conversation. The overarching theme this year was Systems and Science at Crossroads, which reflects the individual work of each team in different ways.

Team 1 explored the roots and the heritage left by the Tavistock Clinic, and later the Tavistock Institute. Members of Tavistock influenced the study of human systems in many ways, challenging assumptions based in traditional science. While work directly stemming from the Tavistock legacy continues, interest in the underlying principles, such as democratically-structured workplaces, can also be found emerging in new forms of organizations, continuing to challenge old assumptions.

Team 2 focused on what they termed Science II, an extension of traditional science which allows for inclusion of “the observer,” and properties such as emergence. Another way of describing this is “second-order science,” (in the same vein as “second-order cybernetics.”)

Team 3 dealt with issues which move beyond current concepts of sustainability, into notions of thriveability. Their work involved an active process of systems design, intended to link a series of international events related to these concepts. A focal point was the 2013 meeting of the International Society for the Systems Sciences in Viet Nam, being planned in partnership with a Living Labs project on Cat Ba Island.

Team 4 was comprised primarily of systems engineers, most connected with the International Council on Systems Engineering (INCOSE). The Conversation provided an opportunity for them to focus intently on the connections between systems engineering and systems science. This work is related to an ongoing project within INCOSE, as part of their Systems Science Working Group, and contributed directly to the Systems Engineering Book of Knowledge (SEBoK). It allowed not only focused time for the team members, but also discussions and collaboration with other systems scientists at the Conversation.

Together the four teams explored some of the boundaries and limitations of traditional approaches to science and organization. While each team’s work proceeded independently, the setting allowed for a great deal of cross-talk and informal exchange between participants and the four teams. Somewhat unique to this Conversation, also, was the intertwining of the Conversation with some of the participants’ work outside the Conversation. While the topics and team members were established for the Conversation itself, in all cases participants were involved in varying ways with prior efforts which fed into the work, and with continuing projects to which the work from the Conversation would be applied.

Short Summaries of the work of each team were published soon after the Conversation in the IFSR Newsletter from the summer of 2012 (Chroust, 2012a).

In this volume the official Team Reports are collected together with papers by individual participants supporting the team’s finding (Chroust & Metcalf, 2012b).

Additional material resulting from the Conversation which was too voluminous and/or too specialized to go into the proceedings were collected as a special supplement volume (Chroust & Metcalf, 2012c).

References:

Chroust, G. (ed.) (2012a) IFSR Newsletter, vol. 29 (2012), no. 1, IFSR - International Federation for Systems Research, Linz, and [http://www.ifsr.org/newsletters].

Chroust, G. , and Metcalf, G. (eds.) (2102b) Systems and Science at Crossroads - Sixteenth IFSR Conversation, Inst. f. Systems Engineering and Automation, Johannes Kepler University Linz, Austria, SEA-SR-32, Sept. 2012 and [http://ifsr.ocg.at/world/files/$12m$Magdalena-2012-proc.pdf].

Chroust, G. , and Metcalf, G. (eds.) (2102c) Systems and Science at Crossroads - Sixteenth IFSR Conversation - Supplement Inst. f. Systems Engineering and Automation, Johannes Kepler University Linz, Austria, SEA-SR-32, Nov.2012 and [http://ifsr.ocg.at/world/files/$12n$Magdalena-2012-supp.pdf].

IFSR (ed.) (2010) Why Conversation and what form do they take? IFSR Newsletter, vol. 27 (2010), no. 1, p. 6 IFSR - International Federation for Systems Research, Linz, and [http://www.ifsr.org/newsletters].

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Team 1: "Revisiting the Socio-ecological, Socio-technical and Socio-psychological Perspectives" (TEAM REPORT)

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Abstract: In this paper we address selected but basic concepts and models created in the Tavistock Institute that seem to offer insights into active adaptation and organizational design, especially those that have established track records for establishing open and democratic organizations. We revisit the socio-ecological perspective, including turbulent environments, as well as the socio-technical and socio-psychological perspectives. Firstly, we introduce the background and history of these concepts and give a short description of each, along with further developments in the area. We address transitions between Design Principle 1 (DP1) and Design Principle 2 (DP2) organizational structures through selected examples, and later apply these concepts in the current dynamic and fast changing organizational structures emerging in the globalized service economy.

Keywords: Tavistock Institute, socio-ecological system, social-technical system, socio-psychological system, turbulent environments, organizational design, Design Principle 1, Design Principle 2, change management, empowerment, Living Labs, innovation

"The choice is between
whether a population seeks to enhance its chances of survival
by strengthening and elaborating special social mechanisms of control
or increasing the adaptiveness of its individual members."
(Emery and Trist 1973, p. 71)

The Conversation within Team 1 began around a general triggering question: *"In which ways is the Tavistock legacy still relevant, and in which ways might these ideas be advanced and/or refreshed (for the globalized/service economy)?"* The thought at the time that the team was being formed was that the legacy of Tavistock and the material that came out of it were quite well known, but that the ideas had fallen out of use and possibly even currency. Through the contributions of Merrelyn Emery to the team, it became apparent very quickly that there were many gaps in information (at least by the other four team members), and varying interpretations of both the history and the theories. That turned the focus for the first part of the week into clarifying and correcting what was known and understood.

Our aim was to revisit and discuss the background and history especially related to the three original perspectives of open systems theory (OST), the socio-ecological, socio-technical and socio-psychological. Within and across these perspectives we explored changing environments, particularly the current turbulent environment, the genotypical organizational design principles (DP1 and DP2), the methods of search conferences and participative design workshops as well as the conditions for successful implementation. The intent was to understand more about the time and the people who developed these concepts and methods, how they worked together and the original inspirations for both theoretical models and empirical applications.

Figure 1a Team 1 – working at IFRS Conversations 2012 at Linz, Austria

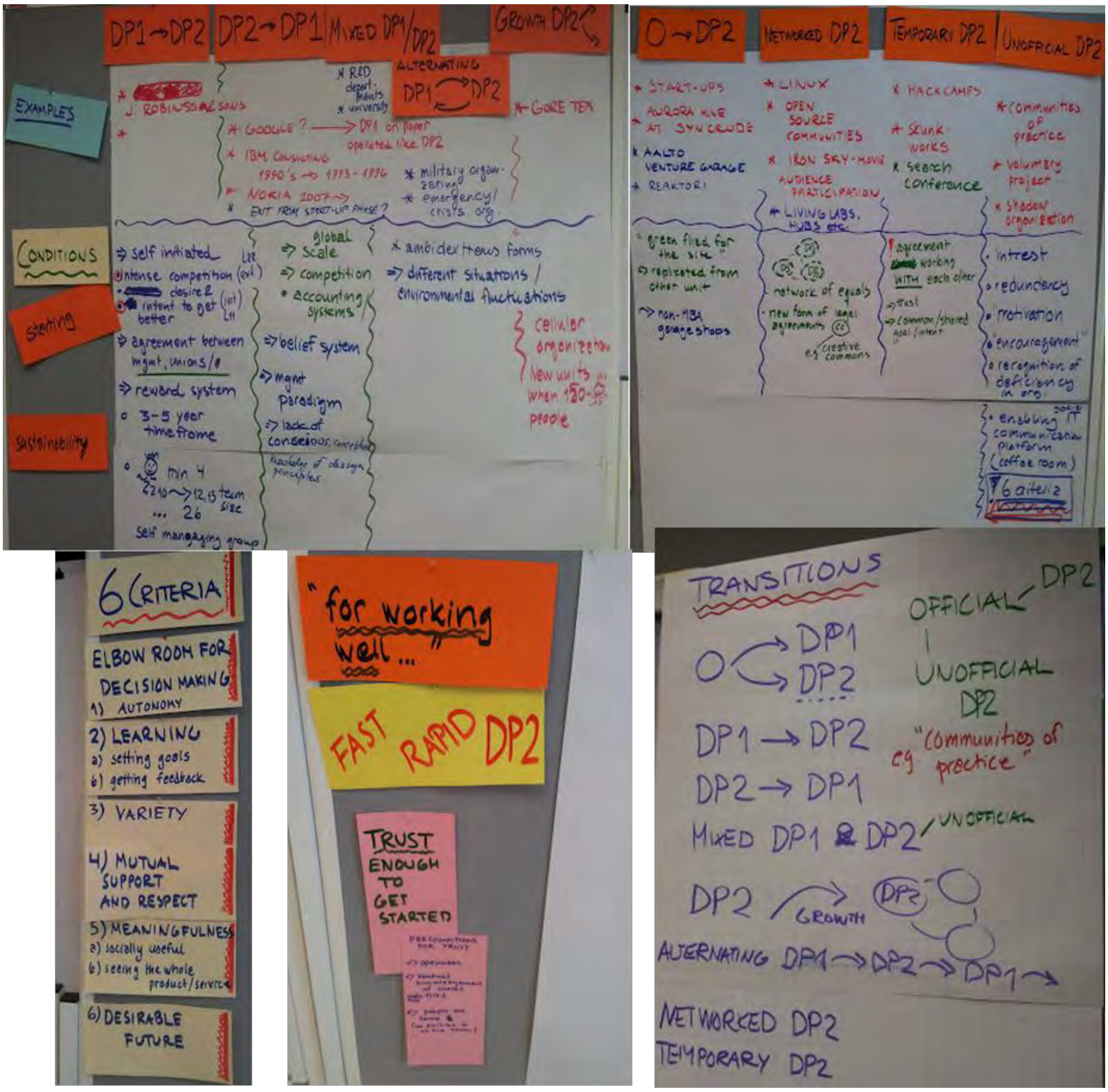

Figure 1b Team 1 – working at IFRS Conversations 2012 at Linz, Austria

In Brief

The work done at the Tavistock institute in its creative period was characterized by Eric Trist as comprising 3 perspectives:

- The ***socio-ecological*** in which the social system transacts with an environment, external to itself but co-implicate with it such that system and environment are mutually self determining and jointly produce outcomes. At the organizational level, a structure created to explore its environment is a socio-ecological organization.
- The ***socio-technical*** which consists of social and technical or technological systems which may or may not be jointly optimized, i.e. may or may not have been designed to ensure that the two systems jointly contribute to the best possible human and organizational outcomes.

- The ***socio-psychological*** differs from the socio-technical only in the fact that it is people rather than technology that constitute the second system, i.e. it is a people-to-people system. As people are all purposeful systems while technology in all its forms is only goal-seeking (Ackoff & Emery, 1972), working with socio-psychological systems to jointly optimize them is more complex and demanding.

As Team 1 learnt during its conversation, the original work done at the Tavistock has evolved into a coherent and comprehensive conceptual framework known as Open Systems Theory. It has also spawned many different variations in different continents and cultures. However, it is a tribute to its pioneers and their cohort of collaborators around the world that it remains relevant and valuable to many attempting to solve today's systemic problems.

1. Background and history

Much of the history of Tavistock, and many articles by its members, can be found in the online version of the Tavistock Anthology: http://www.moderntimesworkplace.com/archives/archives.html. Seeing articles written to capture ideas formally, in retrospect, though, gives little indication about how the ideas came to be, or of the relationships between the people involved.

The Tavistock Clinic had been founded in 1920 by Dr. Hugh Crichton-Miller in London. (The name was apparently associated with the original location, close to the Tavistock Square in London.) It had been established to treat "shell-shocked" soldiers during and after World War I (along with other child and adult maladies). The group was taken more formally into the British military in World War II, where it continued its work with trauma and also expanded into other areas, including officer selection. Tavistock had been funded by the British military during the World War II, and after the war new funding sources were needed. Tavistock operated mainly in two areas. On one side the focus was on organizational development and the other side operated with mental health and psychology. Following WWII, the clinical portion of Tavistock became a part of Britain's newly formed National Health Service, with John Bowlby as its head. In 1946, the Tavistock Institute of Human Relations was founded as a separate organization, funded initially by the Rockefeller Foundation, and headed by Eric Trist. The Tavistock Institute focused on organizational development, and turned towards governmental and business organizations.

Lewin, Lippitt and White's (1939) research on group climates, as well as the initial concepts about action research developed by Kurt Lewin (1938), contributed to the early work at Tavistock Institute. Kurt Lewin had immigrated to the US in 1933 (the same year that he met Eric Trist, briefly, in Cambridge). Working at the time in Iowa, he conducted a series of studies on group climates, using groups of school children. That classic work of Lewin et al (1939) was widely known to social scientists around the world, and was foundational in the development of group and organizational work, particularly socio-technical systems and later the design principles underlying autocracy, participative democracy and laissez-faire. As stated by Merrelyn Emery,

> *These laboratory experiments established that there were only three group climates, now known to be structural genotypes; autocracy (now technically termed bureaucracy) democracy, and laissez-faire (essentially a non-structure). In addition, they established that these structures have profound and predictable effects on the people who live and work within them, regardless of the personalities involved (personal communication.)*

Lewin founded the National Training Labs (NTL) in Bethel, Maine, in 1947, just a year after the Tavistock Institute was formed. Despite the timing and collaboration, there was no formal connection between Tavistock and NTL.

Apart from Lewin and his group, there was also a great deal of international exchange and collaboration which helped to develop the concepts associated with socio-technical systems and open systems more generally, which happened in and around professional meetings and conferences. This included people such as Russ Ackoff, Ross Ashby, West Churchman, Lou Davis and Einar Thorsrud, in addition to Eric Trist, Fred Emery, and others who are typically associated with the work. This collaboration continued well into the 1980s until serious divergences between the continents were confirmed (Emery, 2000).

Another foundational figure in this history was Andras Angyal (see: http://en.wikipedia.org/wiki/Andras_Angyal). While Ludwig von Bertalanffy is the name associated with open systems for most people today, as Merrelyn explained, “everyone had read Andras Angyal, and almost no one [in those groups] spoke of Bertalanffy.”

As Merrelyn explained in her keynote talk to the 2012 European Meeting on Cybernetics and Systems Research (http://www.emcsr.net/) ,

> *There is one other property of human beings and that property creates the need for a genuinely open systems social science: it is the demonstrable fact of consciousness defined as “awareness of awareness” (Chein, 1972, p95; Emery M, 1999, pp70-80). von Bertalanffy’s (1950) formulation of an open system was a brilliant step forward and probably still covers the great mass of animate creatures on Earth. He is rightly called the Father of Open Systems but his conceptualization deals only with people as bodies. There can be little doubt that we are physically adapted to our planet but when we contemplate consciousness, it becomes obvious that we must go beyond von Bertalanffy. (http://www.bertalanffy.org/2011/wp-content/uploads/2012/04/Vienna.OPEN-OR-CLOSEDSYSTEMS.pdf, p. 6.)*

It was primarily the theories of Angyal, then, rather than Bertalanffy, on which Open Systems Theory, with its three perspectives, was founded. Angyal acknowledged systems in an environment where an organism is always subject to the forces of autonomy, acting on the environment, and heteronomy, the environment acting on the organism. These relations are dynamic and ever-changing so "life is an autonomous dynamic event which takes place *between* the organism and the environment" (Angyal, 1941, p. 48, added emphasis). *A system* is defined by its *system principle, unitas multiplex* or construction principle (Anygal 1941, p. 259). This principle expresses the unique relation between the entity and the environment, governs the behaviour of the system and the arrangement of its parts. For human beings, there are two major tendencies, autonomy which asserts the individuality of the person and homonomy which expresses the need to participate in or belong to a unit larger than the self, such as a group or community. Mentally healthy people have a relative balance between the two tendencies.

Emery & Trist (1965) took Angyal’s exposition one stage further as follows (Fig. 2): The open system shows that system and environment and their interrelations are mutually determining and governed by laws (L) which are able to be known. When the system (designated '1') acts upon the environment (designated '2') we say the system is planning (L12). Environment acts upon the system and is known to us through ecological learning (L21). L11 and L22, express the intrinsic natures of the system and environment respectively. The laws that govern them are implicitly learnt about in the Search Conference. The environment, the L22, is defined as the extended social field of directive correlations with a causal texture (Emery & Trist 1965; Emery F, 1977) where the nature of the extended social field affects the behavior of all systems within it. This conceptualization provides both a conceptual, historical and practical framework for cultural change and its fluctuating adaptivity.

> The social field is a directly observable, objective entity in its own right. As a field, not a system, its laws are very different from the laws governing systems. The inclusion of a discrete social environment is the major defining difference between an open and closed systems social science. What Emery & Trist achieved in 1965 was the completion of the conceptualization of the open system that von Bertalanffy so admirably started (Emery, 2012, p. 6)

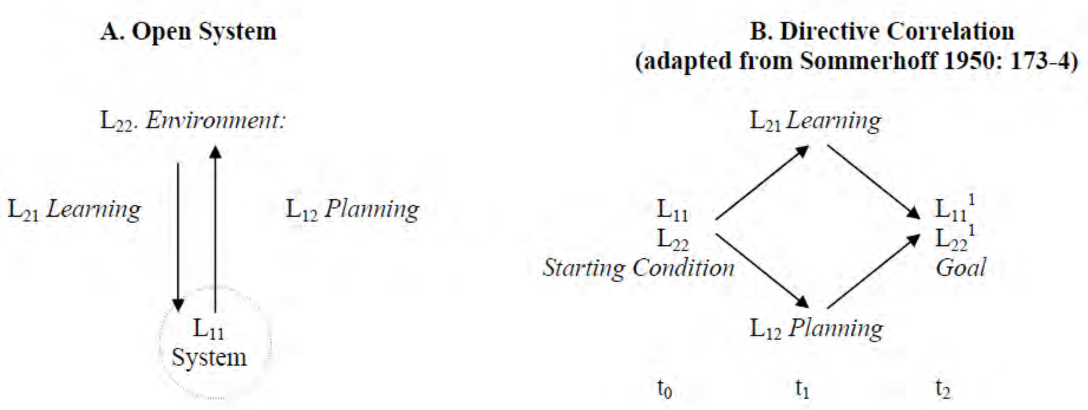

Figure 2. The Open System and Directive Correlation (From Emery (2012).

The two parts of Figure 2 illustrate the only differences between the open system and directive correlation which are that the open system is a picture of a point *in time* with change expressed through learning and planning while the directive correlation is a picture *over time*. The open system includes adaptive and maladaptive relations while the directive correlation expresses precisely when adaptation is or is not occurring.

According to Merrelyn, the strict reliance on Angyal's, Sommerhoff's and Emery & Trist's formulations distinguished the work that she did with Fred Emery and others in Australia from later work by Trist or Ackoff.

> We stuck with the time-based Search Conference where probabilities of various scenarios change over time while Ackoff went with time-free 'idealized design' (Ackoff, 1974, p30). Neither Ackoff nor Trist ever used the design principles which underpinned all our work (Trist, 1986). The Australian group stayed with Angyal's system principle, the unique relation between L22 and L11, and the organizational design principles that determine the shape of the L11…while Trist worked on referent organizations and domain theory (Trist, 1983) (pp. 3-4).

The study most often associated with the Tavistock Institute and socio-technical systems was done by Trist and Bamforth (1951). It began at the Midlands coal field in the UK, in the Haigmoor seam, in 1949. Essentially, it was the time in which mechanized equipment was being introduced into the coal mines in Britain. The changes in technology cut across the traditional social structures of the miners which consisted of self-managing groups without supervision. And while there was some division of labor within groups, there was also a fully shared responsibility for the processes and outcomes. This shared sense of responsibility extended beyond the mine itself into the families and communities. Imposing a factory-like structure on the mining operations created three shifts and seven separate roles. The new technology created high expectations of increased productivity but productivity declined. Rather than the dramatic economic benefits expected, there was an increase in mental illness, absenteeism and accidents amongst other phenomena (Trist and Bamforth, 1951).

"The social scientists discovered a pattern of four interrelated `defence mechanisms' against the new work patterns. Named Informal Organization (forming cliques), Individualism (competition, playing politics), Scapegoating (passing the buck) and Withdrawal (absenteeism, `psychosomatic' illness), they corresponded exactly to the effects of bureaucratic structure found in 1939, thereby demonstrating that the relation of structure and effect held regardless of artificial or real setting. Needless to say, the only cure was to design and implement a variation of the old team structure geared to the new technologies. Socio-technical analysis was born" (Emery M, 1993, p12).

Because of this development, Tavistock Institute was invited to work together with government, labor organizations and companies to revitalize industry and enhance productivity in Norway through the Norwegian Industrial Democracy program (1962 – 67, Emery & Thorsrud, 1969, 1976). They were continuing the work to develop socio-technical approach in a real context and it was during this program that Fred Emery discovered the genotypical design principles (Emery, 1967). These democratic structures were gradually picked up by other Scandinavian companies and spread around the world. In the late 1960's Russel Ackoff invited Fred Emery to his program Social System Science, Wharton Business School, University of Philadelphia. And in 1969 Fred Emery returned to Australia. There the ideas were developed further and elaborated in several areas such as the ideals, towards a fully consolidated theory and practice of active adaptation (Emery F, 1977; Emery M, 1999).

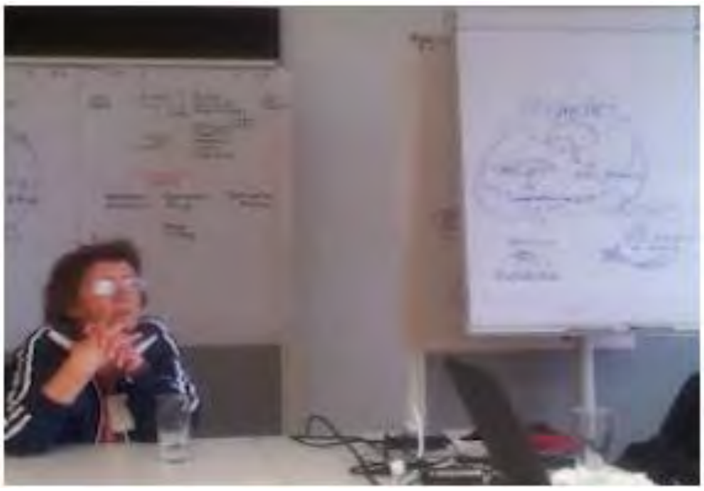

Figure 3 Merrelyn Emery sharing her experiences and views on the socio-ecological, socio-technical and socio-psychological perspectives

Table 2 Chronology of Tavistock Institute, Eric Trist and Fred Emery and the Socio-ecological, Social-technical and Socio-psychological Perspectives

1920: Tavistock Clinic Founded in the UK • Initial Focus on Shell-shocked Soldiers • Developed Expertise in Group Relations, Social Psychiatry and Action Research Military Funding through WWII	**1939:** Lewin, Lippitt & White, Group Climate Experiments • Establishment of Autocracy, Democracy and Laissez-Faire • Action Research
1946: Split after War • Tavistock Clinic (National Health System) – John Bowlby Tavistock Institute for Human Relations – Eric Trist	**1947:** Lewin Founded NTL (National Training Labs) • Applied Social Psychology • Interpersonal Dynamics • T-Groups

1954: Center for Advanced Study of the Behavioral Sciences (CASBS) Founded Bertalanffy, Boulding, Gerard, Rapoport Found SGSR/ISSS	**1951**: Trist and Bamforth, Coal Mining Experiment Owners brought in new technology that destroyed older more collaborative working arrangements – birth of socio-technical systems	**1951:** Fred Emery – One year fellowship at Tavistock **1957:** Emery comes to UK, joins Tavistock **1959**: First Search Conference
1965 – Trist and Emery paper paper on *"Causal texture of Organizational Environment*" **1962 – 1967**: Norwegian Industrial Democracy Program • Joint Project of Government, Labor & Employers • Reports published in English, 1969 and 1976	**Eric Trist** • **1966:** Trist to UCLA • **1967:** Trist to Penn w/ Russ Ackoff Social System Science (S^3) – Tavistock West at Wharton Business School	**Fred Emery**: • **1968**: Emery to CASBS • **1969**: Emery returns to Australia • **1971:** Development of First Participative Design Workshop (PDW) • DP1 -> DP2 • **1972:** First Search Conference (SC) in Australia • **1972:** Ackoff & Emery, *On Purposeful Systems*

2. Introduction of concepts

How people organize themselves to work collaboratively and towards shared or common purposes, continues to interest social scientists, management scholars and leaders. Cooperative work continues to be essential in micro businesses, the start-up phases of many organizations, large corporations, and in governmental as well as non-governmental organizations. When the world continuously changes around us, people and organizations look for new ways of working together, in order to change and adapt. This is increasingly important in the globalized service economy.

Currently we are facing global challenges that affect all our lives. These challenges include the 2009 financial crisis and a faltering global economy, climate change with the related deterioration of the biosphere, and at the local level unemployment, poverty and institutionalized disadvantage. At the same time there is an increased focus on innovation as people try to solve these problems. New organizational structures emerge to support entrepreneurship and new ways of working. The concepts originally developed in the Tavistock Institute seem to be very relevant and offer possible solutions for current challenges.

2.1. Socio-ecological, socio-technical and socio-psychological perspectives

As the Team 1 conversation developed we went further into the socio-ecological, socio-technical and socio-psychological perspectives and how they could be used, advanced and refreshed for the future. More of the week was spent digging into the basic constructs, understanding, for instance, exactly what was meant by Design Principle 1 (DP1) and Design Principle 2 (DP2), and their differences. There were also questions about how the Design Principles related to the different causal texture of environments which had been described (Types I to V, see the next page).

OST as a conceptual framework encompasses different levels of system and environment which are used in various combinations depending on purposes and the nature of the systems concerned, from the family to organizations and communities to the larger society. The immediate environment of an organization may be the global industry in which it operates and this is called the “task environment.” It is documented and analyzed in the Search Conference in same way as the global L22, with the emphasis on the most relevant trends, those elements which affect the relationships and functioning of the system in question, not “everything out there.”

The full conceptualization of active adaptation in practice involves both the socio-ecological perspective and one or more socio-technical or –psychological systems.

2.1.1. Socio-ecological perspective - Causal texture of environment

The basis of the socio-ecological perspective was first published by Fred Emery and Eric Trist in Human Relations (1965a/Vol.III), *"The Causal Texture of Organizational Environments."* In their paper they argued the need for a thorough conceptualization of the open system and documented the changing "causal texture of the environment" over historical time as these contexts have been impacted by technological and other change - at an ever-increasing rate, and toward increasing complexity. As causal textures change so organizations must change to remain adaptive.

As seen in Figure 2, L11 refers to processes within the organization - the area of internal interdependencies and connections. L12 and L21 refer to transactions between the organization and its environment - the area of transactional interdependencies, from either direction from inside out and from outside in; planning and learning. L22 refers to processes through which parts of the environment become related to each other - i.e. producing its causal texture.

Emery & Trist documented four types of environment and discussed the effect of these four environments upon an organization existing in each type of environment. Subsequently, much work has been done on these environments and Baburoglu (1988) explored the fifth type. The first four environments from the simplest through to most complex are explained next.

Environment Typologies

Emery and Trist, (1965) classified environments by the nature of their internal interlocking relations. They defined four environmental fields or external social environments (L22) by their causal textures:

- Type I – Placid, randomized environments
- Type II – Until 1793. Placid, clustered environments, clustered as in nature.
- Type III – 1793-1953. Disturbed, reactive environments, still with stable value systems although competition replaced cooperation
- Type IV – 1953 to the present. Turbulent or dynamic environments
- Type V – vortex environments, where focus is in mere survival (Emery and Trist 1972)

Type I - a placid, random environment is one in which value systems are stable with advantageous and negative resources occurring at random. In placid random environments there is no distinction between strategy and tactics (Emery and Trist 1965). Examples of Type 1 environment are e.g. flea markets and concentration camps where the best tactic is ‘grab it while you can’. Type I doesn’t exist in nature but humans can approximate it.

Type II lasted from the dawn of human history to roughly 1793, the birth of the industrial revolution. It is by far the most adaptive environment people have as yet created. It was characterized by cooperation because people commonly employed the form of organization based on DP2 (see below). The ancient cultures, remnants of which still exist on most continents as our Aboriginal and First Nation peoples, have been extensively studied by archaeologists and anthropologists. Their work leaves little doubt that these cultures were socially sophisticated, peaceful, intimately tied to the land and highly knowledgeable about how the biosphere works (Emery M, 1982). These were social fields isomorphic with the physical world as the organizations and associated cultures mimicked processes seen in nature and were cooperative with laws of nature. Meaningful learning is all that is required for adaptation.

Type III came into being at the beginning of the industrial revolution because as the factory system was built, labour was recruited from the nearby towns and farms. These people worked in groups (DP2 structures) and lived in rhythms dominated by the sun and the seasons, whether in the fields or in cottage industries. They proved unreliable when required to abide by mechanistic factory time and rules. To ensure reliable behaviour, the owners introduced supervisors and when the supervisors proved unreliable, supervisors of the supervisors. For the first time in the West, we had the widespread application of DP1 with its inherent competition. As these DP1 organizations grew so we had large bureaucratic organizations competing for the world's finite resources. Strategy involves a win/lose game with the competition.

Type III came to a slow demise at the end of World War I with the breakdown of the assumptions that had governed the subjection of the people to the state. Since 1945-53 we have been living in a new environment, the Type IV, an unintended consequence of adopting the world hypothesis of mechanism (Pepper, 1942; Emery M, 1999). People finally reacted to the Type III environment, rejecting its assumptions and structures and increasingly taking things into their own hands (Emery F, 1978). As the rug was pulled out from the basis of the stable value system, people were left to derive their new value system and they are still in the process of sorting out what they really value. The Type IV environment is known as 'turbulent' because it is characterized by rapid value shifts and discontinuities.

Type IV, therefore is a dynamic rather than a stable environment. Emery and Trist (1965) argue that the dynamic characteristics arise not only from transactions between the systems within the environment but from the field itself - 'the ground moves'. It is characterized by relevant uncertainty on top of high complexity. Emery and Trist (1965) suggest that for organizations involved with a turbulent environment, the appropriate response is to establish a relationship that transforms the environment into one of the other kinds of environment where less uncertainty exists. These relationships could form organizational matrices or "relationships between dissimilar organizations whose fates are, basically, positively correlated" (p.29), e.g. suppliers or alliance partners. They further hypothesized that certain social values would emerge as coping mechanisms.

Type V, environment Vortex is a consequence of the dynamic processes set in motion by the unplanned consequences of actions taken by one or more stakeholders may develop into what Emery and Trist call "autochthonous processes" (Emery and Trist 1972)

Subsequently, a great deal of empirical and theoretical work has shown that it is the set of human ideals (Emery F, 1977) which only emerge in DP2 structures, that has the power to bring this field under control (Emery M, 1999). Adaptive strategy involves knowing and monitoring the L22 and becomes active adaptive when the strategy influences change in that L22.

Merrelyn presented examples of addressing the environment of the system as the first phase of the Search Conference – see Figure 5. . In the design of the event, it is essential that any system must examine changes in the world around us (the L22) and analyze these by projecting the most desirable and probable worlds. Without this work, a system has no chance of establishing an active adaptive relationship with the L22. Once this formative work has been done, the system can concern itself with its history, its current situation, its most desirable and sustainable future (the L11), the possible constraints and how to deal with them and finally integrate all its learning into action plans that will achieve that most desirable future.

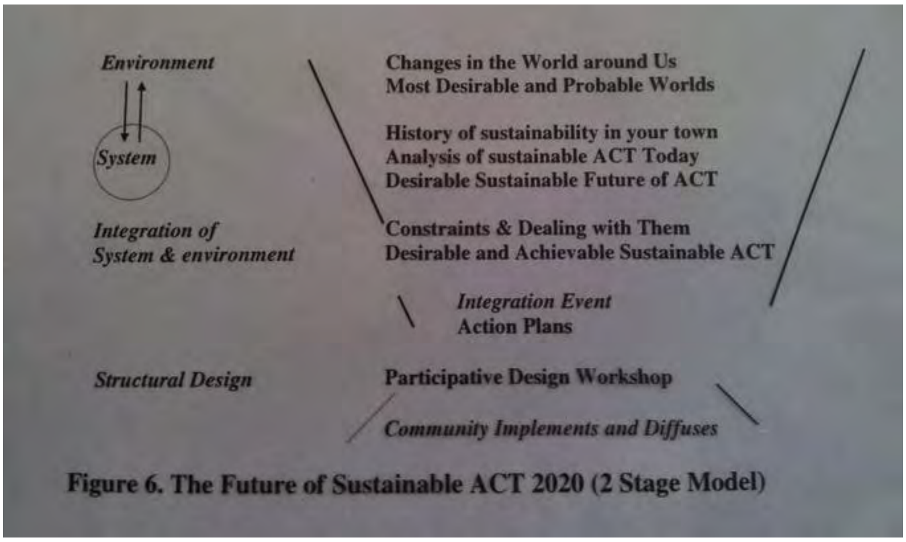

Figure 5 - Examples of addressing the environment of the system as the first phase of the Search Conference

A community emerging through the Search Conference is a socio-ecological system.

2.1.2. Socio-technical perspective

The socio-technical concept arose in conjunction with the first of several field projects undertaken by the Tavistock Institute in the coal-mining industry in Britain. The time (1949) was that of the postwar reconstruction of industry in relation to which the Institute had two action research projects. One project was concerned with group relations in depth at all levels (including the management/labor interface) in a single organization - an engineering company in the private sector. The other project focused on the diffusion of innovative work practices and organizational arrangements that did not require major capital expenditure but which gave promise of raising productivity. The former project represented the first comprehensive application in an industrial setting of the socio-clinical ideas concerning groups being developed at the Tavistock. For this purpose a novel action research methodology inspired by the work of Kurt Lewin was introduced. Nevertheless, the organization was approached exclusively as a social system. The second project considered the technical as well as the social system and postulated that the relations between them should constitute a new field of inquiry (Trist & Murray, Vol 2).

Socio-technical systems used to involve intensive work by teams of expert social scientists analyzing the social and technical systems with the outcome of jointly optimizing those systems to the benefit of both the workers and organizational performance, i.e. maximizing the best of both systems for those benefits. Since the discovery of the genotypical design principles and the development of the Participative Design Workshop, the design work is done by those who work in the organization while the social scientists work only to transfer their social science knowledge through briefings to these organizational members in the process of managing the workshops (Emery & Emery, 1974).

2.1.3. Socio-psychological perspective

Socio-psychological organizations are those where people replace the technical system. Examples are schools, hospitals and prisons. Historically, the source concepts which gave rise to the socio-psychological perspective are psychoanalytic object relations theory, Lewinian field theory, the personality-culture approach and the theory of open systems. An ideal was to keep alive in one's experience the reality of the person, the group, the organization and the wider society, so that one could sense their interconnections. It was also thought desirable at the Tavistock to maintain contact with projects in more than one social sector - not, for example, to spend all one's time in industrial projects. The experience of these projects has led to further conceptual developments. Usually more than one of the source concepts had been drawn on in order to obtain a better understanding of what was taking place or what had to be designed (Trist & Murray, 1993, Vol I).

The original Tavistock Clinic members came from a wide variety of backgrounds, and as noted earlier, worked on projects ranging from "shell shock" (now known as Post Traumatic Stress Disorder) to candidate selection of military officers, to organizational functioning. During the early years, though, all recognized the value of psychological understanding and self-awareness. Even after the split between the Tavistock Clinic and the Tavistock Institute, following World War II, the practitioners in the Institute continued to undergo psychoanalytic training as part of their self-development. Only later was that practice abandoned.

Today, socio-psychological organizations are turned into active adaptive, jointly optimized systems in exactly the same way as are socio-technical organizations but are more complex with more steps involved.

2.2. Design Principles DP1 and DP2

In the IFSR Conversation we discussed the organizational design principles DP1 and DP2 with Merrelyn in detail in order to understand how they affect the ways in which people work together. Since the 1970s, these principles have been one the key concepts of active adaptation as expressed in planning and design. It is, therefore, critical that they are clearly understood.

The first design principle (DP1) is called 'redundancy of parts' because there are more people than are required to do whatever, the activity is. Its other critical feature is that *responsibility* for coordination and control is located one level above where a particular activity is being performed. People are treated as replaceable parts, cogs in the machine. DP1 produces the organizational structures called 'bureaucratic' or 'hierarchical' where the hierarchy is one of dominance. A DP1 structure is one in which everyone, except the person at the top, is licensed to be irresponsible (Emery, M, 2000).

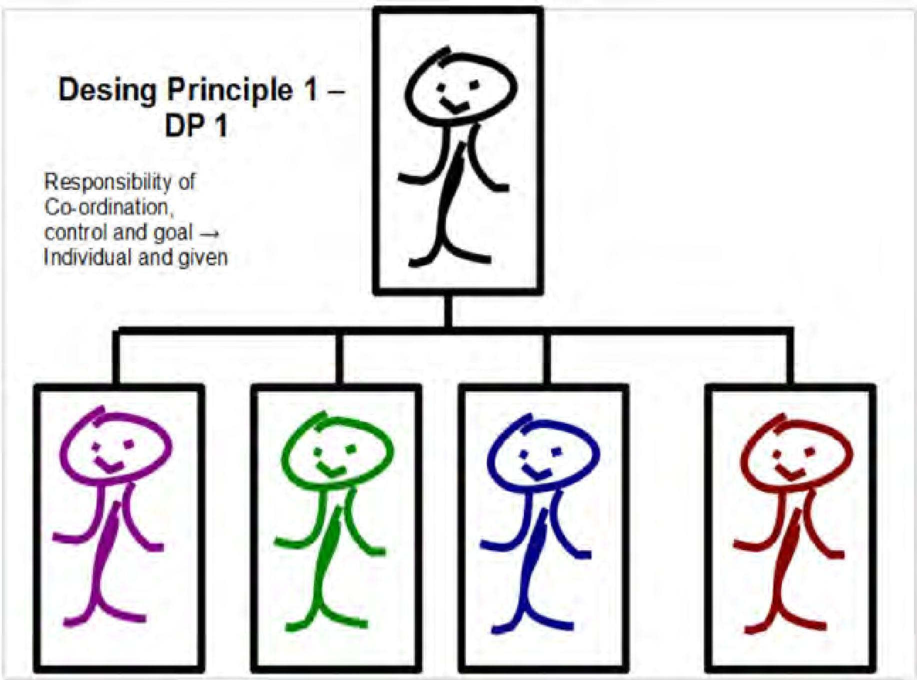

Figure 6 - Design Principle 1 – DP 1

The second design principle (DP2) is called 'redundancy of functions' because more skills and knowledge are built into each person than they can use at any one given time. *Responsibility* for coordination and control is located where activities are being performed. It produces organizational structures called 'democratic', participative not representative. Participative democratic organizations, particularly large ones, may still contain a flat hierarchy but this is a hierarchy of functions, not dominance, where different levels negotiate as peers in order to accomplish the goals of the whole. Contrary to DP1 structures, DP2 structures motivate.

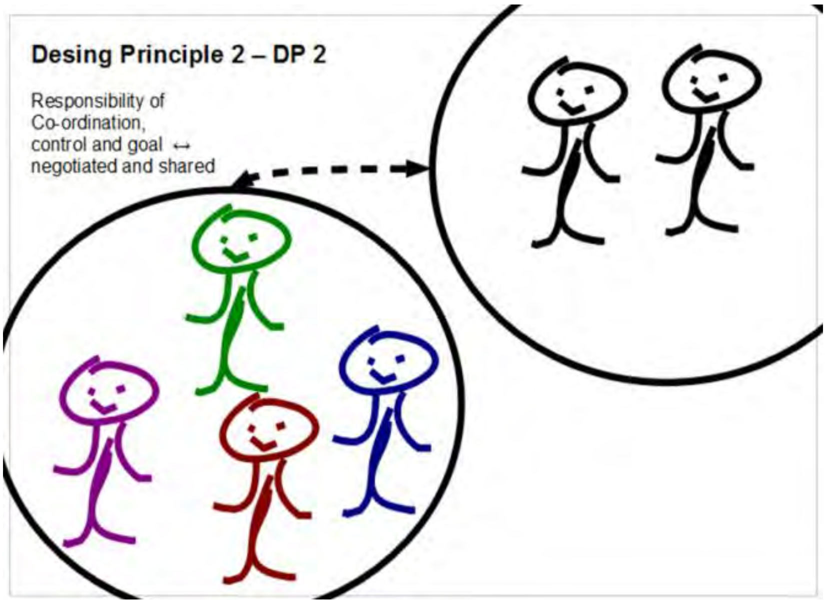

Figure 7 - Design Principle 2 – DP 2

The design principles are very powerful and affect many human behaviours, competition versus cooperation, the quantity and quality of communication, group dynamics and the human affect or emotional system which contributes in turn to the quality of mental health.

These design principles operate at all levels and sectors of society. They underlie the nature of political or governance systems in the same way as the structure of single organizations. Representative political systems derive from DP1. Alternatives flowing from DP2 have existed and currently exist (Emery F 1976a & b, 1989). A participative democracy, therefore, is a system structured entirely on DP2. That is, all subsystems (organizations and communities) and their interrelationships are democratic as well as its overall system of governance. A participative democracy is an open responsible system. (Emery, M. 2000)

2.3. Participative Design Workshop

The Participative Design Workshop (PDW) – was developed in 1971 to replace the old method of STS that had been developed from 1949-1967. It was tested in many organizations and continuously modified until it became fully reliable and fully flexible to change the design principle throughout any organization. There are two versions of the PDW, one for the redesign of existing structures and one for design from scratch. The PDW produces an active adaptive (DP2) system, one in which all people are responsible and motivated to achieve shared goals, and who know how and why to maintain it. Different phases- analysis, change and practicalities, required briefings and the main tasks in each phase are introduced in the Table 3. The version of the PDW for redesign is given in Table 3.

Table 3 Phases of Participative Design Workshop – PDW

Phase 1. Analysis	Phase 2. Change	Phase 3. Practicalities
Briefing 1 - Design Principle 1 and its effects	*Briefing 2 - Design Principle 2 and its effects*	*Briefing 3 - What Is Required to Make the Redesign Work*
• Groups complete matrix for 6 psychological requirements of productive activity. • Groups complete matrix of skills available. • Reports and diagnostics.	• Groups draw up work flow for information and learning. • Groups draw up organizational structure and redesign it. • Reports.	Groups spell out: • a comprehensive set of measurable goals • essential training requirements for start-up (from skills matrix) • other requirements, e.g. mechanisms for coordination, changes in layout or technology, etc. • first draft of career paths based on pay for skills and knowledge. • how the redesign improves scores on the 6 criteria.

For designing from scratch (greenfields) a modified PDW is hung onto the Search Conference. Unless the system affords the learning and support for learning that is required for implementation of the new system principle that welds the previous community or the new organization into an active adaptive system, the work of the Search Conference will ultimately be wasted. The PDW following a search Conference, therefore, answers the question 'how do we organize ourselves to ensure that we reach our Most Desirable Future?'

2.4. Search Conference method

Since the first Search Conference in 1959 (Trist & Emery 1960) theory and practice have undergone intensive integrated development. The first version of Search Conference was conducted in the UK and it was developed further over many years. The first Search Conference in Australia was held in 1972 and again tested and modified to meet the full range of communities, organizations, industries and issues that could benefit from its application.

The Search Conference is an intensive event in the middle of an extended period of preparation and planning and an infinite implementation. Its success depends upon the quality of the preparation and the structures consciously understood and built into the implementation phase as well as design and management of the event itself.

The external structure (design) of the SC is a translation of the open system into practice. The content consists of learning about (and also learning how to use) the environment (L22) and system (L11), and integrating them for active adaptation between changing system and the changing environment. The process consists of integrated learning (L21) and planning (L12).

The Search Conference (SC) establishes an active adaptive relationship between the system and the environment through the creation of a new system principle. The system principle is contained within the new set of strategic goals, the Most Desirable Future of the system. The Search uses our inbuilt capacity to directly extract meaning from the environment and creatively combine that meaning with our ideals. It answers the question 'where and what do we want to be in year X?'

3. Application into current organizations

As the week progressed the team moved from a focus on history and theory (though those continued to be revisited) to questions about where and how the concepts and principles showed up today, in different kinds of organizations and circumstances. Indeed, many of the examples where self-managing work groups had been instituted no longer existed because they came into being before it was learnt how to secure them. This led to questions about transitions of structures within and between organizations. It was apparent that some groups (e.g. some kinds of start-ups) began as self-managing organizations and became more hierarchical as they grew and evolved. Sometimes large corporations or projects experimented with such structures in their efforts towards innovation. One specific example discussed was the building of Terminal 5 at Heathrow Airport, which seemed to function as a DP2 structure throughout the construction phase, but then dissolved entirely when it was handed over to operations. (This was explained in more depth by Hillary Sillitto, visiting from another Conversation team.) This example created an opportunity to discuss a number of aspects about design principles and organizational structures: ways in which the principles may be present in organizations with no connection to Tavistock or socio-ecogical work; transitions between structural forms in organizations, etc.

3.1. Transition between DP1 and DP2 structures

During the IFSR conversations we were discussing the organizational design principles in different contexts, different variations and different transitions between organizational structures. We were sharing examples of organizations and their development from the past as well as current transitions which are on-going. Possible transitions include transition from DP1 to DP2 structure as well as transitions from DP2 to DP1 structure. There are also mixed DP1 and DP2 structures as well as alternating DP1 and DP2 structures. We also discussed growth in DP2 structures. Some of these examples are described in the Table 4 below.

Table 4: Transitions between DP1 and DP2 structures

	DP1 → DP2	**DP2 → DP1**	**Mixed DP1& DP2 Alternating DP1↔DP2**	**Growth DP2**
Examples	J. Robins - footwear Heathrow Terminal 5 (build stage) Harley Davidson SOL	Mining company in UK IBM consulting 1993-1996 Google, on-going Nokia 2007 → exit from start-up phase	R&D departments universities military organizations emergency organizations	Gore Tex
Conditions for starting /	→ Self initiated * intense competition (L22) * desire and intent to get better (L11) * 3-5- yrs (no turning back)	→ search for efficiency → global scale → competition → accounting systems	* ambidextrous forms * different situations and environmental fluctuations	* cellular organization, new units when more than 150 people
for sustaina-bility	agreement between management and union (employees) in Australia (EBA) Enterprise Bargaining Agreement → reward system is payment for skills and knowledge held ;comprehensive set of goals for each group → min 4 people, usually 10 – 15, max 26 self managing group	? belief system management paradigm - must be conscious, conceptual knowledge of design principles		

3.2. Modern and temporary DP2 Structures

Organizational design principles DP1 and DP2 also apply to modern and temporary organizations. We were discussing examples when organizations are created and planned to operate according to DP2 structures and the conditions for starting and required for working well and sustainably. The organizational forms discussed were organizations in the start-up phase, when they are created to operate as DP2 structures, networked DP2 structures, temporary DP2 structures and unofficial DP2 structures. Some of examples are described in the Table 5.

Table 5: Modern and temporary DP2 Structures

	0 → DP2	**Networked DP2**	**Temporary DP2**	**Unofficial DP2**
Examples	Start –up companies Aurora mine at Syncrude Aalto Venture Garage Reaktori	Open source communities Linux Iron Sky movie & audience participation Living Labs Entrepreneurial Hubs	Hack camps / hack athlons Skunk works Search conferences	Communities of practice Voluntary projects Shadow organizations behind official DP1 structures
Conditions starting / for working well	→ green field for the site, replicated from other unit → new "garage shops" (with no MBAs) → small entrepreneurial team	→ network of equals → new form of legal agreements e.g. CC - creative commons and open source licensing	→ agreement working WITH each other → enough trust to get started → common shared goal / intent	→ common interest → redundancy → motivation → encouragement → recognition of deficiency in organization → enabling communication platform, social IT

4. Conditions for Success

During the sessions we also discussed the conditions for success and Merrelyn introduced us to the 4 conditions for influential communication and the 6 Psychological Requirements for productive work (known as the 6 Criteria, for short). The following four conditions have been identified as important for organizations and their operations, for starting, for sustaining and for working well. The four conditions are openness, basic psychological similarity, shared field and trust.

4.1. Four conditions for influential communication (from Asch, 1952)

4.1.1. Openness

Openness is critical for honest discussion and trust and it should be addressed on two levels. Good designs and methods have features to maximize openness. Wherever possible, the planning for an event must be itself participative. The roles, values, and expectations of designers and managers, and the underlying strategy and long term goals, must be also open to inspection and clarified before work proper begins (Emery 2000). Secondly, all notes of joint discussion and plans are made clearly visible to all participants during the sessions. Such openness encourages trust and hence participation as all participants grow in confidence and become more open themselves.

4.1.2. Basic Psychological Similarity: We Are All Human with the Same Human Concerns

When working together towards their most desirable future, people realize they all share basic humanness and concerns. This session elicits the set of ideals and by allowing people an opportunity to share their ideals it not only makes them visible and real but it also almost inevitably confirms that there is an underlying level of concern with humanity and the state of the world. The usually unspoken presence of human ideals is no respecter of gender, race, status or age. By discussing and deciding upon a desirable future in either global or nearer terms, a modus vivendi for working together has been established; a benchmark for the possibility of more creative cooperative work towards common purposes. (Emery 2000)

4.1.3. Emergence of a Mutually Shared Field: we all live in the same world

Shared understanding of the L22 as a context for planning and action helps participants to create common ground. As everybody contributes to the emerging picture of the L22 with the items of data going up on flip charts, people recognize the reality that everybody perceives the same changes in the world around them, and that indeed, they do share a world. These notes then become the fundamental data available for analysis and then synthesis into most desirable or probable futures. Here they further realize that they all make the same meaning out of the data reinforcing the commonality. The data and scenarios remain in full view to function as check point and reality test for any subsequent proposals or plans. Accessible to all, this “big picture” of the environment (L22) serves amongst other purposes that of establishing the validity of the notion that we all live in the same world. Making shared notes can also help participants to question their own hidden assumptions and get on with the task of planning and redesigning their future along more desirable and adaptive lines. (Emery 2000)

4.1.4. Trust: The Development of Individuals as 'Open Systems'

When the above 3 conditions are in place, trust accumulates over time as an individual comes to experience the openness of the world s/he shares with others and the mutual respect and consideration which is accruing from initiating greater depth in communication with the other. As such trust accumulates so do interpersonal relations strengthen and deepen, increasing the probability of mutual learning. For the management of any learning environment the emergence of this trust is an overarching responsibility, involving as it does the individual's trust in his or her own perceptions and learning and the confidence of the group as a whole in its ability to assume responsibility for their futures (Emery 2000).

Trust accumulates to the extent that people find an opportunity to exercise care about their own and shared concerns and can put away gradually, without risk, the masks of passivity and dissociation. The resultant release of energy enhances challenge and consciousness and intensifies interpersonal engagement towards association with the task at hand. Therefore, it leads to more mutually supportive action. Without this spiral of trust, learning, energy and commitment, the process of implementation would be impossible. The three conditions - openness, our shared ideals with no division into us and them, and the acknowledgement of a shared objective field, are the essential preconditions for the development of trust. (Emery 2000)

4.2. Psychological Requirements for the 6 Criteria for DP 2 organizations

We also discussed the 6 Criteria for productive and creative activity which have been identified as important criteria for the successful implementation of DP2 organizational structures. They are invariably correlated with DP2 and inversely correlated with DP1 regardless of how much effort has been poured into ensuring employees have excellent pay and working conditions. The first three pertain to the individual who can have too little or too much and are measured from -5 to +5 where 0 is optimal. The second three pertain to the climate of the organization and of these you can never have too much. They are measured from 1-10. They have been routinely measured in countless surveys and Participative Design Workshops (PDWs) since 1971 (Emery, M., 1993). They provide a highly reliable measure of intrinsic motivation and quality of work regardless of the purpose or nature of the organization, including universities (Emery, M., 2000b). The criteria are presented in the Table 6.

Table 6: The 6 Psychological Requirements (6 Criteria)

	Scale
1. Elbow Room, optimal autonomy in decision making	-5 ….. **0** ….. +5
2. Continual Learning for which there must be a) some room to set goals b) receipt of accurate and timely feedback	-5 ….. **0** ….. +5
3. Variety	-5 ….. **0** ….. +5
4. Mutual Support and Respect, helping out and being helped out by others without request, respect for contribution rather than IQ for example	0 ……… **10**
5. Meaningfulness which consists of a) doing something with social value b) seeing the whole product or service to which the individual contributes	0 ……… **10**
6. A desirable Future, not having a dead end job.	0 ……… **10**

4.3. Complementary approaches

During the IFSR conversations we also addressed various ways in which the socio-ecological, social-technical and socio-psychological perspectives might be advanced. The original concepts seem to be still very powerful for addressing the social challenges in global and in local contexts. However, a lot has happened since the 1950s, 1960s and 1970s when these concepts were originally created.

Information and communication technology and software development has provided new possibilities for communication, working and learning together. The recent development related to social computing and social media can offer new possibilities for implementing Participative Design Workshops and Search Conferences.

During the session we addressed the concepts of "hacker ethic" by Steven Levy 1984 and Pekka Himanen. The idea of a "hacker ethic" is perhaps best formulated in Steven Levy's 1984 book, *Hackers: Heroes of the Computer Revolution*. Both Levy (1984) and Himanen (2000) stated values by hackers related to work itself and about working together with others. Levy's list consisted of sharing, openness, decentralization, free access to computers and world improvement. Himanen (2000) brought up passion, hard work, creativity and joy.

Figure 8 - The Principles of Management 2.0 – hackathon m2 principles

These principles of management are divided into elements – openness, community, meritocracy, activism, collaboration, meaning, autonomy, serendipity, decentralization, experimentations, speed and trust - are currently used in hackerfests, hackathons and hacklab events, where programmers come together to work, collaborate and compete. These new temporary and emergent organizational structures are clearly based on DP2 structures and they are applying similar principles as recommended in the original concepts of Tavistock Institute.

During the week several other possible views to complement the original socio-ecological socio-technical and socio-psychological perspectives were brought up by the participants. We discussed commitment and language action by Fernando Flores. Alexander Lazlo visited the team and introduced us to Flores' views of assertions, assessments, requests, promises, offers and declarations, narratives, vocabularies, conversations and speech acts. We discussed Tim Allen's work on 'complex' and 'complicated' as well as life cycles of organization, different stages, sabotage and unintended consequences. Themes related to resources: matter and energy in natural systems and power in social systems were addressed. We also briefly addresses Kenneth Boulding's 10 Images of change, which could provide an interesting framework, for looking into what has changed over the past 50 decades since the socio-ecological, socio-technical and socio-psychological perspectives were delineated. We considered operating with excess of resources and scarcity. We briefly visited human perceptions as well as beliefs, understanding, credibility, responsibility, ignorance and the limits of perception, knowing and understanding. The 'communities of practice' approach by Etienne Wenger was also brought up to address modern knowledge work in contemporary organizations.

5. Conclusions and the next steps

By the end of the week there were, as always, more new questions and possibilities than final conclusions and answers. It provided, however, a strong foundation for more research into active adaptive and self-managing systems.

After the IFSR meeting team members have been developing materials further. Materials have been used in several educational sessions and research projects. We are looking forward to investigating the area further both with complementary theories as well as empirical examples.

Acknowledgement

We would like to thank all the participants for their active discussion and valuable comments at the IFSR 2012 meeting at Linz. Participants provided information about other organizations that have applied DP2 practices in their structures – including Handelsbanken in Sweden, SEMCO in Austria and SOL in Finland.

6. References

Angyal, A. (1941). Foundations for a science of personality. New York: The Commonwealth Fund.

Asch, S. E. (1952). Social psychology. New York: Prentice Hall.

Baburoglu, O. (1988) The vortical environment: The fifth in the Emery-Trist levels of organizational environments. Human Relations. 41 3 181-210.

Boulding, K. 1956. The Image – Knowledge in Life and Society. The University of Michigan Press. Ann Arbor.

Emery, F. (1967). The next thirty years. Human Relations, 20, 199–237. Reprinted with postscript in Human Relations (1997), 50(8), 885–935.

Emery, F. (19746a). Adaptive systems for our future governance. In Emery, M. (Ed) 1993, Participative Design for Participative Democracy. Centre for Continuing Education, Australian National University. Canberra.185-199

Emery, F. (1976b). The jury system and participative democracy. In M. Emery (Ed.), Participative design for participative democracy (pp. 207–211). Canberra: Centre for Continuing Education, Australian National University.

Emery, F. (1978). Youth, vanguard, victims or the new Vandals? In F. Emery (Ed.), Limits to Choice (pp. 46-59). Canberra, ACT: Australian National University, Centre for Continuing

Emery, F. (1989). Toward real democracy. Ontario: Quality of Working Life (QWL) Centre,

Emery, F E., and M Emery. (1974). Participative design: work and community life. In Participative Design for Participative Democracy, ed. Merrelyn Emery, 100-122. 1989th ed. Canberra: Centre for Continuing Education, Australian National University.

Emery, F., & Thorsrud, E. (1969). *Form and content in industrial democracy.* London: Tavistock.

Emery, F., & Thorsrud, E. (1976). *Democracy at work*. Leiden, Netherlands: Martinus Nijhoff.

Emery, Fred. & Trist, Eric. (1965). The causal texture of organizational environments. *Human Relations*,18, 21-32.

Emery, M. (1982). *Searching: For new directions, in new ways, for new times.* Canberra, ACT: Australian National University, Centre for Continuing Education.

Emery, Merrelyn. (Ed).(1993). *Participative design for participative democracy.* Canberra: Centre for Continuing Education, Australian National University

Emery, M. (1999). *Searching: The theory and practice of making cultural change* Amsterdam/Philadelphia: John Benjamins.

Emery, M. (2000). “The current version of Emery’s open systems theory.” *Systemic Practice and Action Research 13 (5): 623–643*. doi:10.1023/A:1009577509972.http://dx.doi.org/10.1023/A:1009577509972.

Himanen, P.. (2001).*The Hacker Ethic: A Radical Approach to the Philosophy of Business*. Random House. NY.

Levy, Steven. (1984). *Hackers: Heroes of the Computer Revolution*. Doubleday.

Lewin, K., Lippitt, R. and White, R. (1939). Patterns of aggressive behaviour in experimentally created social climates. *Journal of Social Psychology*, 10, 271-99.

Lippitt, R. (1940). An experimental study of the effect of democratic and authoritarian group atmospheres. *University of Iowa Studies in Child Welfare*, 16(3), 43–195

Lippitt, R., & White, R. K. (1943). The “social climate” of children’s groups. In R. G. Barker, J. S. Kounin, & H. F. Wright (Eds.), *Child behavior and development* (pp. 485–508). Norwood, NJ: Ablex

Lippitt, R., & White, R. (1947). An experimental study of leadership and group life. In T. M. Newcomb & E. L. Hartley (Eds.), *Readings in social psychology* (pp. 315–330). New York: Henry Holt

Morgan, G. (1986). *Images of organization*. Sage Publications..

Morley, D. (1989). Frameworks for organizational change: towards action learning in global environments. In *Learning works: searching for organizational futures*, ed. Susan Wright and David Morley. Toronto: The Adapting by Learning Group, York University. [snippet view at Google Books]

Pepper, S. C. (1942). *World Hypotheses.* University of California Press. Reprinted in 1970.

Ramírez, R., J. W Selsky, and K. van der Heijden. (2008). Conceptual and Historical Overview. In *Business Planning for Turbulent Times: New Methods for Applying Scenarios,* ed. Rafael Ramírez, John W. Selsky, and Kees van der Heijden, 17-30. Earthscan. http://books.google.com/books?id=Y0tWYcxjPPgC

Trist E. L. and Bamforth K. W. (1951). Some social and psychological consequences of the longwall method of coal-getting. *Human Relations*. 4, 3-38.

Trist, E. L. and Emery, F.E., (1960). Report on the Barford conference for Bristol/Siddeley, aero-engine corporation. July 10-16, Tavistock TIHR, Document No. 598. London.

Trist, E. L. and Emery, F.E., (1972). Towards A Social Ecology: Contextual Appreciation of the Future in the Present. London, New York, Plenum Press.

Trist, E. L., and Hugh Murray. 1990. *The Social engagement of Social Science: The socio-psychological perspective*. University of Pennsylvania Press. http://www.moderntimesworkplace.com/archives/ericsess/sessvol1/sessvol1.html.

Trist, E.. L., and Hugh Murray. 1993. *The Social Engagement of Social Science: The socio-technical perspective. University* of Pennsylvania Press. http://www.moderntimesworkplace.com/archives/ericsess/sessvol2/sessvol2.html.

Trist, E. L., Hugh Murray, and Frederick Edmund Emery. (1997). *The Social Engagement of Social Science: The socio-ecological perspective. Vol. 3*. University of Pennsylvania Press P http://www.moderntimesworkplace.com/archives/ericsess/sessvol3/sessvol3.html.

Expanding Scope of Systemic Innovation and Socio-Ecological and Socio-Technical Perspectives

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Summary: In this paper I will introduce an expanding scope of stakeholders involved in innovation activities, especially new institutions for innovation, which include open source communities, Living Labs, development labs, hacker events and crowds. Social computing practices enabling interaction especially crowdsourcing practices will be presented. These new emerging phenomena will be discussed from socio-ecological and socio-technical perspectives, and images of change –framework created by Kenneth Boulding (1956).

Keywords: crowdsourcing innovation, open innovation, systemic innovation, stakeholders, social computing, socio-ecological environment, socio-technical system

Abstract: The seminal research work by Fred Emery, Eric Trist and Tom Burns (1961) by Tavistock Institute was addressing themes related to innovation and collaboration. Socio-ecological, socio-technical, and socio-psychological perspectives introduced in relation to organizational change as well as organic and mechanistic views. Innovation still offer valuable views to current business challenges. Also Kenneth Boulding's Images (1956) offers a framework to describe change and currently evolving practices. In the ISSS conference 2011 at University of Hull Mike Jackson brought up in his keynote speech, that it would be very relevant revisit original thoughts of systems thinkers, and see how they would apply in the current business context. IFSR Conversations 2012 at Linz has provided a great opportunity to revisit these original thoughts and enabled inquiry to apply these concepts to current phenomena and challenges.

Recent development of global business networks, emerging new technologies, accelerated speed of development and enhanced access to data, information and knowledge challenge traditional business practices and ways of working. Sustainability has become essential and increasingly important element to long term business success, consumers are becoming more environmentally conscious on socio-ecological issues. There is a shift towards more user-centric development, focus on usability and user experience address socio-technical challenges in earlier stages of development. Social computing and social media application enable interaction with users at earlier stages and in more meaningful ways. Working with communities of practice, user communities and crowds bring up new challenges from socio-psychological perspectives. Wider group of stakeholders are included in innovation practices and new technologies are enabling interactive relationships.

1. From closed towards open innovation systems - expanding scope of stakeholders

The concept of open innovation by Henry Chesbrough (2003) refers to the fact that both internal and external sources can and should be used for innovation. This notion was already brought up by Tom Burns and George Stalker (1961) when they addressed mechanistic and organic structures related to innovation management, whereas mechanistic organizations were bureaucratic, rather rigid and more slow in decision making and in operations; and organic structures were more flexible, dynamic and open. Unfortunately for several decades traditional management practices were applied also to innovation activities and they were considered to be highly secretive and were operated in closed systems mainly within organizations. However, during the past decades, especially companies have been opening up their innovation activities to both directions in the supply chain: towards customers and end-users i.e. downstream and towards suppliers i.e. upstream part of the supply chain. As a result, companies are increasingly dealing with many external parties including suppliers, customers, end-users, governmental organizations and research organizations (see Figure 1) for the pursuit of new knowledge. Also some new institutions for innovation are emerging globally, offering an interesting potential set of new stakeholders for innovation activities.

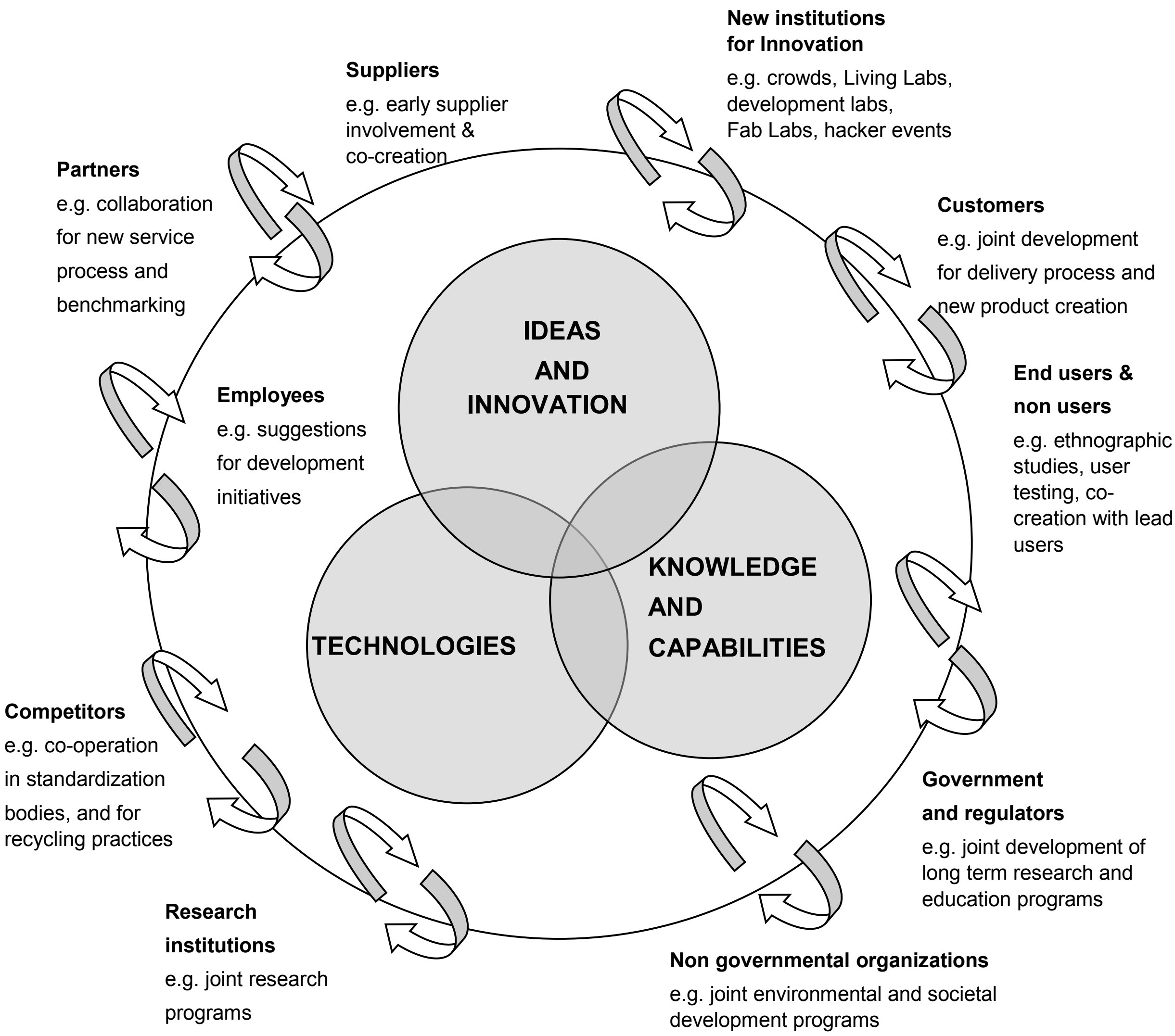

Figure 1 Stakeholder view to collaborative innovation and examples of interactive relationships

With the digital information technologies including social computing as Web 2.0, social media and crowdsourcing it has become easier for organizations to engage these external stakeholders in innovation activities. However, whilst these parties can be regarded as potentially valuable providers of novel knowledge, it may prove challenging for an organization to manage all these inter-organizational relationships as they may differ in relationship focus and in the ways of collaboration. Accordingly, organizations are faced with the challenge of managing and structuring their innovation activities in a distributed environment. The first challenge for an organization is identifying relevant stakeholder groups in the external operating environment (L22) and developing ways to engage them in the innovation activities (L12 and L21).

Systemic Innovation has been defined by Chesbrough and Teece (1996) as an innovation whose benefits can be realized only in conjunction with related complementary innovations. According to Teece (1996) systemic innovation requires coordination throughout the system in order to realize the gains from innovations and it requires significant adjustment of parts in the business system they are embedded in. Teece (1996). For systemic innovation it is very relevant to identify related stakeholders and interaction with them.

1.1. Stakeholders for innovation

Stakeholder theory by Edward Freeman (1984) argues that there are many parties involved in corporate management and related business, including governmental bodies, political groups, trade associations, trade unions, communities, financiers, suppliers, employees, and customers. Sometimes in addition competitors are listed among stakeholders - their status being derived from their capacity to affect the company and its other stakeholders. Originally stakeholder view of the firm was addressing business ethics, morals and values. However, it has later been applied in other areas of management.

In innovation activities suppliers can be engaged with early supplier involvement, they can participate in creation of new products and services. Customers can be invited to participate into joint development for delivery process and new product and service creation. End users & non users are very valuable stakeholders for user testing. Also co-creation with lead users can provide novel insights for new product and service creation. With collaborative ethnographic user studies products and services can be developed to better serve the needs of users.

Different partners are need to new service processes and benchmarking. With research institutions including universities joint research programs can bring novel ideas and technologies into new product and service development. Employees are encouraged to participate via idea competitions and suggestions for development initiatives. These activities are also conducted with ex-employees, retirees and alumni.

Government and regulators are important stakeholders for joint development of long term research and education programs. And companies are increasingly working with non-governmental organizations for example in joint environmental and societal development programs as well as local development initiatives. Competitor collaboration has become more common e.g. via co-operation in standardization bodies, and in some industries for recycling practices.

1.2. New institutions for Innovation

Turner (1997) has defined institution as a complex of positions, roles, norms and values lodged in particular types of social structures and organizing relatively stable patterns of human activity with respect to fundamental problems in producing life-sustaining resources, in reproducing individuals, and in sustaining viable societal structures within a given environment.

New institutions for innovation – open source communities, Living Labs, development labs, Fab Labs, hacker events – have emerged in various contexts since 1980’s and they have been enabling new roles, norms and values, new structures and new ways of working. These new institutions have been expanding into other area and countries. Following open innovation principles the original institutions have offered openly information about their activities for interested stakeholders, and new initiatives have emerged globally across the world.

New institutions and practices enable creativity and adaptive approaches for development, addressing both social and economic issues. Open source communities originally operated mainly in the area of software development. Later practices have been applied in other areas as well. The first Fab Lab was established at MIT in 2002, and now there are ~100 Fab Labs globally and ~30 under development. The first Living Lab was established in 2004, and now there are ~300 of them globally and ~50 under development. While other organizations seek new sources for innovation in collaboration with these institutions their own practices need to change as well. New approaches are needed especially for mutually value-added and respectful collaboration between firms and new emerging institutions.

1.3. Crowdsourcing

One stakeholder group that has been gaining importance lately are crowds, anybody willing to collaborate. Various types of classifications have been done to understand the nature of crowdsourcing phenomenon. Originally, Howe divided crowdsourcing activities into four primary types 1) crowd wisdom; 2) crowd creation; 3) crowd voting and 4) crowd funding. Crowd wisdom relates to scientific and professional problem solving (e.g. Innocentive since 2001), collecting geographic content, aggregating location based data and information (e.g. Open Street Map since 2004) and collecting health and medical data (e.g. Patients Like Me since 2004). Crowd creation relates to distributed work (e.g. Mechanical Turk since 2005, Freelances since 2004) and crowdsourcing platforms for design and art (e.g. 99design since 2008; Express in Music since 2009). Crowd voting is an often embedded element in idea crowdsourcing platforms, as for example in Threadless.com, where people can share, score and comment on T-shirt designs; most popular designs are awarded. Crowd funding relates to funding small businesses and investing in new product and service development (e.g. Kiva since 2004; Kickstarter since 2009) for example in the area of music and art (e.g. ArtistShare since 2003). A similar type of categorization for crowdsourcing activities distinguishes between five main application domains cloud labor, crowd funding, crowd creativity, distributed knowledge and open innovation (see www.crowdsourcing.org).

2. Socio-ecological and socio-technical perspectives

Socio-ecological perspective provides framework for describing, analyzing and planning how a system, a company or an organization, (L11) is interacting with its environment (L22). These interactions have been defined as planning (L12) and as learning (L21). This approach can be used to analyze and explain how companies interact with innovation stakeholders and new institutions for innovation.

The concept of "the causal texture of the environment" created by Emery and Trist (1965) noting that the environmental contexts in which organizations exist are themselves changing under the impact of technological change - at an ever-increasing rate, and toward increasing complexity. This phenomenon seems to be still continuing. The rate of technological change seems to be still increasing, yet at the same time technologies enable people to have enhanced access to information and knowledge globally, and provide new opportunities for collaboration and sharing.

Both Participatory Design Workshop (PDW) and Search Conference (SC) methods offer opportunity of mixed stakeholder groups to plan and learn together. And new communication technology and collaborative IT platforms can offer common ground for discussing shared values, missions and goals, planning and reporting activities, as well as working together.

Socio-technical perspective can address the actual work design, how people work together in collaborative settings, how their work related to the whole organization and to relevant stakeholders. It is also possible to connect the activities to macro society and to global challenges.

3. Change in innovation systems – change in images

We need to revisit our beliefs about existing organizations, practices and ways of working, in order to understand the changes happening in the global society. Kenneth Boulding (1956) asserted that the behavior in the society depends upon the images. These images lie behind the actions of individuals, organizations and societies. The recognition of different images and basic assumptions are important for societal development. Boulding (1956 pp.3-18, 45-63) classified different aspects of images in ten elements. These elements and application to current context is presented below:

- *Spatial image* - the picture of the individual's location in the space around him. This dimension addresses changes in physical environment as well as in information and communication technology - ICT supported virtual environments.
- *Temporal image* - an individual's picture of stream of time and his place in time. This dimension looks into changes in time-based practices, for example short and long term connections, and synchronous and asynchronous connections.
- *Relational image* - the picture of the universe as a system of regularities. This dimension focuses on relations between organizations, and relationships among stakeholders.
- *Personal image* - the picture of an individual in the midst of the universe of people, roles and organizations around him. This dimension views personal aspects and changing roles.
- *Value image* - the ordering of the scale of better and worse of the various parts of the whole image. This dimension invites us to investigate what are the value systems in use, how we appreciate wealth, health, beauty and truth in our activities.
- *Emotional image* - various items in the rest of the image are imbued with feeling or affect. This dimension addresses human behaviors based on emotions, for example the passion for innovation and the fear of failure or success.
- *Conscious, unconscious & subconscious image* - an individual is capable being conscious of all parts of the image with the same degree of intensity, ability to perceive varies, a very small part of an image is exposed to our internal view at the same time. This dimension looks into sources of creativity, imagination beyond rational thinking.
- *Certain / uncertain, clear / vague image* - every aspect of an image is tinged with some degree of certainty and uncertainty. This dimension relates to the vagueness of fuzzy front end of innovation process. Risks are always related to new innovative activities.
- *Real / unreal image* - an image of the correspondence of the image "itself" with some "outside" reality. This dimension challenges us to investigate deeper levels and leads to implementation in real contexts.
- *Public / private image* - whether the image is shared by others or is peculiar to the individual. This dimension provides us an opportunity to address the themes of open innovation and transparency.

Each image is rich and complex. The dimensions above provide a framework for description of complex phenomena. Boulding emphasized that the image is a property of the individual person, so he described different images in the individual level. However, he noted that different dimensions of image could be used by the way of metaphor or analogy for organizations and societies. Some image dimensions are more certain in their nature, some of them are more uncertain e.g. the relational image, value image, emotional image.

Change can be perceived as a mutation of the image created by the true entrepreneurs of society. This change is happening based on emergent activities rising on people's own initiatives. Without this mutation of the image, societies would rapidly settle down in a stagnant equilibrium. As the world moves on, the image does not. This has happened in many societies. In the INSCO project Boulding's image framework is used to describe difference between traditional and emerging new institutions for innovation. The new images can be seen as extensions and modifications of the old.

4. INSCO Project - Innovation in Sourcing Competencies

This paper is based on research done for INSCO Project, which is a TEKES (the Finnish Funding Agency for Technology and Innovation), university and industry funded parallel research consortium project, conducted at Aalto University during 2011 – 2012. The project is carried out with co-operation with researchers from Aalto University, Oulu University, Kasetsart University (KU) (Thailand), CSIR / Meraka Institute and Rlabs, ReConstructed Living Lab (South Africa). Collaboration with Finnish industry is conducted with three partners: Konecranes, NSN and Teleste. These industrial partners have also their own parallel development projects, derived from specific and concrete development and business needs. Collaboration between the industrial partners and research team form a natural platform for research and benchmarking. Research methods included case studies, interviews, participatory workshops, development projects and identification and benchmarking of new practices.

The INSCO Project includes six work packages: 1) collaborative practices with suppliers in early life cycle phases, 2) management of innovation focused sourcing relationships, 3) use of demos, prototypes and pilots, 4) practices for indirect sourcing, 5) approaches with developer communities, living labs and practices for early customer involvement and 6) approaches for crowdsourcing. Research methods include case studies, interviews, participatory workshops, development projects and identification of and benchmarking with new practices. INSCO Project is looking into new practices for sourcing and new practices for sourcing innovation.

5. Conclusions

Expanding scope of innovation addressing both systemic and social perspectives is elementarily important for addressing global and local societal and environmental challenges. There are more and new kind of stakeholders involved in innovation activities. Socio-ecological and socio-technical perspectives provide good approach for collaboration towards desired future.

Further work is needed on understanding how these new institutions are managed and how they can successfully collaborate with more traditional institutions. Also the creation of sustainable financial models is an important theme for further studies. Next step will also include research on the creation of global community -based Hub network for entrepreneurs. More research activities, interviews and workshops will be conducted during spring 2012 together with selected Living Labs and other new institutions.

Other approaches to organizational design e.g. heterachy by Gunnar Hedlund, holographic organizations by Arthur Koestler, democratic organizations by Russ Ackoff, fractal organizations by Margaret Wheatley, living organizations by Rene Dubos and network organizations by Manuel Castels will be addressed to investigate this further.

6. References

Boulding, K. (1956) *The Image – Knowledge in Life and Society*. The University of Michigan Press. Ann Arbor paperbacks.

Burns, T; Stalker, G.M. (1961) *The Management of Innovation*. 2nd ed. London: Tavistock Publications.

Chesbrough, H. (2003) *Open Innovation - New Imperative from Creating and Profiting from Technology*. Harvard Business School Press.

Chesbrough, H. and Teece, D.J. (1996) Organizing for Innovation: When is Virtual Virtuous? *Harvard Business Review*, 74:1 (January-February 1996), 65-73

Emery, F. and Trist, E. (1965). The causal texture of organizational environments. *Human Relations*, 18, 21-32.

Freeman, R.E. (1984*). Strategic Management: A stakeholder Approach*. Boston: Pitman

Teece, D.J. (1996) Firm Organization, Industrial Structure, and Technological Innovation, *Journal of Economic Behavior and Organization* 31:2 (1996), 193-224.

Turner, J. (1997) *The Institutional Order*. Longman

Team 2: "Science II: Science Too!" (Team Report)

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Abstract: *For the past century, Western science has focused on the idea that the world is organized around discrete objects which aggregate and have simple relationships. The paradigm is that of physics. All things should be explainable through rules, laws, and algorithms. The observer is not a part of the observation since the "things" themselves constitute reality. Despite the successes which this frame has produced, it has a serious deficiency: How is it that the actions and behaviors of sentient creatures are best described by rules for non-thinking objects? How is it that context is deemed to not matter? And what about complexity? Those relationships which cannot be described by the simple? The physics based frame has no answer and instead discards these issues with the magic words: Ceteris paribus. But we do not live in a Ceteris paribus world. Thus, arises the need for some other kind of science..*

Keywords: Science, Physics, Systems, Models, Frames of Reference

Our mission was to begin to articulate a new perspective on science. Most observers believe that science is a rigorous expansion of common sense. Common sense is defined by Merriam-Webster as, "sound and prudent judgment based on a simple perception of the situation or facts." It is believed (by both common sense and science) that in most cases that simple perception is "good enough". But, simple perceptions fail to adequately capture the import of context or situation. They are poor at reflecting more than single order effects (where a leads to b). By relying on common sense, we are in effect relying on the assumption that simple perceptions are adequate for the task or judgment at hand. But are they?

Jay Forrester has noted: "While most people understand first-order effects, few deal well with second- and third-order effects. Unfortunately, virtually everything interesting lies in fourth-order effects and beyond."

When simple perceptions are inadequate, then the need for tools that enable better access to “what, who, and how much” one needs to know becomes painfully obvious. Expanding upon common sense -- either in the form of developing better tools for simple perceptions, better methods for simplifying complex perceptions, or better approaches for making judgments based on these simple perceptions just will not help in that portion of the world where "success" lies in developing an understanding of boundaries, constraints, and possibilities inherent in the interactions of large numbers of autonomous and semi-autonomous agents.

Many attempts have been made over the years to refine the notion of common sense -- nearly all have run into the same obstacle: simple perceptions are oft times inadequate to capture what we need to know about a given situation or context in which we find ourselves. Our observation is that the current conceptions of science run into this same obstacle. Thus, arises the need to expand our repertoire beyond common sense, and beyond the simple – into a new realm for science – Science II

Photo below: The Science II team at work

Task 1: Define the Issues

We began by raising issues:

- Social Science practitioners express frustrations/limitations with Science I
- General needs of a philosophy/epistemology of Science
- Specific needs for a hypothetical Science II
- What would that Science II include?

And went on to discuss frustrations and limitations regarding Science I (as expressed by individual members of the team):

- Methodological misfits
- Reliable prediction is not always possible
- Our ability to "see" and "express" certain phenomena is restricted by Science I in use
- The experience of "x" is not the same as the label "x"
- Ceteris paribus is nonsense

And with the Philosophy of Science as commonly used:

- Articulations of examples are most commonly physics based
- Despite the claims by physicists, other sciences cannot be reduced to physics or its equivalents without raising issues of both epistemology and ontology
- Other sciences have unique requirements demanding exact articulations
- Systems composed of thinking elements should not be described using methods developed for systems with non-thinking elements

This led to some initial conclusions. The basis for social sciences and design (pragmatic assumptions) is different from the "hard" sciences. There is a need to deal with ideas and communication in social systems. Thus, the Philosophy of Science needs expansion to include paths to potential logics of the social sciences. Example questions might include asking "What is the basic unit (individual, group, set, dynamic, environment, etc.?)." Thus Science II will require different languages than are commonly used in Science I. Science II will require different frameworks of thinking. Meta-level thinking is an opportunity which can create the need for new strategies of simplification so as to meet requisite variety.

Task 2: Expand upon Science as a Way of Thought

Generally science is understood as a methodical way of perceiving and cognizing, using observation, building mental models by learning. Beginning with consciousness and higher consciousness science developed from pre- stages (e.g. observation of natural cycles and adapting to them) in pre-history epochs to its actual highly sophisticated constitution. Early phases were closely enmeshed with magic and religious beliefs and rites to control natural events. Mesopotamia created with early topology and cosmology early mathematics to regulate agrarian cultures. Eastern philosophy contributed: India and

China. In the medieval epoch formal Greek and pragmatic Roman philosophy, enriched by indigenous thought, grew into alchemy and astrology; the precursors of Post-Renaissance science and of the actual state of scientific research. Science has been and actually remains a learning system consisting of the triangle of the observing scientist, the topic of research and the modes of observation and conclusion.

Actual Science appears a human property to survive and develop emerging with changing inner and outer environments based on methodical learning. In Post-Renaissance science focused on Physics and the methodical rigorousity in physical experimenting, in concluding, in evaluation, validation etc. In the main stream methods derived from physical research where also applied to the non-physical sciences, namely to the life sciences, the anthropologies and humanities. They are addressed here summarily as social sciences. In the beginning the formal structures, the algorithms and the physical base of non-physical sciences were investigated, contributing to a formally/physically grounded understanding. Focusing nearly exclusively on that aspect it became obvious, that on that formal base social/societal objects could not be sufficiently be explored nor be understood nor be guided/controlled. The somewhat misleading term second order science denotes the return to the comprehensive conception of science as a means to cope with the world as described above. The formal physical base is complemented by indigenous modes of research fitting to the social (and other complex life) systems in question. In particular meaning is included. Accordingly epistemology is reconsidered and differentiated as to be adapted to the qualities of the actual object of the research. A movement 'back to basics' comprises virtually all sciences,. It responds also to extended scientific environments in the physical science as e.g. quantum physics, cosmology or eventually endo- and exo physics or the fractal nature of time and space experienced. Systems and cybernetics grounded and stimulated the process of scientific emergence, in particular systemics and cybernetics of second order. They acted and act like a hub in the network of rethinking and reinventing epistemology on the disciplinary and cross-disciplinary level. Their concepts supply the crucial points of epistemological departure for a transdisciplinary grounding of science.

Being aware of the above challenge the Team contributed by complementing the above from different focuses:

- Central to research is hypothesizing and modeling. Representation – based on labels and categories- is confined to deal with simple models not accounting for contextual complexity and change. Models to inquire complex topics need be more complex themselves, including narratives. They treat context not as a scaffold, but as a participating factor. They permit to include experiences without losing overview. The latter approach is called comprehension. Comprehension permits flexible adaptation and extension to the qualities of the actual topic. It provides e.g. the base for anticipation essential for life systems.
- Refined modelling takes care also of the co-action of the social/societal research object with the theory and epistemology employed. That proves necessary e. g. in consulting, politics, etc, that is generally in management and control. The role of the observer, that is the mental models of the -consultant, the strategist, the politician determine intent and measures. Well known is the soft systems methodology. Practice examples were discussed.
- Complexity (not only) in social systems is closely linked with meaning. Examples from inquiries in the feeling of well-being and expectations for the future reveal a most complex network governing the attitudes of people to the social/societal group they are member of. The existing –or the missing – participation on social community life turns out an essential factor of a vigorous social life. Examples were given.
- Reflecting the triad scientist – object – epistemology, investigating the role of the observer is assigned a pivotal role. The gradual deeper acknowledgement of the influence of the observer

supports a critical rethinking of the 'subjectivity' and the proneness of results in societal research as to theories and models hypothesized.

- What is not in mathematics, cannot be in physics, nor in life systems, respectively in the epistemology of sciences. However, the mathematics of physical systems cannot one to one be applied to life systems. Investigation is needed whether an advanced, specific mathematics for life sciences needs to be developed from the physico-chemical base of life, e.g. the order of natural elements.

What Does This Imply for Science II?

We need to enrich the systems approach and reconcile the Eastern and Western approaches. It seems that Science II demands narratives. We used the example of Medical Heuristics (e.g. narratives told by physicians to patients). Because Science II includes Reflexive Anticipation more variety is needed in describing homeostasis and balance relationships. The very notion of "Best Practices" needs to be re-examined. Finally Science II needs to find ways to express circular causality.

We then tried to systematize our thoughts.

Task 3: We asked "What Happens When We Add the Observer to Science?"

Science I as traditionally understood has attempted to exclude the observer from having an active role in the scientific enterprise. Conclusions are supposed to be observer independent. Multiple experiments and the doctrine of falsification are supposed to render Science I objective and remove subjective bias. This notion was perhaps best captured in Karl Popper's three worlds.

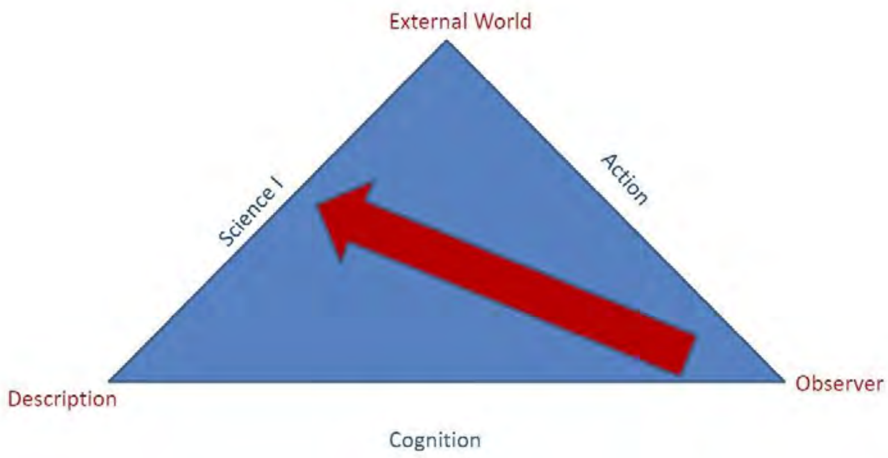


Figure 1: Based upon Karl Popper's notion of three worlds, the arrow captures the question of adding the observer to the Science I axis.

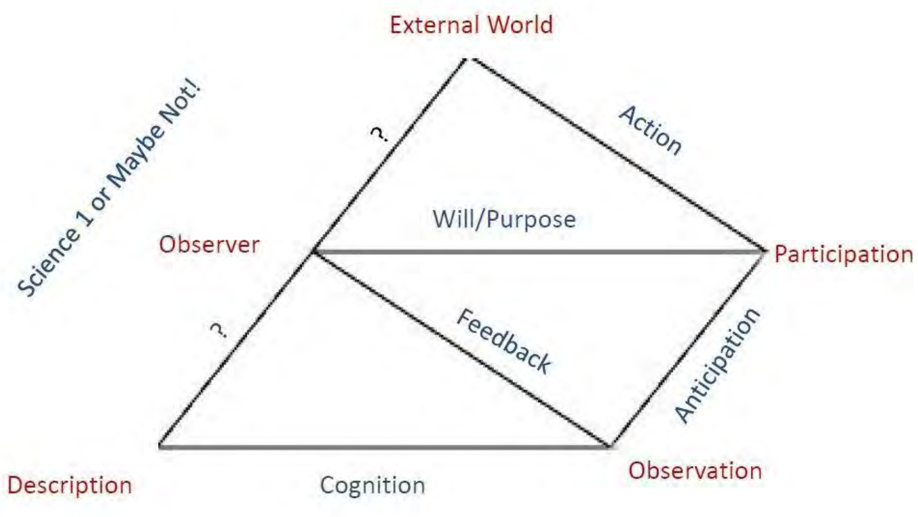
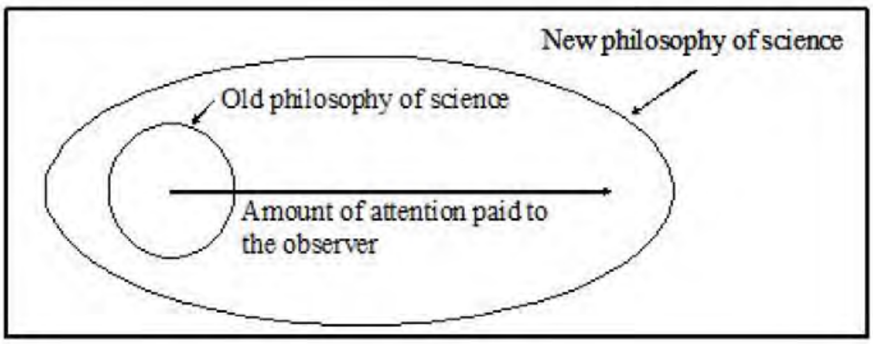


Figure 2: We folded the right corner of the triangle in Fugure 1 and then labelled the resulting axes. This chart allowed us to discuss in greater depth implications of the role of the obsever.



"All statements made are made by an observer." (Maturana)

Figure 3: Our initial conclusion was that "adding the observer" resulted in a broader prhilosphy of science rather than a replacement philosphy of science. Thus Science II functions in addition to Science I.

Task 4: Then we asked: what happens when we add feed-forward reasoning to Science?

- Language changes to include future tense
- Acting now in order to affect the future (telos, and why?)
- Spontaneity, Proactivity, and Anticipation play roles. All three act as circular inputs to goals. New learning cycles may emerge.
- Explanations cannot rest on labels but demand consideration of circular feed-forward-feedback effects
- New relations are introduced and new critical thresholds must be considered
- Knowledge is expressed more as methods (how) and less as theory (what)
- Recognize the role of implicit knowledge

Task 5: Finally we asked: what happens when we add Will/Purpose to Science?

- Final cause becomes a basis of reasoning
- Consideration of the combinations and permutations of the affordances available becomes important
- Actors/observers/systems can be combined in multiple ways which give rise to potential conflicts of will
- Politics then may rear its ugly head
- The possibility of such conflicts demands the articulation of habitus so as to enable the exploration of commonalities and differences

Task 6: Recast the Ontology of Science and of Scientific Thought

When we pondered these questions we approached science as a process in evolvement. We observed that roughly four phases may be distinguished: 1st the 'world' how it is (simple positivism), 2nd the world as it is seen by the scientist (cybernetics II); 3rd the world how it has become: the dynamics of evolution, of complexity, of meaning; emergence. 4th the deep structures (networks, fractals, processes like dimensional re-entry). These can be pictured:

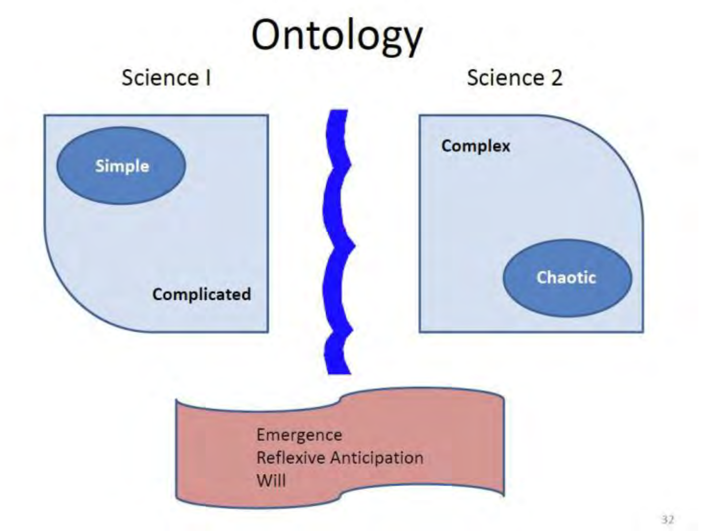


Figure 4: The ontology chart we developed to indicate the roles of both Science I and Science II. The red area at the bottom lists qualities which distinguish the two .realms

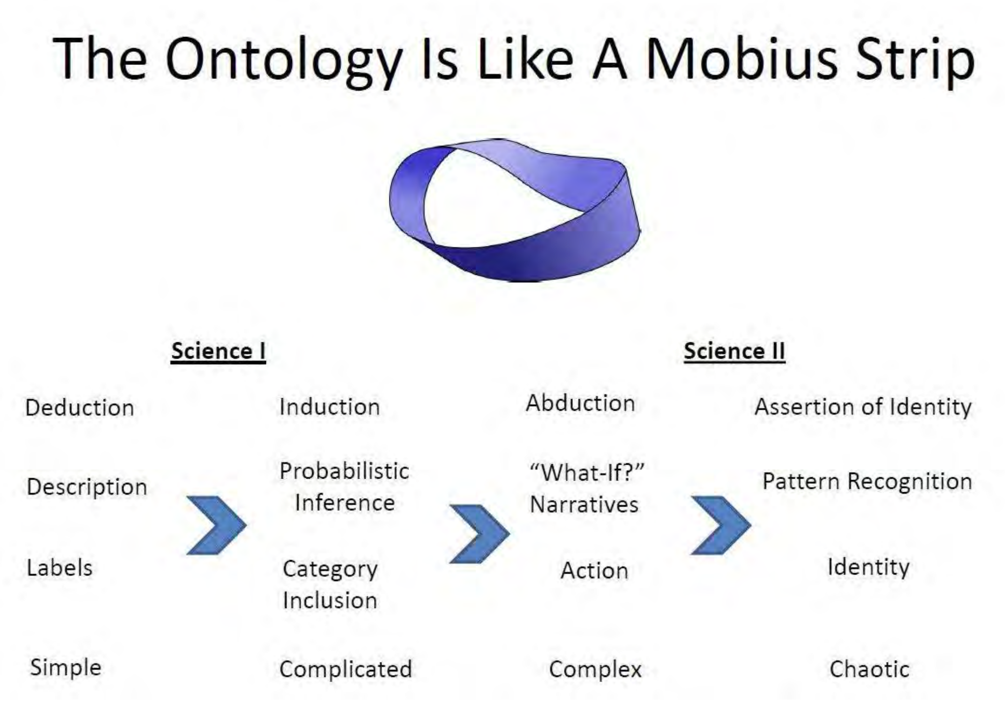


Figure 5: While Figure 4 suggested that the realms were divided, Figure 5 is meant to emphasize their interconnection. A mobius strip is a one dimensional continuous surface – so too are the transitions between and amongst the realms of Science I and Science II.

In conclusion we analyzed the differences between science (I) and second order science (Science II) as to their origins; historically and connected to the process of science as an emergence process. Why is Science II needed and, measured by the challenges, not yet sufficiently understood and solved? Only a new epistemology and ontology behind can adapt the potentials of science to deal with the looming natural, demographic and social singularities. Addressed are mainly but not exclusively societal, social and ecological challenges. If the observer and environments - in Science I but parameters - are included in the scientific process, participation, will and purpose (meaning) are added. The acknowledgement of feed forward, of the influence of the social habitus (specific social environments) enables anticipation, permits grounded guidance and control. The latter rises new problems: the abyss of politics, power play, of vested interests. Final cause is essential (anticipation), as is non-Aristotelian logic. Epistemology is implied deliberately as an active means and object of research. Research in itself is seen a learning process in a continuous line of learning and meta-learning. Contexts remain not fix parameters, but become catalysts participating in the research process. The differences are reflected in a differing ontology in Science I and Science II.

Summary

The summary of our considerations is displayed in the two figures below

Science I and II are Ontologically Distinct

Science I
- Prediction
- Retrospective thinking
- Physics is Closed to Emergence (Chemistry/Biology Not)
- Excludes Observers
- Category Based
- Mathematics dominates Symbol Code

Science II
- Preparedness
- Anticipatory Proactive thinking
- Explicitly Embraces Emergence
- Includes Observers
- Based on "What-If?" Models
- Narrative Explanations

Science II constitutes a tool both for theory/model building and pragmatically problem solving.

Figure 6: A summation of the distinctions between Science I and Science II.

Highlights

Science I
- Retrospective
- Prediction
- Closed to Science II
- Positivist/Realist
- Code Based (labels)
- Context as Parameters
- Quantitatively Measurable

Science II
- Anticipatory
- Preparedness
- Open to Science I
- Constructivist/Pragmatic
- Cue Based (affordances)
- Context as Participatory Catalyst
- "Lossy" Descriptions

Figure 7. Characteristics which distinguish the ***practice of science*** in the two realms.

References:

Abductive Inference: Computation, Philosophy, Technology, by John R. Josephson; Susan G. Josephson (ISBN: 0521575451)

Anticipatory Systems, by Robert Rosen; Judith Rosen; John J. Kineman; Mihai Nadin (ISBN: 1461412684)

Belief Revision Meets Philosophy Of Science, by Erik J. Olsson (ISBN: 9048196086)

Boundaries And Barriers, by Anders Karlqvist; J.L. Casti (ISBN: 0201555700)

Carving Nature At Its Joints, by Michael O'Rourke; Joseph Keim Campbell; Matthew H. Slater (ISBN: 0262516268)

Causality And Explanation, by Wesley C. Salmon (ISBN: 0195108647)

Causality and Modern Science, by Mario Augusto Bunge (ASIN: B0007DWG70)

Ceteris Paribus Laws, by John Earman, Clark Glymour and Sandra Mitchell (ISBN: 9048161738)

Coherence in the Midst of Complexity: Advances in Social Complexity Theory, by Hugo Letiche, Michael Lissack , Ron Schultz (ISBN: 023033850X)

Context As Other Minds, by Talmy Givon (ISBN: 1588115933)

Creating Scientific Concepts, by Nancy Nersessian (ISBN: 0262515075)

Dynamics In Action: Intentional Behavior As A Complex System, by Alicia Juarrero (ISBN: 0262600471)

Explaining Explanation, by Lee McIntyre (ISBN: 0761858695)

Explaining Explanation, by David-Hillel Ruben (ASIN: B0086OJZQC)

How Scientists Explain Disease, by Paul Thagard (ISBN: 069105083X)

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Human Nature And The Limits Of Science, by John Dupre (ISBN: 019926550X)

Induction and Deduction in the Sciences, by Friedrich Stadler (ISBN: 9048165555)

Memory Evolutive Systems; Hierarchy, Emergence, Cognition (Studies In Multidisciplinarity), by Andree C. Ehresmann; Jean-Paul Vanbremeersch (ISBN: 0444522441)

Representing Reality: Discourse, Rhetoric And Social Construction, by Jonathan Potter (ISBN: 0803984111)

Rethinking Explanation, by Johannes Persson; Petri Ylikoski (ISBN: 1402055803)

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The Semantic Turn, by Klaus Krippendorff (ISBN: 0415322200)

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Theory And Truth: Philosophical Critique Within Foundational Science, by Lawrence Sklar (ISBN: 0199251576)

Thought And Language, by L.S. Vygotsky (ISBN: 0262720108)

Team 3: *Curating the Conditions for a Thrivable Planet:*

Systemic Leverage Points for Emerging a Global Eco-Civilization

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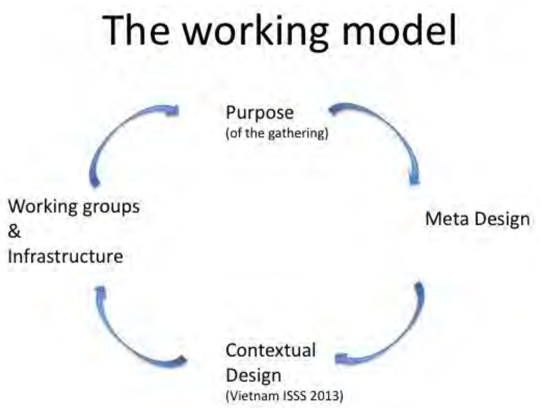
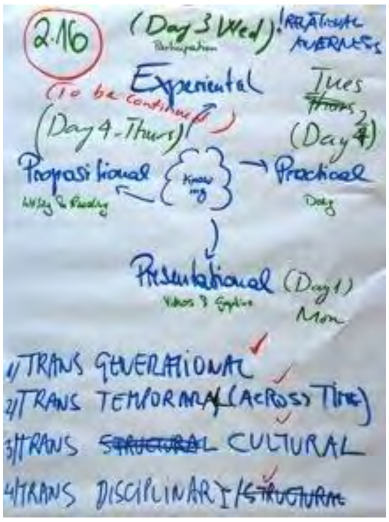
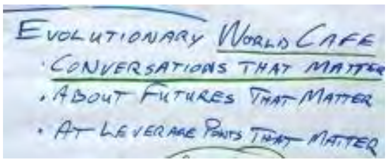
Abstract: Our team worked on the practical design challenge of creating a series of related international events that address issues of livability and thrivability in terms of systemic socio-ecological innovation. To do this, we focused at two systemic levels of intervention: at one level (which became the meta-level), we focused on *curating the conditions for a thrivable planet.* This was the larger vision – the idealized design objective that allowed us to contemplate a variety of pathways to address this objective. In this sense, it served as a design attractor for our work. We then chose to focus upon one feasible and realizable pathway that could serve as a functional prototype for addressing the meta-level objective. The 57th



Meeting and Conference of the ISSS, set for Viet Nam in July of 2013, was selected to serve as the systemic case for our specific contextual design initiative. This became our system in focus, and our design efforts were then concentrated on setting an actionable agenda for the realization of this event.



Given that there are numerous pathways to address the meta-level design objective, we set the system level objective for the ISSS Conference based on the theme of *Systemic Leverage Points for Emerging a Global Eco-Civilization.* By setting this focus we intended for ISSS 2013 to provide both a platform for other contextual designs framed within the meta-level objective of *curating the conditions for a thrivable planet,* as well as to catalyze the emergence of a network of such initiatives through the specific system level focus chosen for this event. We considered that the selected conference theme would attract living cases of systemic sustainability – those which demonstrate socio-ecological innovations that span social, technological, economic, agricultural, and infrastructural domains. By focusing ISSS 2013 on the exploration of both real-world cases of systemic sustainability and theoretical models dedicated to their promotion, this event will serve to seed the emergence of a Global Living Laboratory network of such initiatives. The result of this event would therefore be the emergence of an auto-catalytic socio-technical system focused on individual projects of systemic sustainability that collectively contribute to the creation of conditions for a thrivable planet.



The design we worked out for ISSS 2013 was based on the four ways of knowing described by Heron and Reason in 1997[1], moving from experiential knowing to presentational knowing to propositional knowing to practical knowing. Through both local and virtual conversation-based systemic inquiry, our design offers a key example of systemic socio-ecological innovation aided by collective intelligence.[2]

Keywords: Thrivability, systemic leverage points, eco-civilization, conscious evolution, curated emergence, systemic sustainability, ISSS 2013, Viet Nam.

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1. The 'why' of what we are doing

- We know we cannot solve the problems in a meeting. so we create living laboratories where people learn simply systems tools to help them change their mindset from linear to more holistic thinking…
- We *can* change society through the type of work we are doing.

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[1] Heron, John and Reason, Peter (1997). A participatory inquiry paradigm. *Qualitative Inquiry*, 3(3), p. 274-294.

[2] For a general overview of the four teams that met in Linz, Austria, for the 16th IFSR Conversation Event, see: Chroust, G. (ed.), *IFSR Newsletter*, Vol. 29 (2012), No. 1. IFSR - International Federation for Systems Research, Linz, Austria, Sept. 2012 [http://ifsr.ocg.at/world/files/NL29_1.pdf].

- Co-creation is a main aspect of this work – of the *why*.
- To prevent wars
- To ways design of bridging civilizations, to bring cross-civilization wisdom.
- To find ways of honestly engaging in societal change that addresses the common good of the broader society.
- To move toward a society that acknowledges through learning that the complexities we are facing in the world are multi-dimensional, multi-scaled, and interconnected and that there is therefore a need for a new way of thinking and acting in dealing with issues of governance at all levels of human interaction.
- To work towards a society, then it should be about a society where the full development of the whole supports the full development of all of its members

1.1 Sharing experiences that provide tools for us to draw upon

The **Change The Game initiative** is an inter-personal network. It seeks to bring together the people who are the leaders in paradigm change around innovation, ethics and leadership. The goal is to have **people engage in ways that multiply the resources available to them**. It is focused on a process of **self-organization around common interests.**

InCo – innovation communication, a movement founded by Violeta – has to do with promoting mass innovation as a driver for society. We cultivated the emergence of leadership from within by having individuals being just very active nodes, not pushing or pulling anyone anywhere… We created for the corporate environment a **horizontal infrastructure to support mass innovation**. It works for any organization. We also started the case of innovative local communities. It was important that all the participants had a common experience and common language to help emerge common projects. The cohesion through **activating the base of the pyramid creates the platform for innovative thinkers and doers** to really get things going — see http://www.incomovement.eu/ for more on InCo.

The **Living Laboratory for Managing Complex Issues** offers a methodology for creating informal learning spaces or platforms. We also offer a mechanism for creating effective future systems thinking/acting leaders through the Eco-Policy Game, which is part of the Eco-Policy Aid project.

The **Giordano Bruno GlobalShift University** offers a platform for **engaging a broad cross-section of humanity** that both has and does not have access to opportunities for higher education in a learning process that provides both their local and global conditions. Its **R&D branch provides relevant learning content and processes for emerging a thrivable planet.** It produces a huge pool of students who are in search of systemic sustainability projects in which to engage. It offers a rich and extensive network of content developers and luminaries.

Collective Intelligence initiatives (via George Por).

For details see:

http://blogofcollectiveintelligence.com/

http://blogofcollectiveintelligence.com/2009/04/16/chaordic_dialogue_practice/

2. Salient Points

2.1 The framework has to be normative

We ought to be trying to create the 'fuzzy guiding principles' that provide a framework/structure within which people can contribute their gifts to an emergent (but directional) process. (The directionality relates to the issue of emerging a global learning society for a new eco-civilization.)

2.2 We need to start with the young, as a major leverage point

Engaging in inter-generational learning processes are essential for the future of all.

2.3 The evolutionary process as a tendency

We can think of evolutionary process as a tendency toward greater *structural complexity* and *organizational simplicity*, more efficient modes of operation, and greater dynamic harmony.

2.4 Eco-civilization's built-in values replace morality

If we show people how they gain value for themselves as well as for their systemic environment, they can see that there is real value creation. Then you don't have to talk about morality any more. This is what I call the normal living of an eco-civilization. You don't have to imply any other values to it, because it is already there.

2.5 The importance of ensuring that ideas/information travel through systems seamlessly

To make sure that the ideas and information are traveling through seamlessly. Making sure that there are coherent flows and processes that empower and enable the people in the associated networks and all the information is moving fluidly throughout such systems as meetings, sessions, conferences, media, etc.

We are witnessing the awakening of a global subjectivity, a global consciousness, at the same time as a global heart awakening, that is facilitated to these information flows which help break down all the barriers to their emergence.

2.6 Systemic Leverage Points to Intervene in a System

For details see:

http://en.wikipedia.org/wiki/Twelve_leverage_points
http://www.developerdotstar.com/mag/articles/places_intervene_system.html

3 Parking lot (highlights for future consideration and processing

If one of the conditions for Designing Learning Systems for Global Sustainability is creating a Global Knowledge Pool, then wouldn't it be useful for modeling it in a very small scale, by **prototyping a pool of our group's relevant knowledge?**

What can we do so that we **have access to and can rely on each other's knowledge** to deal with the challenge of important pieces of contribution from different people being overlooked because we are so focused on a sequential conversation

If we want to be part of the narrative, it could be useful to take a systemic look at these narratives articulated by Duane Elgin here: http://www.integralrevolution.com/integral-activism-in-the-social-commons . These narratives are of universal concern, simple and relatively easy to understand, emotionally powerful, and able to call forth our higher potentials; and all involve a time of profound initiation and deep transformation:

3.1 Humanity is Growing Up

Over tens of thousands of years, the human species has been learning and maturing. We have moved from our childhood as awakening hunter-gatherers to our late adolescence as a species on the edge of a planetary civilization. We are now moving collectively through a rite of passage, toward our early adulthood as a human community.

3.2 A Global Brain is Awakening

An unprecedented revolution in global communications is underway, integrating powerful technologies ranging from wireless networks to Internet connections, cell-phones, televisions, and much more. Combined, these technologies are rapidly wiring the global brain and supporting the awakening of collective consciousness from a local to a global scale.

3.3 Humanity is on a Heroic Journey

The Hero's Journey has three, major stages: separation, initiation, and return. Over the past 45,000 years or so, the human community has moved from a long stage of separation from nature and one another, and we are now moving into a time of initiation, from which may come the insight to begin our journey of return to living in harmony with Earth, one another, and the living universe.

3.4 Choosing Conscious Evolution:

Consciousness is the knowing faculty. Our capacity for reflective or witnessing consciousness – to know that we know – enables us to take greater responsibility for our actions and their consequences. Unprecedented global crises are pressuring human consciousness to develop further, and we are poised to awaken to a collective knowing that we can choose consciously to evolve our capacities for living in harmony with the rest of life.

4 Designing ISSS 2013

Next, we turned to the case issue of how to design and structure the upcoming international conference of the ISSS – the International Society for the Systems Sciences, which is the premier systems society founded in 1954 by Ludwig von Bertalanffy, Kenneth Boulding, Ralph Gerard, and Anatol Rapoport. It will hold it's 57th annual meeting and conference from 14-19 July 2013, and this provides an excellent vehicle for us to focus our interests upon.

4.1 Naming convention

The title we chose pertains to the meta-design objective and the sub-title pertains to the specific project of ISSS 2013. Other project and learning spaces in service of the title will be integrated as other sub-titles.

Curating the conditions for a thrivable planet

systemic leverage points for emerging a global eco-civilization

4.2 The contribution of the Global Evolutionary Learning Laboratory (GELL) approach

GELL links biosphere reserves that are managed sustainably, in a way that allows to learn with and from each other. These places are living laboratories. They are not conservation areas (by and large), and people live there and there are businesses there, etc. They come together once a year to share – through their own cultural, political lenses –and experiment with different ways of managing these areas.

4.3 We are interested in finding the systemic interventions (not the 'management strategies') to achieve the goal of systemic sustainability

UNESCO has promised to fund some of the potential participant funders to come to the conference and learn about the GELL.

In combination with the ISSS, we would like the SIGs to showcase their knowledge and experience in systemic sustainability to the GELL membership, and we want the GELL membership to showcase their projects and models to the SIGs.

Desired outcomes

1. getting potential funders by grabbing their imagination
2. creating informal co-learning about systemic interventions (for thrivability)
3. supporting different ‘small’ communities (Cat Ba, a project in Cambodia, etc.) contributing to the global knowledge pool about sustainability
4. extension of the Llab concept to other parts of the world
5. getting R&D involvement by inviting systems thinkers from around the world to become involved in the Global Evolutionary Learning Labs meta-project and specific systemic interventions.
6. getting youth involved with the Eco-Policy game

Let’s take that framework and enrich it with the involvement of as many “show case” projects in systemic sustainability from around the world. We could spotlight the inspirational cases from around the world and give them the opportunity to share with each other and learn from each other.

4.4 Other contribution of cases offered to take to the conference

CTG – the Change The Game initiative founded by Stefan – is really a connector of initiatives rather than a project generator, itself. As such, it can help identify the players in the field, contact them, and also work on it so that they feel they want to come.

The School of Commoning (George Pór, Director) offers its now-forming network, the Convergence for Commons-based Economy, as yet another connector of initiatives, akin to the concepts outlined in “Full Spectrum Economics: Toward an Inclusive and Emancipatory Social Science”. (See related overview of the 12-seminar launch program in London, May 7-18, 2012.)

Global Commons work as promoted both by George (above) and by Stefan through CTG activates in the Salzburg Seminar Series - http://www.world-commons-forum.org/ and http://www.changethegame.org/news/3-event-news/19-global-commons-dialog.

The Input Paper written by Mary Edson for this IFSR Meeting here in Linz serves as an excellent background document and reference work for the what we are doing together here.[3]

We have catalysts, such as CTG, and attractors, such as the actionable vision of *curating the conditions for a thrivable planet through systemic leverage points for emerging a global eco-civilization.*

4.5 Stakeholders of ISSS 2013

- systems scientists
- systems practitioners

[3] Edson, Mary. Developing Resilience in Project Teams – A Path to Enabling Organizations for Thrivability. In Chroust, G. , G. Metcalf (eds.), *Systems and Science at Crossroads - Sixteenth IFSR Conversation* Inst. f. Systems Engineering and Automation, Johannes Kepler University Linz, Austria, SEA-SR-32, Sept. 2012. [http://ifsr.ocg.at/world/files/$12e$Magdalena-2012-proc.pdf]

- legal entities
    - R&D institutes
    - SD
    - ASC
    - INCOSE
    - ANZSYS
    - UKSS
    - IFSR
- ISSS members
- Children and youth
- Affiliate Networks
    - Salzburg Global Seminars
    - Change The Game
    - Giordano Bruno GlobalShift Universities
    - InCo network
    - China and Japan systems interests
- Funders
    - business people
    - philanthropists
    - social entrepreneurs
    - UNESCO
    - Clinton Initiative

There is no systems approach to addressing the need for facilitating the boundary interactions of the various stakeholders. We have a great opportunity here!

It is also an opportunity to learn from such para-systemic, multi-stakeholder collaboration management approaches as the U Process, developed by Otto Scharmer, MIT. An example of that is ELIAS that stands for Emerging Leaders Innovate Across Sectors. It's about creating platforms for leading and innovating on the scale of the whole system.

Another multi-stakeholder boundary management approach is Spiral Dynamics' Meshworks to Thrive and Help Thrive, developed by Dr. Don Beck. George offers to be a resource person for both approaches if need be.

Also Gerald Midgley and Critical Thinking and Boundary Technique as resources and aspects to be included and involved.

4.6 Needs & Contents

- systems scientists
    - venue to present their work
    - updates from the field
    - support of their networks
    - seeking and discovering collaboration
    - networking
    - enlightened by different perspectives
    - academic career development

- systems practitioners
    - to get theoretical background in one's area
    - to meet inspirational, like-minded, insightful people
    - learning from others

- life examples
- business credibility

- members
  - institutional thrivability
  - relevant themes
  - voting and participating in the future of ISSS
  - identification with SIGs
  - to be understood and recharged/appreciated
  - belonging to a tribe
  - having an intellectual home

- Affiliate Network Members
  - present work
  - network with affiliate projects
  - to initiate joint projects
  - exchange of speakers/membership
  - reduction in rates for participation
  - sharing resources/infrastructure
  - co-planning events (places and time schedules)
  - public credibility

- funders
  - public relations
  - political agendas
  - meeting requirements for CSR
  - charisma building
  - opportunity for 'doing good' in the world
  - meaningful investment opportunities
  - awareness of emerging trends
  - new project evaluation parameters
  - successful cases
  - linking old paradigms to new paradigm perspectives

  (Potential funders need to be educated about the fact that we are looking for systemic intervention points and not for quick fixes.)

- youth
  - to have a voice and to be heard
  - to have an influence
  - access to new ways of thinking
  - to participate in the learning, design and application process, and in particular, mutual, intergenerational learning
  - to have systems/systemic experiences

o eco-policy type games

o legal entities (associated with the ISSS)
- obligation to hold members meeting
- SIG sessions to report work (May-September)
- Council + membership, board, trustees meetings
- Office and VP (admin): only person who can sign for ISSS resources
- Board-agreed conference budget
➔ include interests/needs of the list from Funders & Supporters, above

4.7 Value Proposition

4.7.1 connect with people and ideas who hold a new paradigm
4.7.2 connect with people who carry out real projects that make a difference and can be used in other parts of the world
4.7.3.1 match making systemic needs with systemic solutions
4.7.3.2 supporting practice with theory and enriching theory with practical lessons
4.7.1 learn how to identify systemic interventions points / learn how to perceive systemic sustainability / learn how to utilize systemic leverage points

4.8 Common themes among the needs identified, above

4.8.1 Networking
4.8.7 Communication platforms
4.8.2 Living case and successful examples
4.8.3 Relevant themes
4.8.4 Intellectual home base: the need to be understood and appreciated
4.8.5 Funders and supporters who emerge and appreciate new paradigms
4.8.6 Starting with the youth

Be part of the creation of a new paradigm. Based on living cases and successful examples and the creation and application of theoretical foundations. Individuals will be acknowledged for their contributions.

4.9 Contents
- measuring and evaluating methods appropriate to the new paradigm
- first session presents a case for the WHY of needing to curate the conditions for a thrivable planet
  + deals with what people are going to see
    • here is where you are going to see these real-life things – on Cat Ba, and here in Hai Phong, etc.

4.10 Scenarios
- video-brainstorming (e.g. World Economic Forum)
- linking up remote stakeholder groups via hybrid (on-site/online) World Café

4.11 Structure

4.11.1 pre-conference
4.11.2 conference
4.11.3 post-conference

- to get really motivating speakers for the plenary sessions

- to create **nodes** where the theory people and the practice people meet to improve their process, foundations, models, etc.

- expanding existing projects and moving them into new areas through matching project in the Global **LLab** Network sort of thing…

- to offer an exhibition option through **posters** that allow for the show-casing of theory and practice

- side-events

+ visits – Cat Ba biosphere

+ games – eco-policy game

+ break-out sessions – information technology

- workshops – systems primer

- proceedings (now entirely online), enhanced by hyper-trails that reflects patterns that connect content across papers, thus laying foundations for an ISSS knowledge base

- presentations of living cases

- PARTNERS in the offer of ISSS 2013:
    - ISSS (Jennifer)
    - Hai Phong (Lien in collaboration with Nam)

4.12 Logistics:

- one bus per day from Ha Noi to Hai Phong City (approx. 100 by train or coach)
- at least half a dozen flights from Ho Chi Ming City to Hai Phong City
    - continuous bus service from Hai Phong City airport to conference venue
- lots of hotels conveniently located within walking distance of the City Convention Center (built last year). If you have to take a taxi, it's just 1 or 2 dollars.
    - on Hoang Dieu Street
- welcome reception, conference dinner, all lunches, tea, rooms and equipment provided free of charge
- day trip to Cat Ba island provided as well

[See Appendix 2 for further details on the design of the conference flow]

5. Perspectives and dimensions to consider in the design

5.1 Four ways of knowing

We want to have the design of ISSS2013 thoroughly informed by a balanced distribution of 4 ways learning/knowing described by Heron[4], and Heron and Reason in 1997[5]. The indented line under each definition refers to data from Heron's 1996 book chapter.

- *Experiential knowing* – learning through online forums, interactive chats, observation, reflection on personal experience.

[4] Heron, John (1996) Bulleted definition of co-operative inquiry. Adapted from Chapter 3 of *Co-operative Inquiry*, London, Sage, 1996.

[5] Heron, John and Reason, Peter (1997). A participatory inquiry paradigm. *Qualitative Inquiry*, 3(3), p. 274-294.

- knowing by acquaintance is manifest as imaging and feeling the presence of some energy, entity, person, place, process or thing.

- *Presentational knowing* – learning through movies, graphics and diagrammatic presentations, animations, expressive arts.
  - intuitive knowing of significant pattern is expressed in graphic, plastic, moving, musical and verbal art-forms.
- *Propositional knowing* – learning through readings, lectures, writing.
  - knowing that is expressed in statements.
- *Practical knowing* – learning through doing, participating, designing different types of projects (e.g., research inquiry, problem-based learning, project oriented learning, service learning).
  - knowing how is expressed in the exercise of a skill.

5.2 Design dimensions to consider

- trans-generational
- trans-cultural
- trans-disciplinary
- trans-temporal
- inclusive frames of relational awareness (male/female, yin/yang, etc.)

5.3 Value propositions continued from previous day (completing entries from section 4.5, above)

- legal entities
  - finding people, providing resources, and creating space to fulfill formal obligations
- members
  - the idea of belonging to a 'tribe' relates to the notion of celebrating one's community of interest
    - + also thinking about this within a domain of practice
    - + include and highlight greater relational awareness
  - shaping and having a void in the organization
  - emerging and constituting the tribe

- systems scientists
  - to have a voice and to create an impact in the field of systems science
  - situating oneself at the leading edge of the field

- systems practitioners
  - to improve and enhance my own services
  - seeking to form strategic alliances
  - push the boundaries of my own practice

- affiliate networks/members
  - gain wider exposure and recognition
  - situating yourself in your professional value web

- youth/students

- to build confidence
- to be heard
- to be part of the society and feel like a member of the tribe
- to identify role models and mentors
- to have a fun engagement that increases my social capital
- to be part of a prestigious
- to flaunt my awesomeness and have it recognized
- opportunity build confidence AND be provocative heralds of change: rock the system - awesome!

+ to maximize that value, it will be essential to open pre-conference conversations with youth groups that have already embraced an evolutionary perspective, e.g. Generation Waking Up

5.4 Virtual participation and collective intelligence processes

If we applied state-of-the-art thinking, tools, and methods for augmenting collective intelligence (CI) to the CI of ISSS2013 attendees and stakeholders, then we could **create a huge breakthrough in advancing the theory and practice of global learning systems**!

5.5 Use cases may include

Building on the global nature of GELL, we're seeking to emerge a web of nodal relationships, as a show-case for the ISSS. We could take one of the ISSS sessions and send it around the world through different time-zones for others to work on between days of the conference, and send us back their input available next morning.

For example, we could have *Planetary Speakers* enriching the output from one day to the next from other parts of the world, and they could offer asynchronous and virtual counter-parts to the *Plenary Speakers* at the conference each morning.

George offers to add a few more use-case scenarios based on today's work on the layout of the conference.

5.6 Funding opportunities for the "collective intelligence" aspect of ISSS2013

Virtual teams in global businesses work around the clock. We could offer our moving the edge of CI experiments to potential sponsors, as their low-cost R&D lab in pushing the envelop of what is possible in hybrid (on-site/online) CI augmentation.

In addition, to technology companies we could offer the benefit from well-designed, high profile, trailblazing application using their collaboration technologies.

The third and more immediate source of funding can come from an energetic, concerted *crowd funding* campaign that needs to be managed by a team, not one person.

5.7 Software tools

Resource for collaborative and participatory creative design work (like we're doing here), in a way that includes local and distant people: http://www.comapping.com/

George offers to develop this section into the technology layer of his event design Innovation Architecture that involves the artful integration of virtual and face-to-face events, supported by an online environment optimized for that integration.

5.7.1 TEDx Viet Nam – to be part of the one major evening event at Vietnam2013? (The TED talk series focus on Technology, Education and Development – http://www.ted.com)

That would require close collaboration with one of the number of current Vietnamese TEDx organizers or open conversation with a new one eligible to get the TEDx franchise.

5.8 Meta-thoughts for later processing

George noted the following: Through this type of interaction between the group in Linz and me in London, we are also building/contributing to a field of collaboration practices that engage groups at multiple location, using both synch and asynch modes of communication, different modalities (audio, video, text), multiple media channels and software tools. If feels like I'm dipping into the ocean of wisdom expressing itself in the experiences that each participant brings to the group. Then I'm diving for a gem and surfacing back to this screen, where I'm jotting down ideas/inspirations that it evokes. It's like being in a jazz band and enjoying ensemble playing.

6 Taking stock of where we have been

6.1 The big goal is the Thrivable Planet.
6.2 We have identified the needs related to this goal, and the people most likely to be involved in addressing them.
6.3 We have then decided that we are going to do one thing to do this, ourselves: we are going to have an ISSS2013 event.
6.4 From this, we considered what the *value propositions* are that we can offer toward the toward the Thrivable Planet objective.

7. Three aspects of the emerging guidelines

7.1 documenting the guidelines of a global interactive initiative for an ecology of institutions and initiatives, from which a thrivable planet can emerge
7.2 providing an experiential basis for feeling what it would be like to be a part of an initiative like that
7.3 pointing to (in very pragmatic ways) a living model of an eco-system of initiatives for collaboration around systemic sustainability.

8. Required initial conditions

- Emergence *only works* if/when there are individuals responsible for making things happen.
- *Push:* setting 'initial conditions' for the self-organization of a global, systemic process of project collaboration
- *Pull:* seeding 'attractors' for engagement in the process of weaving together new ways and best practices for shifting the paradigm toward a thrivable planet.
- Having the ISSS Council make an ongoing commitment of the ISSS to promote global action systems for sustaining and advocating a systemic thrivability agenda.
- We need to set up a knowledge repository, where we can read and share all that we are doing and coming up with.
- We also need to have an annual meeting of this group (even if it were in direct conjunction with the annual ISSS meeting).
- One of the things on the program that I would like to see is an inter-generational learning event.

9. The Collective Intelligence (CI) Initiative of ISSS2013

10.1 Purpose

10.1.1 To create a breakthrough in advancing the theory and practice of global learning systems, while benefiting all (individual and collective) participants from its evolutionary advantages.
10.1.2 To form a "collective intelligence" community of practice, a global network of CI

researches and students that can provide an ongoing link to upcoming systems conferences and their funders/supporters, in diverse regions of the world, after ISSS 2013.

10.2 Core idea

10.2.1 The core idea of this initiative is to prototype a CI-enhancement platform
that integrates social, electronic, and cognitive technologies and processes
for augmenting the collective intelligence of participants
in a series of global-scale learning events.
10.2.2 The prototype should be scalable and capable to support
an expanding web of co-creative, nodal relationships among individuals and groups,
forming a social innovation ecosystem optimized for augmenting
the CI of all nodes, and the ecosystem as a whole.

George's document called "Augmenting the Collective intelligence of ISSS2013" (see Appendix 1) outlines five prototyping case opportunities, as examples, building on some of our current projects. Once we become clear on which of the prototypes can get funded and how, then we will overlay Collective Intelligence Initiative on the design we have already made for the conference.

George accepted our invitation to be the Chief Architect for the CI Initiative of ISSS2013, and outlined what he offers to do in the "Augmenting the Collective intelligence of ISSS2013" section of this report that follows.

Final Note:

If you are interested in seeing the raw transcript with all the diagrams and graphic material generated by Team 3, please refer to the full length 46 page report from which this current report was excerpted.[6]

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[6] Laszlo, Alexander. IFSR Conversation Event at Linz – 14-19 April 2012. In Chroust, G., G. Metcalf (eds.), *Systems and Science at Crossroads - Sixteenth IFSR Conversation – Supplement.* Inst. f. Systems Engineering and Automation, Johannes Kepler University Linz, Austria, SEA-SR-32, Nov. 2012. [http://ifsr.ocg.at/world/files/$12f$Magdalena-2012-supp.pdf]

Appendix 1

11. Augmenting the Collective intelligence of ISSS2013

Collective Intelligence (CI) is a shared or distributed intelligence that defines the capacity of groups, organizations, and social systems to evolve towards higher order complexity and harmony. It is an emergent property resulting from the operations of such evolutionary mechanisms as variation-feedback-selection and differentiation-integration-transformation of insights, knowledge and inspiration. Collective Intelligence is related to the central theme of the 2013 conference of the International Society for the Systems Sciences (ISSS) through the notion of Relational Intelligence (RI). As presented in the Incoming Presidential Address for this year, RI is an integral non-siloed systemic intelligence that conveys "the capacity to engage a higher consciousness that synergizes the various forms of intelligence exemplified by recent studies in consciousness and related fields into one holistic engagement with experience."[7]

The challenges of increasing complexity facing the human community at every scale cannot be solved without learning how to connect and bring into play the higher knowing and deeper sensing faculties of all of us. The good news is that evolution tends to make whole what was previously partial. Therefore, the emergence of collective minds from individual ones – without loss of identity but only gaining of synergy – is as natural as the emergence of molecules from atoms. The Collective Intelligence Enhancement Lab (CIEL) will serve as a prototype for enabling this type of learning and emergence on the scale of the 2013 conference of ISSS. The CIEL social learning system (the platform and the processes for making use of it) will be made available to project supporters and other interested stakeholders.

11.1 WHY — The Collective Intelligence Initiative

The 57th ISSS Meeting and Conference of 2013 "will be designed so as to be a key example of systemic socio-ecological innovation aided by collective intelligence. As a systemic design experiment in and of itself, the objective of the 57th ISSS Conference is to accelerate, richly connect, and increase the diversity of the processes by which all those who participate in the conference – either in person at the time of the conference, or virtually before, during and after the conference – are able to share, create, and innovate theories, methods, and practices that foster new paradigms in planetary thrivability and systemic conviviality."[8]

The CI Initiative will lay the foundations for an inter-disciplinary community of "collective intelligence" practice, comprised of researchers, students, designers, social innovation leaders, artists, etc., which will have ongoing links to ISSS, IFSR, INCOSE, and other professional communities in the systems sciences field and beyond. A collaborative relationship with INCOSE will play a particularly important role in reaching one of the key objectives of the CI Initiative: identifying the systemic leverage points for the mega-project of transition an ego-civilization to an eco-civilization.

To enable those possibilities, we launch a Collective Intelligence Initiative, the core idea of which is to prototype a CI-boosting platform that integrates social, electronic, cognitive, and inner technologies and processes for augmenting the relational and collective intelligence of the participants and their communities of practice or communities of interest. The working name of the platform is the Collective Intelligence Enhancement Lab (CIEL).

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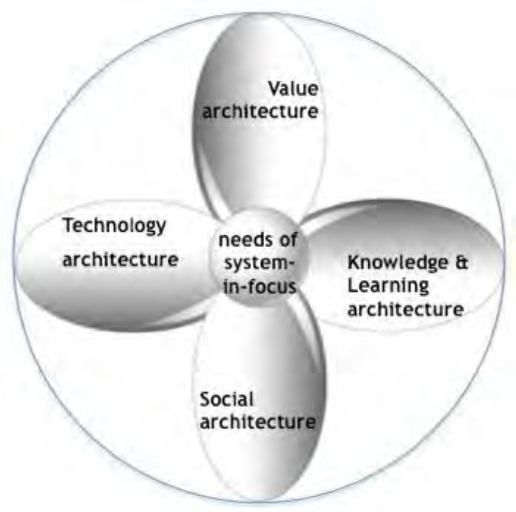
[7] Incoming Presidential Address for the 57th Meeting & Conference of the ISSS; see also de Quincey, Christian (2005), *Radical Knowing: Understanding Consciousness through Relationship*, Park Street Press.

[8] *Ibid*. Incoming Presidential Address.



11.2 WHAT — The Collective Intelligence Enhancement Lab

CIEL will be “an auto-catalytic socio-technical system focused on individual projects of systemic sustainability that collectively contribute to the creation of conditions for a thrivable planet.”[9] It will be a vehicle for enabling dialogue and collaboration among diverse and geographically dispersed individuals and institutions with a shared focus, built on the Innovation Architecture design framework and centered on an innovation ethic.

We use the Innovation Architecture framework to optimize CIEL for creating the best conditions for its users to discover and practice how to collaboratively identify systemic leverage points for evolutionary transformation in organizational and social systems. That framework will also allow the design team to:

- Foster the co-evolution of self-organizing "emergence" and deliberative "design."
- Focus attention, first, on the high-leverage segments of the design’s critical path.
- Evaluate choices and tradeoffs among numerous design options, guided by a small set of generative design principles.
- Use the architectural layers as headings of a checklist for achieving the coherence and completeness of the design, by cycling through them in multiple, re-iterative loops.

The Innovation Architecture itself is an innovation in “socio-technical systems” design, which has built-in fractal patterns of isomorphism that facilitate the replication and scaling of systems created with it.

The **knowledge and learning layer** of the CIEL Innovation Architecture is concerned with (a) how we create/acquire, organize, portray, and share knowledge, and (b) how we enhance existing and develop new, individual and collective capabilities.

The primary concerns of the **social layer** are how we maintain and nourish co-creative stakeholder relations, foster high levels of participation, and promote the most favorable conditions for self-organization and co-governance. The scope of the “we” (system-in-focus) will change, as the circle of involvement expands throughout the three consequent cycles of the action research for prototyping CIEL.

The **technology layer** is concerned with (a) defining the optimal mix of features, configuration options, and modes of usage for powering up the social, knowledge/learning, and value creation architectures, and (b) embedding in the platform the technical conditions for its co-evolution with the individual and collective needs and aspirations of its users.

The **value creation layer** is about creating measurable value for the user community and its stakeholders, attracting the support needed for developing CIEL, including funding and making the project self-sustaining over time.

In the center, we hold the needs and aspirations of the stakeholder groups that are the system-in-focus of the Innovation Architecture, which can be a community, a team, company, country, region, interest group, or as in our case: a design team -> a professional conference -> the social field of evolutionary emergence.

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[9] *Ibid*.

When the propeller blades start turning, the wind picks up and creates a vortex of innovation running through the four architectures. Each stream of innovation is strengthened by the combined power of the others. They interact, cross-fertilize and co-evolve with each other and the community. Each of them needs to receive expert attention, and much of it is needed simultaneously.[10]

11.3 WHO — The Players

The people and groups involved in the projects are:

A. CIEL Design Community

This international, interdisciplinary, and intergenerational group of professionals is comprised of the main actors, who will carry out the work of prototyping and popularizing the CIEL platform, products and processes. More than a project team, this group us also a learning community, the seed of the “collective intelligence” community of practice, where people enjoy combining their talents to contribute together to the emergence of sustainable and evolutionary futures.

B. CIEL User Communities

1. Evolutionary Learning Lab for Systems Education at the University of Adelaide, for which CIEL will galvanize its 7-stage learning cycle
2. ISSS Systems Education SIG, where the Evolutionary Learning Lab for Systems Education at the other universities will meet to launch the Global Evolutionary Learning Lab (GELL) sketched out in the next section
3. Global Learning Lab Network (GLL Net), whose annual meetings will be supplemented by CIEL, as a collaboration platform, thus enabling it to morph into GELL
4. Related systemic thrivability, mass innovation, and collective intelligence initiatives around the world, which will benefit from the shared resources of the CIEL platform, including their combined knowledge and relational capital
5. ISSS Evolutionary Development SIG, for which collaborating with the CIEL community will provide a live case, a self-running demo of the emergence of a Designing Community, to be presented at the 2013 conference
6. ISSS 2013 attendees (in person and virtual)
7. International Council on Systems Engineering (INCOSE), with which we’re in conversation about developing an application of CIEL that uses Big Data for affecting the systemic leverage points for emerging a global eco-civilization.

C. Sponsoring organizations

1. Universities that sponsor the development of CIEL will not only see their systems education programs galvanized GELL, but also have a chance to re-purpose our advanced, virtual learning environment to their other departments as well.
2. Corporate sponsors will benefit from the Thrivable Planet theme of ISSS, as an enabler of Blue Ocean strategies, and from CIEL as their low-cost R&D lab in augmenting collective intelligence.
3. Foundations that support discovering ways to shift global breakdowns into global breakthroughs, will have an opportunity to leverage the impact of their funds with the globally connected minds of systems scientist empowered by CIEL.

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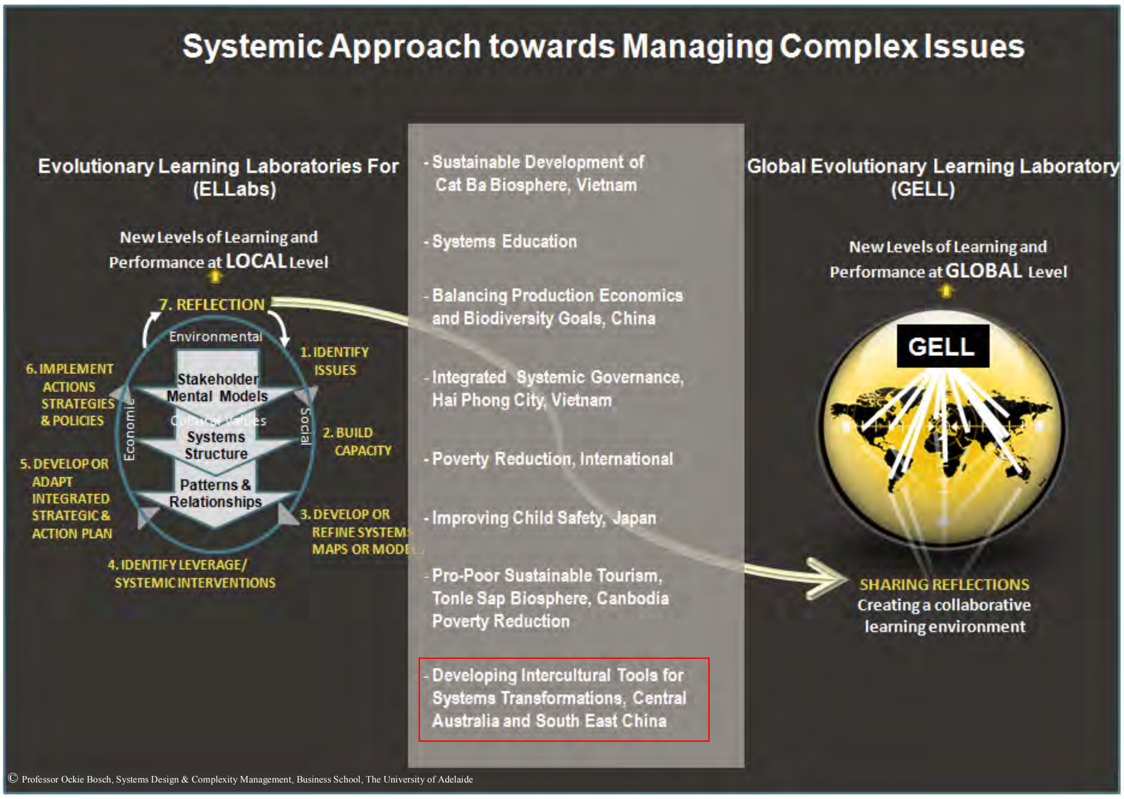
[10] "Liberating the Innovation Value of Communities of Emerging Principles, Practices and Policies" (2005) Practice" by George Pór, in the textbook on "Knowledge Economics: Principles, Practices and Policies" — George Pór, the Chief Architect of the CI Initiative, introduced and successfully used the Innovation Architecture framework in the European Commission, INSEAD, and the Climate and Development Knowledge Network, among other organizations and events.

11.4 Creating the Design Space for a Global Evolutionary Learning Laboratory (GELL)

One of the main functions of CIEL will be to create a platform upon which to consolidate a series of initiatives already begun around the world in the form of Evolutionary Learning Laboratories (ELLabs).[11] CIEL will provide an operational holding container in the form of the ISSS 2013 Conference in Vietnam during which the various ELLabs , along with similar systemic sustainability initiatives from around the world, will be brought into relationship to form a Global Evolutionary Learning Laboratory (GELL).



11.5 HOW — Methodology

The functional operation of CIEL as a dynamic system in its own right will be accomplished through the application of a modified and enhanced version of Participatory Action Research, known as GAR – Generative Action Research.

GAR methodology is a *cyclic*, *emergent*, *participative and normative direction generating* approach to the co-creation of meaning, knowledge, capabilities, or prototypes, by groups and organizations at increasing scale. Those four characteristics turn the circles presented below into sequences of an expanding spiral.

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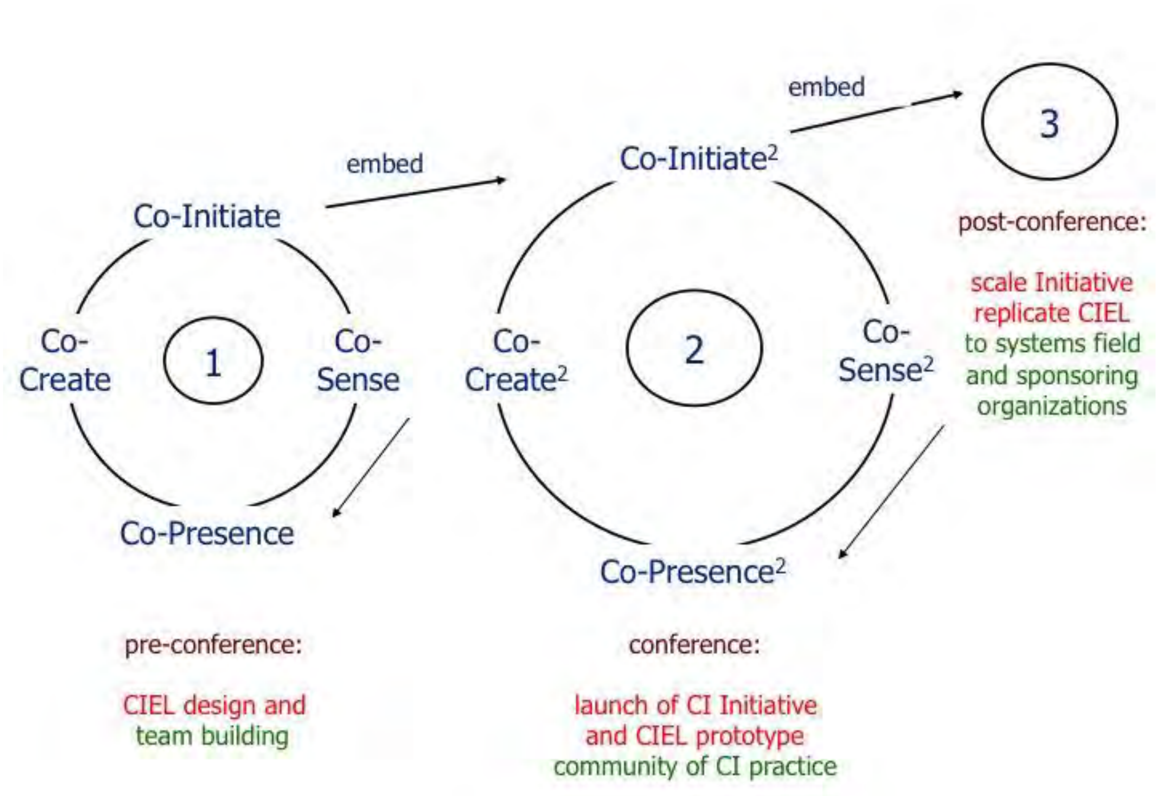
[11] Bosch, Ockie (2012). "Creating a Platform of Systems Interdependencies on which to Build Good Policy and Investment Decisions." A publication of the Systems Design and Complexity Management Group of the Business School of the University of Adelaide, Australia.



The diagram above illustrates our integration of the Generative Action Research methodology (developed by George Pór) with the Theory U process design within each cycle, which puts the synergy of two epistemic schools of thought in service of achieving greater results even with limited resources.

Cyclic — Action and understanding go through cycles of deliberate intervention and reflection.

Emergent — GAR design is not fully specified in advance of the inquiry, thereby allowing its cycles to respond to relevant knowledge emerging from the previous cycle. By way of such a guiding process, GAR remains flexible, yet robust, capable to adjust to changes in the emergent process of knowledge creation.

Participative — Those whose action are likely to affect or be affected by the intended systemic change are involved in designing the actions to be taken in the subsequent cycle.

This action research is “generative,” which means, it has the properties of self-sustaining, self-improving, co-evolving, and self-propagating. It means that its results can:

- **Sustain** themselves after the completion of the initial cycle
- **Enhance** their value continually, by becoming target for ongoing improvement conversations
- **Co-evolve** with their environment and grow into patterns of higher complexity and syntony
- **Inspire** partners and other stakeholders to re-use and replicate them

11.5.1 **Normative Direction Generating** — Rather than being either a matter of micro-management and control or of aleatory and random processes, a process that is direction generation can arise from fuzzy guiding principles of dynamic self-organization. By agreeing that all the products and outcomes of our design efforts must be life-affirming, future-creating, and opportunity increasing, we establish the basis for collective ethical decision taking. This, in turn, has a “feed forward” function that evolves the system in certain directions, even though the specifics of that direction are not previously determined.[12]

11.6 The Four Fields of Coherence

The concept of “fields of coherence” rounds out the GAR methodology with a “spatial” dimension, i.e. within each phases of the three cycles, the process design will attend the observation to the criteria, enablers, and hindrances of coherence described as follows.

> “1. At the first coherence domain – conviviality with oneself; personal or internal thrivability – the practices involve centering, quieting the monkey-mind, listening with every cell of our being. These practices cultivate intuition, empathy, compassion, insight that matches outsight, and a willingness to explore and follow our deepest calling.
>
> 2. At the second coherence domain – conviviality with others; community or interpersonal thrivability – the practice involves deep dialogue and collaboration. Coming together to learn with and from each other and to engage in coordinated action with considerateness, openness, and joy in order to enable collective wisdom.
>
> 3. At the third coherence domain – conviviality with nature; ecosystemic or transpersonal sustainability – the practices involve communing; listening to the messages of all beings (whether they be waterfalls, animals, mountains or galaxies) and acknowledging our interdependence and ultimate unity.
>
> 4. At the fourth coherence domain – conviviality with the flows of being and becoming; evolutionary or integral thrivability – the practices involve learning to read the patterns of change of which we are a part; learning to hear the rhythms of life and becoming familiar with the improvisational jam session that nature has been playing since time immemorial.”[13]

11.7 The Challenge

CIEL will function as the design engine of the 2013 Conference. It will address both the bootstrapping of the design of the process of designing all the steps that lead up to the conference in July of 2013, as well as the operational design of the week-long conference, itself. The main focus of this design will be primarily two-fold: first, to provide a lived experience of systemic sustainability based on relational intelligence and augmented by collective intelligence, and second, to create the support system for the GELL to be introduced and accelerated onto the global scene at the conference, itself. CIEL is an unprecedented and challenging undertaking. To succeed will require the collaboration of many of us.

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[12] See the concept of ‘macrodetermination’ in *The Systems View of the World: A Holistic Vision for Our Time*, by Ervin Laszlo.

[13] *Op. cit*. Incoming Presidential Address.

Appendix 2

12. ISSS 2013 Conference Flow (continued from 4.11 and 4.12)

12.1 Plenary Sessions – one per day for four days (Mon-Thurs) + Friday closing plenary
12.2 Pre-conference activities
- a. workshops and special offers
- b. opening reception (Alexander, Ockie, Jennifer, Nam)

12.3 Day 1 – focus on Presentational Knowledge
- a. Wednesday Plenary showcasing systemic sustainability projects from around the work networking discussion
  - i. the idea would be to do a Progressive Plenary with both local and international project presentations as we move through the different areas of Cat Ba (much like what was done at the Salzburg Innovation Seminar of CTG in 2010)
- b. Opening Plenary and Welcoming Ceremony – Monday 9am
  - i. Dr. Thanh + ministers (10 mins – Nam & Alexander)
    - 1. Address (formal)
      - a. Dr. Thanh (90 mins – Ockie & Nam)
      - b. Alexander (90 mins)
        - i. thrivability
        - ii. leverage points
        - iii. systemic sustainability
        - iv. tie to 2012 focus (service systs/nat systs)
- c. Tea Break – 10:30am (30 mins)
  - i. Two (2) speakers (40 mins + 5 mins Q&A each)
    - 1. Ockie Bosch (Ockie & Alexander)
      - a. on how this conference does what Alexander says
    - 2. Speaker on how Systems Scientists can meet this challenge (possibly Ervin)
      - a. overview
      - b. *relevance*
      - c. inclusive of many points of view
      - d. SS2 orientation
      - e. Call to participation/action
- d. Lunch (12:30 – 60 mins)
- e. Break-out session (1:30 – 90 mins)
  - i. Intergenerational Challenge Game (youth) (Nam, Ockie, Violeta)
  - ii. Meet the Youth – organize the session *with* the youth
    - 1. explore the issue of Thrivable Planet, etc.
  - iii. give each student a copy of Eco-Policy
- f. Break (3:30)
- g. Break-out session (4:00 – 120 mins)
  - i. SIG and paper streams (Jennifer, Mary, Alexander, SIG Chairs)
- h. Break (6:00)
- i. Evening Session – Intergenerational Challenge (game) (7:30-9:00pm – Ockie, Nam, Violeta – with Stefan)
  - i. students play game
  - ii. ISSS Board Meeting
  - iii. Improvisational Participatory Arts event (Alexander, Lien, Judith)

12.4 Day 2 – focus on Practical Knowledge
- a. Plenary (9am – 90 minutes)
  - i. Systems Scientist who addresses gaming need and power
  - ii. Malik who addresses specific example (Ockie)
- b. Break (10:30)
- c. Eco-Policy Game contest (11:00 – 90 mins – Malik, Ockie, Nam)
- d. Lunch
- e. Break-out session (1:30)

i. SIGS & Paper Presentations plus Posters
1. track for systems basics (Jennifer, Alexander, SIG Chairs)
f. Break (6:00 pm)
g. Cultural Evening
i. Music + Fun
ii. ISSS Council Meeting

12.5 Day 3 – focus on Experiential Knowledge
a. Cat Ba progressive plenary process (Nam & Ockie)
i. Gathering – details about the day
ii. Journey throughout the island
1. Content nodes – 4 nodes
a. local presenters
b. global presenters
c. dialogue
d. discussions
e. integration
iii. Wrap-up session
iv. Return to conference site and hotels

12.6 Day 4 – Focus on Propositional Knowledge
a. Opening Presentation – Key Official (9am – Alexander)
i. who understands what we're doing
ii. who can present/discuss leverage points
iii. who are successful
1. E.g., Bill Gates/Gates Foundation, Georg Soros, Richard Branson, CEO STAR Alliance
2. always plan with back options
b. Roundtable with Funders, Supporters, Investors
c. Break (10:30)
d. Case Examples from Funders and Supporters
i. VINNOVA (proactive investment sort of orgs) (Violeta)
ii. STAR Alliance (Ockie)
e. Break-Out Sessions (1:30pm)
i. SIGs, papers, Systems Basics track(s) (Jennifer, Alexander, SIG Chairs)
f. Break (3:30)
g. Evolutionary World Café – focus on propositional interaction (4:00 – Alexander)
a. conversations that matter
b. about futures that matter
c. at leverage points that matter
ii. George notes: All that will matter only if the output form the World Café will be recorded, and text and images organized digitally in a way optimized for participants who are provided with structures of engagement for follow-up action.
iii. Alex&er comments: Ideally, we will have a "report back" session for sharing of results and outcomes from each table…
h. Banquet and Awards
i. ISSS Vickers and Rapoport awards
ii. Eco-Policy award
iii. Host (Viet Nam) award
1. present(s) for Dr. Thanh (Ockie, Nam, Alexander)
i. Past Presidents and Student SIG reflection and visioning dialogue

12.7 Day 5 – closing and launching
i. Student Presentations (Vickers and Rapoport winners) (9am – Mary, Alexander)
ii. SIG reports (Violeta, Mary, Alexander)
iii. Host Appreciation – formal thanks
iv. President's Wrap-up (Alexander)
b. Break (10:30)

c. Incoming President's Address (11:00am)
d. Membership Meeting (12noon)

13. Conference Preparation activities

- ⦿ Guideline paper (Alexander and Ockie)
- ⦿ Tourism options (see Post Conference activities, below)

14. Post Conference activities

- ⦿ Paper for proceedings (Alexander and Ockie)
- ⦿ SIG follow-up
- ⦿ Tourism activities – especially with a week between ISSS & ASC in China (Ockie and Nam)
  - o make a presentation about tourism options at ISSS2012
    - ▪ possibly on Friday
      - • at lunch time
    - ▪ AV presentation in the Registration area running on a loop
    - ▪ *designed and set up by 15 July 2012*
  - o design packages from Viet Nam Office of Tourism
    - ▪ for pre-conference (long and short tours)
    - ▪ for post-conference (long and short tours)
  - o STAR Alliance discount (Ockie)
    - ▪ setting them up as "the Official Airline of ISSS '57"

15. Functional Domains of Responsibility of this team

- ⦿ Executive Actions + ISSS Admin issues ➔ Jennifer
- ⦿ Project Workflow ➔ Mary (plus ISSS Head Office through Jennifer)
- ⦿ Logistics (esp. in Vietnam) ➔ Nam
- ⦿ Executive Decisions and Thematic orientations ➔ Alexander (with Jennifer)
- ⦿ Marketing strategy ➔ Stefan and Violeta – but only in terms of what coordination of others
- ⦿ Web presence ➔ Stefan – but only with ideas and coordination others

16. Cross-checking outcomes

- ☒ Plenaries
- ☒ visits and tours
- ☒ Posters
- ☒ World Café, expert panels
- ☒ Lab (set now as one full day)
- ☒ Nodes (with meetings of different network stakeholders)
- ☐ Moderators – session chairs
- ☐ Rapporteurs – synthesizing and distilling key points from each session
- ☐ TEDx Viet Nam – more appropriate for the Guidelines than for ISSS2013
- ☒ parties
- ☒ games

16.1 Value propositions check

- ☒ members – to shape and have a voice about future dev
- ☒ affiliate networks/members – wider exposure to share
- ☒ systems scientists – to have a voice and create impact
- ☒ systems practitioners – to push boundaries and create alliances
- ☒ funders and supporters – connect with people of leverage
- ☒ youth – to connect with mentors and role and rock the world
- ☒ legal entities – to have space to fulfill obligations

16.2 Pending tasks to be put into our project work-flow (Mary)

- ☐ Sub-themes for each of the days of the event – Alexander
- ☐ Trans-cultural activities and experiences – Nam and Ockie
- ☐ Letter that describes what this conference is about – Alexander

17. Collective and Individual "To Do List" (Mary)

[continued from 'Conference Preparation activities' and 'Post Conference activities' above]

- Test the model for the Viet Nam 2013 Conf at the San Jose 2012 Conf – Alex&er
- List of affiliate networks with contact people – Stefan
- Find and Obtain Sponsorships – Jennifer (with Michael Singer)
  - Finance Officer for ISSS to be taken on by Michael (most likely) at ISSS2012
  - STAR Alliance connection – Ockie
- Challenge Future connection with Eco-Policy game – Violeta (CF) E-P (Ockie/Nam)
- Championing "crow funding" pitch – George
- Definition of the node topics/spots on Cat Ba – Ockie, Nam, Violeta and Stefan
- Gaming Resources/Speaker – Stefan with Alexander
- Find an engaging keynote speaker from business – Stefan with Alexander
- Enhance affiliate networks – Stefan, Ockie and Alexander
- Project workflow and planning – Mary
- Communication facilitation – Mary
- Introduction of local (Viet Nam) organizing committee to the ISSS Office – Nam
- Formal establishment of the International Organizing Committee – Alex&er
  - all team members propose their own official titles – EVERYONE
- Preparation of Tourism Presentation for San Jose – Nam
- Arrange and organize photo-gift for Dr. Thanh – Nam with Lien
- Systems set-up for ISSS (papers, registration, etc.) – Jennifer
- Hand-off of Vickers/Rapoport awards at ISSS2012 – Alexander with Jennifer
- Award for Eco-Policy game – Ockie

Developing Resilience in Project Teams

A Path to Enabling Organizations for Thrivability

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Introduction

In the context of global sustainability and stewardship, this paper pertains to an ongoing systems research conversation, "Enabling organizations for thrivability: New perspectives on form, structure, and process in favor of human and societal prosperity." It focuses on a central question, "What could we possibly achieve if we co-create radical innovative patterns together, learning from other practitioners who are experienced in biology, technology, sociology, management, development, design, and ...?" This question has been posed by Alexander Laszlo as the foundation of an ongoing discussion started at the European Conference for Systems Research (2012) in Vienna, continued at the International Federation for Systems Research Conversation (2012) in Linz, Austria (Chroust and Metcalf, 2012), and developed for a conference theme for the International Society for the Systems Sciences (2013) in Vietnam.

This paper discusses specific themes that emerged from the results of a case study about resilience in a project team (Edson, 2011). The case study explored a university project team which built a solar house as part of a competition in the Department of Energy's Solar Decathlon. The discussion develops the themes, specifically project leadership and organizational culture, into competencies for adaptive capacity and resilience as a path to thrivability. The themes are then applied to a second case of a project team at the Cat Ba Biosphere Reserve in Vietnam.

Definition

Project team resilience is the ability of a project team to adapt to and learn from adversity to achieve its goals and objectives while maintaining the integrity of its structure and function. Groups and teams have adaptive capacity when they learn through experience, store knowledge, create flexibility in problem solving, and make decisions that balance power among interest groups. Resilience is the result of a team's adaptive capacity which encompasses learning to live with change and uncertainty, nurturing diversity for resilience, combining different types of knowledge for learning; and creating opportunity for self-organization towards social-ecological sustainability (http://www.resalliance.org/index.php/adaptive_capacity, para. 2, 4).

Attention is given to the impact of organizational culture (Schein, 2004), distinct from anthropological culture (Hall, 1977), on these two approaches (management versus leadership) to conducting projects. The group development model (Tuckman & Jensen, 1977) and the ecological model of adaptation (Gunderson & Holling, 2002) were presented and their terms defined in two previous papers (Edson, 2011, 2010). Specifically, the terms used in these models - forming, storming, norming, performing, and adjourning; exploitation, conservation, release, and reorganization, were explored in depth. In addition, the four principles of CAS theory used to understand the relationship between the two models (self-organization, hierarchy, emergence, and learning), as well as creative destruction were clearly defined in the context of the research. For a greater understanding of the concepts presented in this paper, readers are encouraged to refer to the two papers. For a better understanding of the how the study was conducted, readers are encouraged to read the related dissertation (Edson, 2011) available through the ProQuest database.

An important distinction is made between project management and project leadership. According to the Project Management Institute (PMI), a project is a temporary, planned activity with a unique goal that is temporary and time bound (2012). Project management in organizations is a strategic activity that applies knowledge, skills, and techniques to efficiently and effectively execute projects. Project management is further defined as a discipline which involves organizing, planning, and managing the scope (goals, objectives, requirements, and constraints), resources (people, budget, material, and equipment), and time (allocations and deadlines) of a project. PMI states that it entails five processes including: 1.) initiating, 2.) planning, 3.) executing, 4.) monitoring and controlling, and 5.) closing. PMI emphasizes that many projects encompass large, technical initiatives across diverse disciplines and global geographies, and “all must be expertly managed to deliver the on-time, on-budget results, learning and integration that organizations need" (http://www.pmi.org/en/About-Us/About-Us-What-is-Project-Management.aspx, para. 5).

For the purpose of this discussion, project leadership is defined as a project manager’s interpersonal skills to influence team members’ performance to achieve the goals and objectives of the project. This definition is based on Chemers (1997) definition of leadership as, “the process of social influence in which one person can enlist the aid and support of others in the accomplishment of a common task.”

Preoject Team Research

In 2011, I completed a research study of a project team exploring its development for evidence of resilience (Resilience Alliance, 2009) in the face of adversity (McMillen, 1999; Seery, Holman, & Silver, 2010). The study design used a systems research approach of theoretical pluralism (Midgley, 2011) through complex adaptive systems (CAS) theory (Miller & Page, 2007; Schneider & Somers, 2006) to explore the relationship between a group development model (Tuckman & Jensen, 1977) and an ecological adaptation model (Gunderson & Holling, 2002). Briefly, Tuckman and Jensen’s (1977) phasic model included forming, storming, norming, and performing. Gunderson and Holling’s (2002) dynamic model of ecological adaptation included exploitation, conservation, release, and reorganization. The project team was comprised of approximately 200 students and faculty at Cornell University (CUSD). CUSD was one of twenty academic teams that had entered into an international competition sponsored by the DOE to build a solar home as part of the department’s consumer education program for energy efficiency, the Solar Decathlon (http://www.solardecathlon.gov/).

Through data analysis of 30 interviews (Kvale, 1996) with the CUSD’s project team members and archival documents (Werner, 2009), a relationship between the two models was established using four principles of CAS theory. CAS are diverse, interconnected systems that exhibit self-organization (purposeful internal evolution), hierarchy (certainty created through structures that bring order and meaning), emergence (a coherent and integrated dynamic of innovation), and learning (planned application of experience to future events) in response to environmental feedback in light of uncertainty (Ahl & Allen, 1996; Ashby, 1962; Argyris, 1999; Bennett & Bennett, 2004; Corning, 2002; Gunderson & Holling, 2002; Goldstein, 1999; Holland, 1992, 1999; Kauffman 1993,1996; Lewes, 1875; Mintzberg & Westley, 1992). In addition to comparing and contrasting the models to understand the relationship between the models, the results were analyzed for evidence of creative destruction (Schumpeter, 1942; Sombart, 1913), in which innovation supplants established processes that no longer serve the goals and objectives of the project team.

Since the inception of the DOE’s Solar Decathlon in 2002, CUSD had built three different solar homes (2005, 2007, and 2009) and reorganized three times for each project, incorporating lessons learned from experience into the next iteration of their work. Over a two year period (2007-2009), CUSD constructed a unique, cylindrical, solar home and successfully competed in the DOE’s 2009 Solar Decathlon despite a $60,000 shortfall. The research results showed that CUSD exhibited Tuckman and Jensen’s (1977) phasic model of group development - forming, storming, norming, performing, and adjourning. In addition, the project team manifested processes of Gunderson and Holling’s (2002) model of ecological adaptation – exploitation, conservation, release, and reorganization. Significant transformation resulting from a major shift in how CUSD operated at a critical inflection point (Jarman & Land, 1992) demonstrated creative destruction. Nested cycles of adaptation through norm renegotiation occurred at multiple levels throughout the team.

Beyond establishing a relationship between the group development and ecological adaptation models, the CUSD data analysis revealed that resilience in a project team is dependent upon agency on its own behalf to sustain, adapt, and transcend itself in the face of uncertainty (Prigogine, 1997). In other words, a project team’s success in achieving its goals and objectives depends on its adaptive capacity. The research showed CUSD's adaptive capacity through its ability to consciously recognize the necessity of change, to consciously take behavioral and material action to adapt, and to embrace change through creative destruction, innovation, an integrative learning. The distinction between project management and emergent project leadership was clearly evident by the acknowledgment by the team of the contributions made by a key individual (PL1).

After the 2009 Solar Decathlon concluded, CUSD adjourned, reflecting on its learning and reorganizing for its next project. In its third reorganization, CUSD's adopted an expanded agenda focusing on sustainable design beyond the DOE's efficiency agenda for the Solar Decathlon. As a result, the team no longer competes in the Solar Decathlon. CUSD currently has three different, sustainable design projects in progress internationally.

The most salient themes from the research that relate to thrivability are project leadership and organizational culture. Project leadership (an influential role beyond project management) may be leveraged to develop adaptive capacity and resilience as a pathway to thrivability through integrating understanding of the context in which a project team is operating (i.e. its organizational culture). In other words, developing leadership competencies at the project management level may support increased adaptive capacity through group norm renegotiation around managing uncertainty, especially when the culture and environment support adaptation. As transformative leverage points, project leadership and organizational culture are relevant to the central topic given the larger context of global sustainability. Specifically, the context includes stakeholders with global imperatives including urgency around human survival and sustainability in a rapidly changing world environmentally, economically, and socially. Project leadership is pivotal in the success or failure of a project team's achievement because it touches all its goals and objectives.

Project Leadership Lessons from Ecological adaptive Management

A case study by Frances Westley in *Panarchy: Understanding Transformations in Human and Natural Systems* (Gunderson & Holling, 200

2) outlines characteristics of "the adaptive manager as decision maker" (p. 352). Westley states that a key to adaptive decision making, as opposed to rational and traditional decision making, is "to strengthen the match between decisions and the demands of the decision making environment" (p. 352). She notes that in ecological systems there are at least four decision making environments including the ecosystem, the political system, the organizational system, and the interorganizational system. Westley cites a specific case of an environmental manager, Evan Karel, who successfully negotiated the complexity of his project and its stakeholders to become an adaptive manager. The lessons for adaptive managers that Westley derived from the case are summarized as follows:

• Adaptive management requires strong values as opposed to rational analysis. Karel grew up with a love of science and respect for people in equal parts.

• Adaptive management requires juggling multiple strategies and goals. Karel exhibited aptitudes for being a scientist collaborator, politician, and agency manager simultaneously.

• Adaptive management requires strong emotional self-discipline, little aversion to conflict, and great humility. Karel recognized when he was arrogant and how it backfired during attempts to coordinate agency and community interests. He acknowledged the essential role of building trust to foster cooperation.

• Adaptive management requires that the manager capitalize on the energy and movement of others, which entails a keen sensibility to recognizing opportunities for emergence and leveraging them. Karel was positioned to evaluate opportunities because of his involvement at the four decision making levels. He make efforts to be inclusive in his decision making process by involving disparate parties and interests. (pp. 352-354)

Upon review of Westley's (2002) case study, its similarity to PL1's project management was remarkable. The following analysis outlines the parallels between PL1's role leading the CUSD team and Westley's view of adaptive management:

• Adaptive management requires strong values as opposed to rationale analysis. As a carpenter working in Annapolis, MD, PL1 attended the DOE's Solar Decathlon in 2005. PL1 subsequently applied to the Art, Architecture, and Planning Program to specifically get involved with the solar house project. PL1 chose to enroll in Cornell's program because he had strong appreciation of architecture and great respect for the 2005 project team. He apprenticed during the 2007 project with the objective of learning as much as he could about project management and construction. Clearly, he wanted to be a part of a project and a community who shared his values about sustainable design and construction.

• Adaptive management requires juggling multiple strategies and goals. PL1 exhibited aptitudes for being an architect, collaborator, politician, and agency manager simultaneously through his competence in understanding the project at technical, interpersonal, and organizational levels.

• Adaptive management requires strong emotional self-discipline, little aversion to conflict, and great humility. From the comments made during the interviews, PL1 was humble about what he did not know, competent about what he did know, and magnanimous when dealing with peers and others. PL1 did not appear to relish conflict; however, he did not back away when the project's goals and objectives were in question. He showed confidence in the face of uncertainty. PL1 elicited respect and trust at every level in the decision making process including team members, faculty, university administration, alumni, and the board of trustees. As a result, the project team had strong cohesion and commitment, as well as collaboration at multiple levels with seemingly divergent goals.

• Adaptive management requires that the manager capitalize on the energy and movement of others, which entails a keen sensibility to recognizing opportunities for emergence and leveraging them. PL1 positioned himself, first as an apprentice and then as a leader, to evaluate opportunities because of his involvement at the four decision making levels (team member, subteam leadership, leadership board, and trustee leadership). PL1's recruitment of essential talent at critical junctures in the project demonstrated his ability to identify project team's needs and exploit the necessary resources to get them filled. For example, PL1 enlisted MBAs to organize the business team and an architecture/sculpture student to design and fabricate the kitchen module.

PL1 attempted to be inclusive in his decision making process by honoring the democratic organizational structure and eliciting diverse opinions, especially from subteam leaders (Postmes, Spears, & Cihangir, 2001). As an adaptive manager who put the goals and objectives of the team before his individual, ego driven prerogatives, PL1 emerged as an example of servant leadership (Greenleaf, Spears, & Covey, 2002).

The correspondence between adaptive management and successful project management has several implications for project leadership and organizational resilience. First, a project leader needs to compellingly share the goals, objectives, and vision for the project as the team and its stakeholders. Organizationally, this assumes that the project leader agrees with the means to the end (organizational structure, processes, and feedback), as well as the end product (goal). Second, a strong project leader ideally should have experience at multiple levels of the project to understand how processes work and how much time is necessary to achieve desired results. From the data, it was clear that the project leader need not be an expert in every area, but understands the limits of personal knowledge. Understanding one's limitations, the successful project leader trusts and listens to team members to gather the necessary information for decision making. This requires a degree of comfort with and an ability to manage uncertainty at different levels (personal, team, project, and environment). Third, successful project leaders address conflicts directly, yet with diplomacy. Again, the underlying project leadership attributes of trust building and humility support resolution of conflicts by working toward a common vision and collaboration. Fourth, a successful project leader is able to recognize momentum and maintain it through the project's completion. A universal thread throughout these four aspects of project leadership is a humanistic value of respecting the people with whom you work and understanding that they want to achieve the common purpose to which they committed.

Project Leadership for Thrivability - the CAT BA Biosphere Reserve

Integration of CAS principles, specifically self-organization, hierarchy, emergence, and learning, with the project leadership competencies revealed in the research study of CUSD2009's resilience may provide powerful leverage in projects focused on global sustainability and thrivability. For example, in this section, these factors are cast into a global context provided in a case study about managing the Cat Ba Biosphere Reserve (CBBR), Vietnam, in a paper by Nguyen, Graham, Ross, Maani, and Bosch (2012). In this discussion, I apply what was learned from the research results from CUSD2009 to the case of CBBR.

Briefly, the purpose of the CBBR project, a pilot program described in Nguyen et.al (2012), was to educate a group of Vietnamese environmental and developmental professionals about sustainable management of a world biosphere reserve systems thinking approaches to transcend organizational and disciplinary divisions. The paper describes not only the transformative learning that took place during the project, but also the systemic approaches applied by the CBBR team to conduct the project, such as effective use of feedback to adapt the presentation of material (specifically, communication techniques internally and externally).

The CBBR team was primarily composed of nine academic staff members from the former School of Integrative Systems (SIS) at the University of Queensland, Australia. The CBBR team was cross-cultural, including a Vietnamese academic as essential support to the program leader. Like the CUSD project team, the CBBR project team consciously chose a democratic, “peer-to-peer” form. While Nguyen et.al (2012) focused on the delivery of education, the paper describes the high degree of interaction and feedback with the participants that prompted adaptation by the CBBR team to accommodate their requests. From the reflections expressed in the paper, the team can be observed as moving through phases of Tuckman and Jensen’s (1977) group development model, as well as demonstrating CAS principles of self-organization, hierarchy, emergence, and learning at multiple levels. The extent of transformative learning is evidence not only at the conclusion of the program, but during a post program evaluation six months later.

Project leadership competencies demonstrated by the CBBR team are described as follows:

1. Adaptive management requires strong, humanistic values (Weisbord, 2004) as opposed to rational analysis. While rational analysis may have served as the foundation for the instructional design of the pilot program, the CBBR team commenced the program with a strong sense of humanistic values by involving the participants in critical decisions concerning content, delivery, and evaluation of the program from the beginning during self-organization (Nguyen et.al, 2012). Using learning adult principles outlined by Burns (1995, 2002), collaboration, cooperation, and self-reflection were inculcated into the program. Through application of these principles, the CBBR team adapted the program to suit the participants’ needs such as communication skills for “managing up” and sharing information with local stakeholders.
2. Adaptive management requires juggling multiple strategies and goals within multiple levels of cultural contexts. The CBBR team applied multiple learning strategies to convey knowledge to participants through use of systems thinking models, as well as mind mapping (Buzan & Buzan, 1996), force field techniques (Carmen & Keith, 1994), focus groups (Krueger & Casey, 2000), and the fishbone technique of evaluation (Malouf, 2003). The delivery of education occurred at multiple levels of learning through auditory, visual, and kinesthetic methods (Markova, 1995; Markova & Holland, 2005). Since the goal of the program was to instill competencies to advance the sustainability initiatives of the CBBR, the experiential portions of the program were essential in securing participants’ competency in rural community development and collaborative management using participatory methods and gender analysis tools. This was demonstrated by the observation made by Nguyen et.al (2012) that,

   > The mixed mode of delivery of the training programme (short courses, meetings and field visits) was effective and successful. Participants learnt the theories, concepts and techniques in the short courses, and then were given a chance to see many of these applied in practice. The participants have taken away many lessons and new knowledge, and many of them have been successfully applied into their work.

   The effective use of hierarchy, organized teaching models and methods that fostered efficient knowledge transfer was evident from the CBBR team’s outcomes.
3. Adaptive management requires strong emotional self-discipline, little aversion to conflict, and great humility. These characteristics are not easily observed in the paper by Nguyen et.al (2012) perhaps because of the inherent humility of the authors themselves or the nascent way these characteristics manifest. These characteristics are sometimes tacitly understood and emergent. Evident in the paper is the extent of care put into the design, implementation, adaptation, and application of the pilot program. Personal knowledge of two of the leaders of this program allow me to extend that the project was led with judicious planning and attention to detail with responsiveness to participants’ concerns. The degree

of adaptation of the program required the ability to confront shortfalls and conflict in timely and effective ways. The CBBR team had to overcome several obstacles, such as lack of integrated planning, through critical reflection and evaluation. The regularly scheduled evaluations provided feedback that demonstrated self-discipline, low aversion to conflict, and humility to some extent by actively seeking out criticism that would improve the program in the short and long-term.

4. Adaptive management requires that leaders capitalize on the energy and movement of others, which entails a keen sensibility to recognizing opportunities for emergence and leveraging them. The pilot program instituted by Nguyen et.al (2012) has capitalized on the energy and movement of the initial group of environmental and development professionals by mobilizing advocates for their program throughout Vietnam. This is shown by the authors' reflections that the project has "started to 'snowball'":

   While education and learning were the main objectives of the CBBR pilot program, it was observed that learning was occurring at multiple levels and dimensions, as this excerpt states,

   > In addition, the value of this programme for participants representing different levels of governance could go some distance in removing barriers of communication and information flows and improve decision making processes. It has also developed a common understanding of the issues created – a shared vision and commitment for action. Because the participants hold relevant and important positions directly related to the management of the CBBR, the involvement of power and leadership, as suggested by Vemuri (2009), will be of significant importance for the seamless continuation of the CBBR project.

   The multi-disciplinary and systemic approach helped participants co-create value for themselves and one another, as well as to become more resilient in their own roles as environmental and development professionals. The multi-dimensional approach served to strengthen rather than fragment the effectiveness of the program.

Based on project team research viewed through a lens of CAS and an adaptive model used in ecology, the CUSD research study and the CBBR case study addressed "thrivability" in terms of collaboration, innovation, and learning. Specifically, both cases explored how project teams collaborate to co-create value as complex adaptive social systems in a multidisciplinary environment (Jehn, Northcraft, & Neale, 1999; Page, 2007). Organizational resilience, specifically through adaptive capacity including competencies of project leadership and adaptive management as shown by these cases, was revealed as an outcome of learning through leveraging multidisciplinary experience.

Summary and Conclusions

Four key project leadership competencies that support organizational resilience and global thrivability are:

1. Project leadership requires strong, humanistic values as opposed to rational analysis. The process of self-organization is not a straight-line progression. It is dynamic with elements of forming, storming, and norming. Humanistic values provide a basis of human respect toward building trust that team members appreciate as they proceed through the group development process, working towards common goals and objectives.
2. Project leadership requires juggling multiple strategies and goals within multiple levels of cultural contexts. This may be understood to mean "have a plan but do not cling to it." Organizational structures, like training methods and budgets, provide artifacts of common meaning mutual understanding.
3. Project leadership requires strong emotional self-discipline, little aversion to conflict, and great humility.
4. Project leadership requires that leaders capitalize on the energy and movement of others, which entails a keen sensibility to recognizing opportunities for emergence and leveraging them.

Continual scanning the external environment and stakeholders for indicators of change and feedback is critical for team adaptation at the organizational level, as well as at the global level. CUSD learned this lesson late in their project and had to change quickly. In contrast, the CBBR pilot involved stakeholders early and often, eliciting periodic evaluations for feedback and adaptation. One strategy uses periodic SWOT analysis to check that the team's goals remain relevant and in alignment with the objectives of the larger vision and purpose for the project. This strategy builds adaptive capacity that promotes project team and organizational resilience. From a systems perspective, the outcome suggests that project teams and their leaders should function as open systems rather than closed by soliciting feedback from relevant stakeholders and their operating environments.

Both CUSD and CBBR teams demonstrated the importance of diversity on multiple levels. An attitude of openness to understanding differences and finding similarities, whether technical, organizational, or cultural is characteristic of project leadership for thriving global communities. The CBBR team actively recognized the need for cultural understanding by retaining a Vietnamese academic in a leadership role from the beginning of the pilot. While useful cross-cultural sensibilities may not have been necessary for CUSD, but for CBBR and projects like it, they are critical to the success and thrivability of such endeavors. Adaptation that considers cultural context, norms, and consequences of change is more likely to be adopted in local implementation.

Organizational change is difficult because of systemic interdependencies with embedded hierarchies. In other words, organizational culture can become embedded and intractable resulting in resistance by the actors. This phenomenon can be observed in artifacts, processes, and behaviors that become implicitly accepted and inculcated into daily operations. This is evidence of Bertalanffy's (1969) principle of "progressive mechanization," in which hierarchy in an organization creates specialization in the pursuit of efficiency (p. 213). Yet, an organization becomes inflexible because hierarchy assumes stability in the environment (p. 213). As Farson (1996) puts it, "this presents us with the paralyzing absurdity that the situations we try hardest to avoid in our organizations would actually be the most beneficial for them" (p. 126). As a result, the inclination to address uncertainty with increased control is counterproductive.

In Gunderson and Holling's (2003) model of ecological adaptation the tension between hierarchical stability and progressive emergence is at the inflection point between Conservation and Release. When the tension is so great that it puts the socio-ecological system at risk, the inflection point indicates a threshold for Creative Destruction. In organizations, hierarchy is useful in providing structure; however, when hierarchy becomes bureaucracy it impedes progress and innovation by binding organizational resources. An adversity or crisis, especially one that introduces requisite variety (Ashby, 1962) through diversity, at this inflection point prompts evaluation for conformity and renegotiation of group norms. As a result of adversity, the organization is faced with uncertainty.

Project team leaders who keep their teams focused on the vision and goals of their projects through adept management of uncertainty are successful in overcoming adversity. They build adaptive capacity through learning from experience. Comfort with uncertainty and leveraging diversity are essential factors in successful adaptation to change. As observed in CUSD2009, diversity in terms of multiple disciplines and cultural points of view can potentially strengthen an organization rather than disrupt it (Seery, Holman & Silver, 2010). Project leaders who have cross-cultural sensibilities can leverage team strengths and mitigate weaknesses by consciously addressing value differences (Jehn, Northcraft & Neale, 1999). Embracing change (incremental and transformational) and trust in the emergence of innovation are hallmarks of project team and organizational resilience.

In conclusion, leaders of organizations that have made resilience and global thrivability top priorities need to focus their attention on leverage points that will support development of adaptive capacity. Project managers can play an essential role "enabling organizations for thrivability" through development of four project leadership competencies described in these two case studies. Three recommended approaches that may be effective in bringing these competencies into organizations are: 1.) implementing selection processes that elicit interviewee demonstration of these four competencies for project management positions, 2.) participative education and training in these competencies, and 3.) cross-cultural and project team coaching that develops the organizational bench strength in these competencies. Further, senior organizational leadership is encouraged to evaluate its positions concerning risk tolerance and the extent of its expectations concerning organizational culture and conformity to norms. Finally, to combat organizational tendencies towards "group-think," senior leaders might consider evaluating the effectiveness of organizational feedback methods from internal and external stakeholders (Janis, 1971, 1982). Groups at all levels tend to become insular. Project team leaders are wise to confirm the relevance of the organizational goals and objectives in the context in which the outcomes will operate.

References

Ahl, V., & Allen, T. F. H. (1996). *Hierarchy theory: A vision, vocabulary and epistemology*. New York: Columbia University Press.

Argyris, C. (1999). *On organizational learning* (2nd ed.). Malden, MA: Blackwell.

Ashby, W. R. (1962). Principles of the self-organizing system. In H. Von Foerster & G. W. Zopf, Jr. (Eds.), *Principles of self-organization: Transactions of the University of Illinois Symposium* (pp. 255-278). London, UK: Pergamon Press. Retrieved from Google Scholar database.

Bennett, A., & Bennett, D. (2004). *Organizational survival in the new world: The intelligent complex adaptive system*. London, UK: Elsevier.

Bertalanffy, L. (1969). *General systems theory: Foundations, development, applications*. New York, NY: George Braziller.

Burns, R. (1995). *The adult learner at work: A comprehensive guide to the context, psychology and methods of learning for the workplace*. Chatswood, New South Wales, Australia: Business & Professional Publishing.

Burns, R. (2002). *The adult learner at work: The challenges of lifelong education in the new millennium*. Crows Nest, New South Wales, Australia: Allen & Unwin.

Buzan, T. & Buzan, B. (1996). *The mind map book: How to use radiant thinking to maximize your brain's untapped potential.* New York: Penguin.

Chemers, M. (1997). *An integratve theory of leadership*. Mahwah, NJ: Lawrence Erlbaum Associates, Publishers.

Chroust, G. & Metcalf, G. (2012), eds. *Systems and Science at Crossroads - Sixteenth IFSR Conversation*, Inst. f. Systems Engineering and Automation, Johannes Kepler University Linz, Austria, SEA-SR-32, Sept. 2012 and [http://ifsr.ocg.at/world/files/$12m$Magdalena-2012-proc.pdf].

Corning, P. A. (2002). The re-emergence of emergence: A venerable concept in search of a theory. *Complexity, 7*(6), 18-30. Retrieved from http://www.complexsystems.org/publications/pdf/emergence3.pdf

Day, D. & Lord, R. (1988). Executive Leadership and Organizational Performance: Suggestions for a New Theory and Methodology. *Journal of Management, 14*(3), 453-464.

Farson, R. (1996). *Management of the absurd: Paradoxes in leadership*. New York, NY: Simon and Schuster.

Goldstein, J. (1999). Emergence as a construct: History and issues. *Emergence: Complexity and Organization, 1*(1), 49–72.

Greenleaf, R. K., Spears, L. C., & Covey, S. R. (2002). *Servant leadership: A journey into the nature of legitimate power and greatness*. Mahwah, NJ: Paulist Press.

Gunderson, L. H., & Holling, C. S. (Eds.). (2002). *Panarchy: Understanding transformations in human and natural systems*. Washington, DC: Island Press.

Hall, E. T. (1973). *The silent language*. New York, NY: Anchor Books.

Holland, J. H. (1992). *Adaptation in natural and artificial systems: an introductory analysis with applications to biology, control, and artificial intelligence.* Cambridge: Massachusetts Institute of Technology Press.

Holland, J. H. (1999). *Emergence: From chaos to order.* New York, NY: Basic Books.

Janis, I. L. (1971, November). Groupthink. *Psychology Today*, *5*, 43-46, 74-76.

Janis, I. L. (1982). *Groupthink: Psychological studies of policy decisions and fiascos* (2nd ed.). Boston, MA: Houghton Mifflin.

Jarman, B., & Land, G. (1992). *Break-point and beyond: Mastering the future today*. New York, NY: HarperCollins.

Jehn, K. A., Northcraft, G. B., & Neale, M. A. (1999). Why differences make a difference: A field study of diversity, conflict, and performance in workgroups. *Administrative Science Quarterly, 44*(4), 741-763. Retrieved from ABI/INFORM Global. (Document ID: 47697767)

Kauffman, S. A. (1993). *The origins of order: Self-organization and selection in evolution*. New York, NY: Oxford University Press.

Kauffman, S. (1996). *At home in the universe: The search for laws of self-organization and complexity*. New York, NY: Oxford University Press.
Kvale, S. (1996). *InterViews: An introduction to qualitative research interviewing*. Thousand Oaks, CA: Sage.
Lewes, G. H. (1875). *Problems of life and mind,* (First Series), **2**, London, UK: Trübner.
Markova, D. & Holland, B.H. (2005). Appreciative inquiry: A strategy for change in systemic leadership that builds on organizational strengths, not deficits, *School Administrator, 62* (2), 30-5. Retrieved on 4/5/2012 from http://www.aasa.org/SchoolAdministratorArticle.aspx?id=8776.
Markova, D. (1995). *The open mind: Discovering the six patterns of natural intelligence unlocking the wisdom of your mind for faster learning and communication*. Newburyport, MA: Conari Press.
McMillen, J. (1999). Better for it: How people benefit from adversity. *Social Work, 44*, 455-468. Retrieved from Academic Search Premier database.
Midgley, G. (2010). Theoretical Pluralism in Systemic Action Research. *Systemic Practice and Action Research,* 24(1), 1-15. doi: 10.1007/s11213-010-9176-2
Miller, J. H., & Page, S. E. (2007). *Complex adaptive systems: An introduction to computational models of social life*. Princeton, NJ: Princeton University Press.
Mintzberg, H., & Westley, F. (1992). Cycles of organizational change [Special issue]. *Strategic Management Journal, 13*, 39-59. doi:10.1002/smj.4250130905
Nguyen, N.C., Bosch, Ockie J.H., & Maani, K.E. (2011). Creating 'learning laboratories' for sustainable development in biospheres: A systems thinking approach. *Systems Research and Behavioral Science, 28*, 51-62.
Page, S. E. (2007). *The difference: How the power of diversity creates better groups, firms, schools, and societies*. Princeton, NJ: Princeton University Press.
Postmes, T., Spears, R., & Cihangir, S. (2001). Quality of decision making and group norms. *Journal of Personality and Social Psychology, 80*(6), 918-930. doi:10.1037/0022-3514.80.6.918
Prigogine, I. (1997). *The end of certainty: Chaos and the new laws of nature*. New York, NY: The Free Press.
Puydt, P. E. de (1998). *Panarchy* (Trans. J. Zube with A. Falk). (Original work published 1860). Retrieved from http://www.panarchy.org/depuydt/ 1860.eng.html
Project Management Institute (2012). Definition of project management from the Project Management Institute (PMI). Retrieved on February 1, 2012 from http://www.pmi.org/en/About-Us/About-Us-What-is-Project-Management.aspx
Resilience Alliance (2012). *Adaptive capacity*. Retrieved from http://www.resalliance.org/
Resilience Alliance. (2009). *Resilience*. Retrieved from http://www.resalliance.org/
Schein, E. H. (2004). *Organizational culture and leadership* (3rd ed.). San Francisco, CA: Jossey-Bass.
Schneider, M., & Somers, M. (2006). Organizations as complex adaptive systems: Implications of complexity theory for leadership research. *The Leadership Quarterly, 17*, 351-365. doi:10.1016/j.leaqua.2006.04.006
Schumpeter, J. A. (1942). *Capitalism, socialism and democracy*. New York, NY: Harper.
Seery, M. D., Holman, A., & Silver, R.C. (2010). Whatever does not kill us: Cumulative lifetime adversity, vulnerability, and resilience. *Journal of Personality and Social Psychology, 99*(6), 1025-1041. doi:10.1037/a0021344
Sombart, W. (1913). *Krieg and Kapitalismus*. München, Germany: Duncker & Humblot.
Tuckman, B. W., & Jensen, M. C. (1977). Stages of small-group development revisited. *Group and Organization Studies, 2*, 419-427. Retrieved from ABI/Inform Global database. (Document ID: 656378061)
United States Department of Energy (2009). *Solar decathlon*. Washington, DC: U.S. Department of Energy. Retrieved from http://www.solardecathlon.org/
Weisbord, M. R. (2004). *Productive workplaces revised: Dignity, meaning, and community in the 21st century*. San Francisco, CA: Jossey-Bass.
Werner, C. (2009). *Cornell University Solar Decathlon Silo House: Architecture and energy-efficiency in a small, transportable house*. Unpublished master's thesis, Cornell University, College of Art, Architecture and Planning, Ithaca, New York.

Team 4: Towards a Common Language for Systems Praxis

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Abstract: *We explored developing “common language for systems praxis” to help systems theorists and systems practitioners deal with the major cross-discipline, cross-domain problems facing human society in the 21st Century. For the first three days, we explored a broad range of issues, from previous efforts at standardization; to the nature of language, culture, and praxis; to the relationship between systems science, systems thinking, and systems approaches to practice. On day 4, we used Checkland’s CATWOE approach to understand the usage, context, and constraints for any common language for systems praxis. On day 5, this checklist helped us develop a diagram showing how an integrated approach to Systems Praxis could put theories from Systems Science and Systems Thinking into action through technical Systems Engineering and social Systems Intervention.*

We learned that the best medium for communication across different ‘tribes’ is patterns, and that a common language for systems praxis could use system patterns and praxis patterns to relate core concepts, principles, and paradigms, allowing stakeholder ‘silos’ to more effectively work together. We captured this vision in a diagram that provided a neutral ‘map’ each tribe can use to explain its own narrative, worldview, and belief system, as well as to appreciate how the various worldviews and belief systems complement and reinforce each other within systems praxis. Further development of the diagram post-conversation led to the Systems Praxis Framework (in the Addenda to this report).

Keywords: systems praxis, common language, systems thinking, systems science, systems engineering

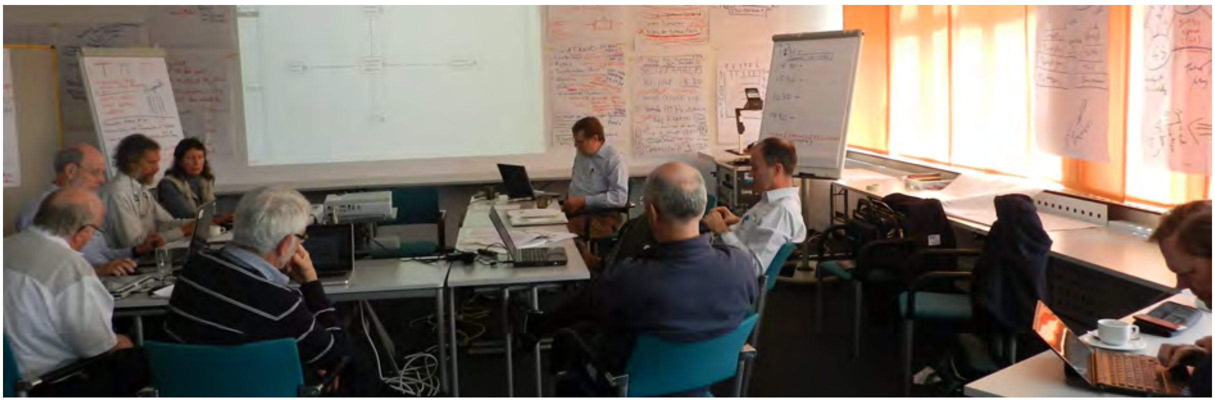


photo by team member Tatsumasa Takaku

Contents

1. Introduction

There are many theories and approaches for recognizing and creating systems. Systems praxis, as a human activity system, prescribes competencies and processes for organizing various technologies into responsive systems. This activity is greatly complicated by varieties of systems types and the lack of common language among systems theories and practices. This conversation sought to clarify attributes of language for collaboration, co-learning and co-evolving in system praxis. It was also hoped that outcomes from the week might inform design of a set of domain-oriented but interoperable ontologies that could markedly increase the coherence of knowledge exchange and choice-making during systems praxis without constraining invention and innovation.[1]

Team 4 exchanged discussion papers and other reference material and began weekly teleconferences in advance of the conversation. One issue that emerged early on was the difficulty of setting a goal for the conversation week given the level of abstraction and ambitious scope of the topic. A summary of team concerns and possible goals for the week included[2]:

- Goal of group 4 is not clear or is not consistent among group members;
- A single common language is historically problematic (but single common ontology is also historically problematic);
- Contrast a single common language with domain specific languages; systems praxis is multi-lingual, multi-domain (even within a given system);
- Focus on concepts or ontology, not language?
- Focus on shared understanding, shared knowledge, shared vision?
- Importance of views and models throughout.

Ultimate goal	Conversation goal this week
Define and adopt one common language	Clarify attributes of one common language
Define and adopt one common ontology	Clarify attributes of one common ontology
Define and adopt a small core common language	Clarify attributes of a small core common language
Define and adopt a small core common ontology	Clarify attributes of a small core common ontology
Define and adopt a set of common ontology views	Clarify attributes of a set of common ontology views

[1] Preliminary Systems Science Working Group material on this topic is available at http://sites.google.com/site/syssciwg/meetings/workshop-2012-january

[2] See D. Hybertson's "Comparison of Team 4 position paper themes and concepts" in the Addenda to this report.

Given the breadth of possible tasks for the week, we spent several days in wide-ranging discussion before using Peter Checkland's CATWOE approach to concretize a vision for the project.

This report presents 1) some of the issues raised during initial explorations; 2) the results of the CATWOE analysis on day four; and 3) some of the material that went into our successful completion of the "Unifying Systems Praxis" diagram on day five. A comparison of concepts and themes from participants' position papers; some short position papers from participants; and the *Systems Praxis Framework*, an evolution of the diagram from work subsequent to the conversation, appear in the Addenda to this report. Longer contributed materials, together with team meeting notes in outline form, can be found in the Supplement at http://ifsr.ocg.at/world/files/$12f$Magdalena-2012-supp.pdf.

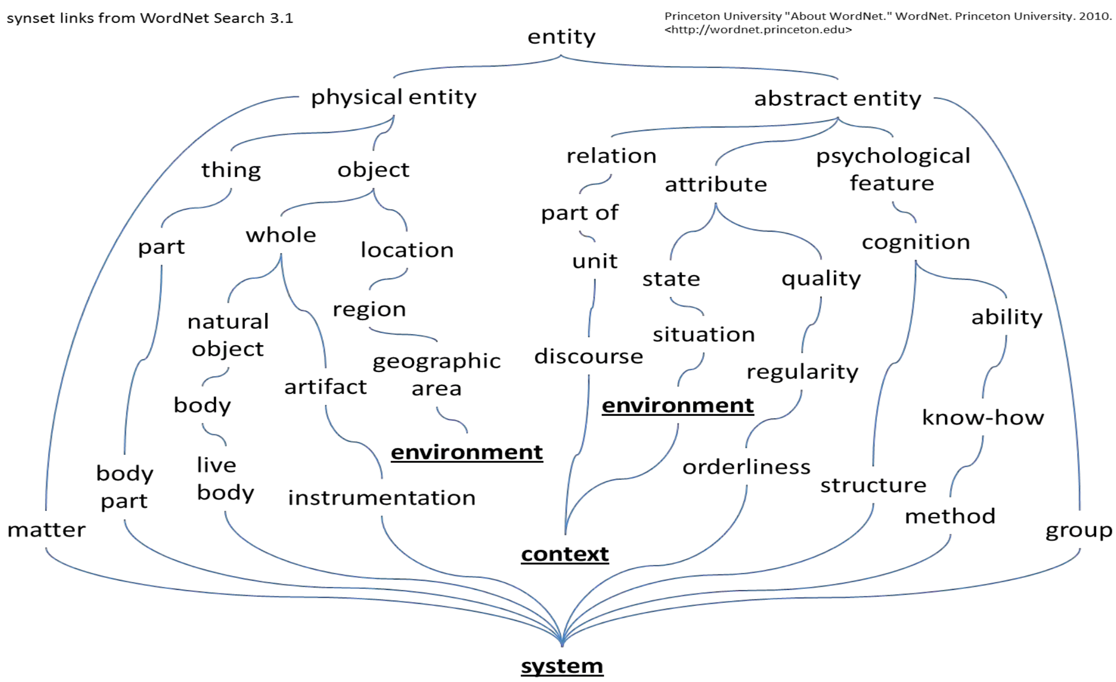
2. Issues considered during initial explorations

2.1. Challenges of standardizing languages

What can we learn from prior efforts to standardize language? One participant, having reviewed three major efforts to identify and standardize appropriate 'term use' in particular contexts, found that

> Two aspects of these three efforts are revealing: 1) none appear to be used by authors or editors of new works to actually reuse definitions across domains with few providing reuse even within domains; and, 2) most terms have several, sometimes conflicting, definitions. Given these observations, why might we expect that an effort to understand "the attributes of language that most interested parties could adopt and employ and that proves necessary and sufficient for collaboration, co-learning and co-evolving in the system praxis field" may yield substantive results?[3]

As further evidence of challenges in communicating with specific terms, the graphic depiction (below) of relationships found in WordNet synsets emphasizing "system", "environment" and "context" reveals a wide range of possible interpretations of these terms and their relationships to each other.



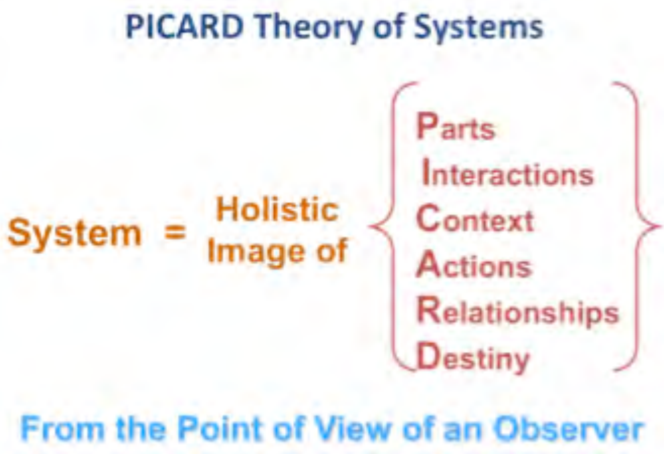
Source: R. Martin (2012); reprinted with permission

[3] See R. Martin "Obstacles to a unified praxis ontology" in the Addenda to this report.

2.2. The meaning of “system”

There is no clear agreement on the definition of the term “system”. One broadly adaptable approach holds that a system might be composed of things that are real, but this does not necessarily mean the system itself has a reality of its own. The system is a particular set of attributes of a collection of things that interact or relate to each other in some manner. Since there are an infinite number of variables and constants associated with any one thing or collection of things, then it does not make sense that the “system” is all of these attributes. One must choose which attributes are of interest, which is another way of saying that we have a “system of interest.”

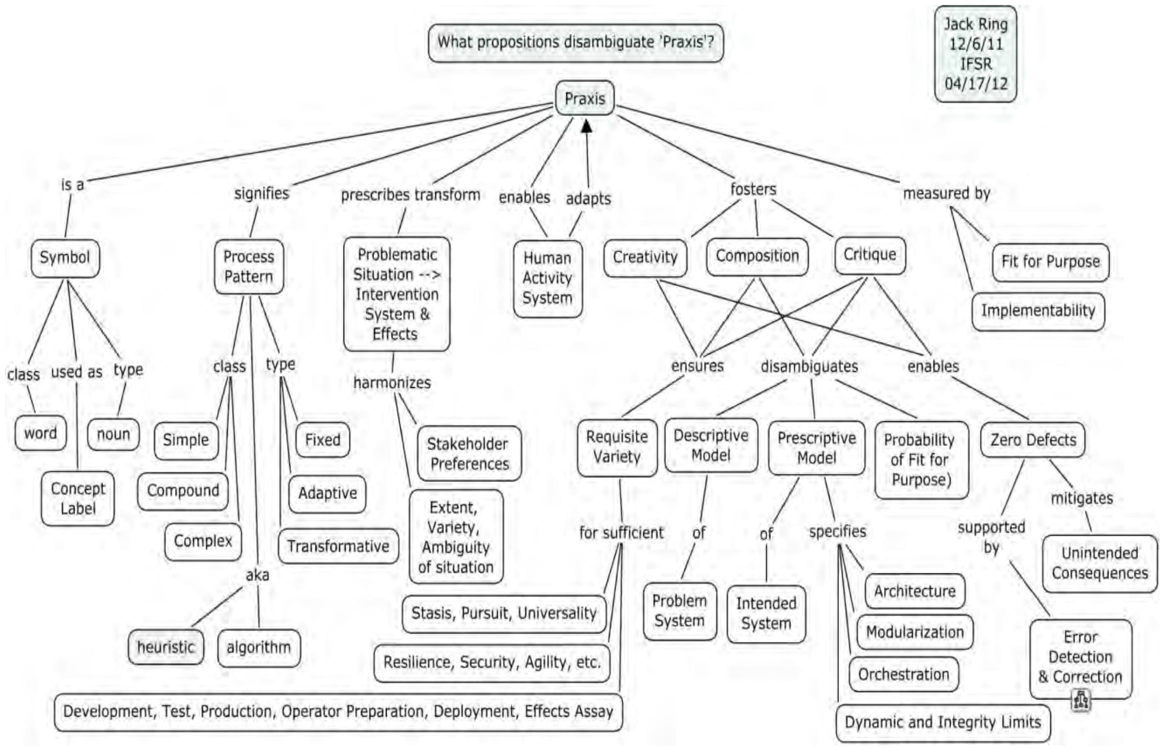
The choice of appropriate attributes to consider in the SOI entails the use of systems thinking. The PICARD theory (or systems thinking framework) is a way to characterize the different categories of ‘stuff’ that can make up a certain system of interest. PICARD stands for parts, interactions, context, actions, relationships, and destiny, as illustrated in the figure.



Source: J. Martin, (2007); reprinted with permission

2.3. The meaning of “systems praxis”

Our intent was to clarify the attributes of a language that most interested parties could adopt and employ for collaboration, co-learning, and co-evolving in the “systems praxis” fields. A concept map drawn the previous year by Jack Ring gave one approach to explicating the meaning of “praxis”:



Source: Ring (2011); reprinted with permission

From literature searches, we found uses of “praxis” as “putting theories into action” or “theory-informed practice”. We came up with working definitions of “systems praxis” as:

- Translating theory into action by thinking and acting in terms of systems.
- The act of engaging, applying, exercising, realizing, or practicing ideas about systems.

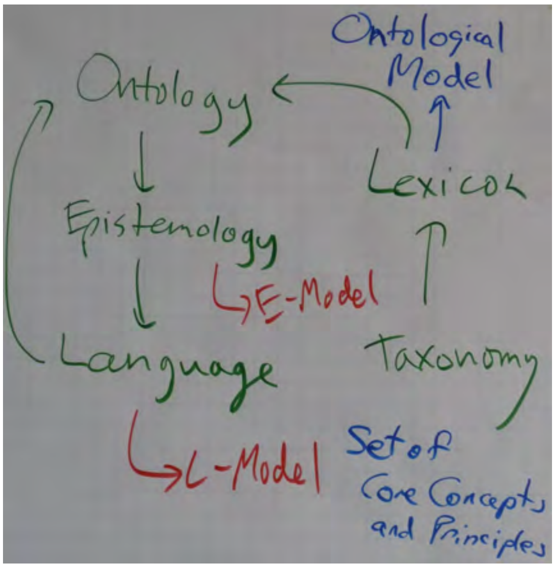
Systems praxis also includes the appreciation of systems by recognizing the quality, value, magnitude, or significance of, e.g., things or people as they contribute to system behaviors that lead to desirable outcomes.

2.4. Differences separating systems communities

We discussed at length the explicit and implicit differences that separated the various communities of systems theory and practice.

The IIGSS “Streams of Systemic Thought”[4] diagram identifies lines of influence among those who have contributed to systems thinking from the early days of philosophy (e.g., Lao Tzu, Heraclitus, Plato, Aristotle) to more recent work (e.g., Peirce, von Bertalanffy, Ashby, Warfield). In addition to identifying lines of influence, the diagram is color-coded according to category of major work:

- General Systems
- Cybernetics
- Physical sciences
- Mathematics
- Computers & informatics
- Biology & medicine
- Symbolic systems
- Social systems
- Ecology
- Philosophy
- Systems analysis
- Engineering.



If integration between all these systems-related fields is possible, what would it require in terms of language, epistemology, ontology, culture, …?

We considered the “three cultures” of science, humanities, and design identified by Cross (1982):

> In most cases, it is easier to contrast the sciences and the humanities (e.g., objectivity versus subjectivity, experiment versus analogy) than it is to identify the relevant comparable concepts in design. This is perhaps an indication of the paucity of our language and concepts in the ‘third culture’, rather than any acknowledgement that it does not really exist in its own right. But we are certainly faced with the problem of being more articulate about what it means to be ‘designerly’ rather than to be ‘scientific’ or ‘artistic’.
>
> Perhaps it would be better to regard the ‘third culture’ as technology, rather than design. This ‘material culture’ of design is, after all, the culture of the technologist—of the designer, doer and maker. Technology involves a synthesis of knowledge and skills from both the sciences and the humanities, in the pursuit of practical tasks; it is not simply ‘applied science’, but ‘the application of scientific and other organised knowledge to practical tasks...’[5]

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[4] International Institute for Global Systems Studies (2001). See http://www.iigss.net/files/gPICT.pdf.
[5] Cross, 1982. pp. 221-223

According to Cross, the three cultures are distinguishable by how education in that culture entails 'enculturation' in the three aspects:

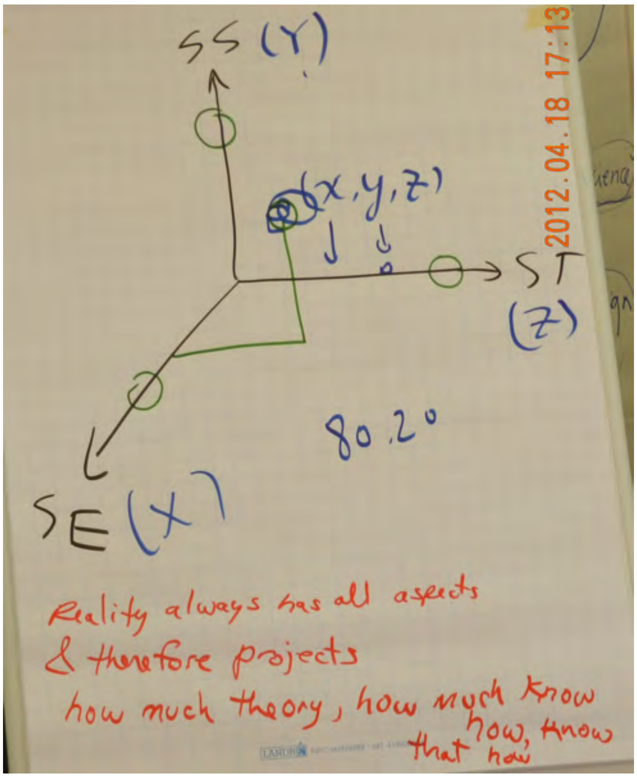
- transmission of knowledge about a phenomenon of study
- training in appropriate methods of enquiry
- initiation into the belief systems and values of the 'culture'.

Culture	Phenomena	Methods	Values
Science	Natural world	• Controlled experiment • Classification • Analysis	• Objectivity • Rationality • Neutrality • Concern for 'truth'
Design	Man-made world	• Modeling • Pattern-formation • Synthesis	• Practicality • Ingenuity • Empathy • Concern for 'appropriateness'
Humanities	Human experience	• Analogy • Metaphor • Criticism • Evaluation	• Subjectivity • Imagination • Commitment • Concern for 'justice'

Elements of the Three Cultures (after Cross,1982)

2.5. Relationships between Systems Science, Systems Engineering, & Systems Thinking

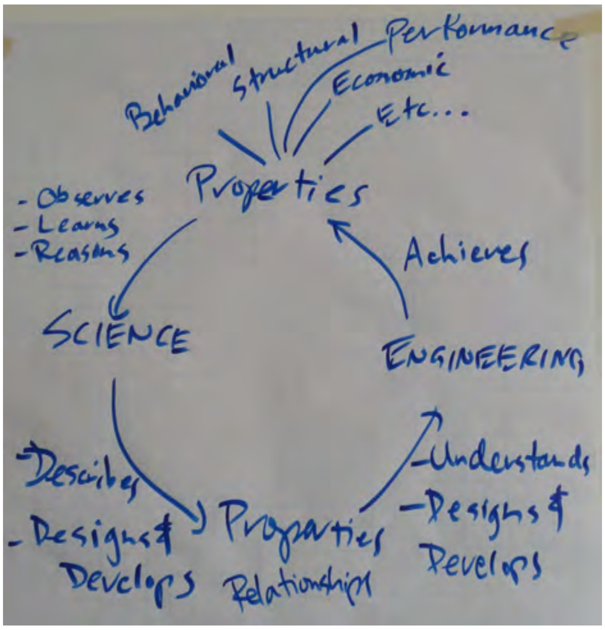
We discussed how the reality of systems praxis always contains some degree of each of our three main areas of focus: systems science (SS), systems thinking (ST), and systems engineering (SE). In the past, when 80% of systems engineering projects arguably involved few problem dimensions requiring systems science and systems thinking, it was possible to ignore the need to communicate with those other fields, let alone integrate them into a unified systems approach or systems praxis.



This no longer seems to be the case.

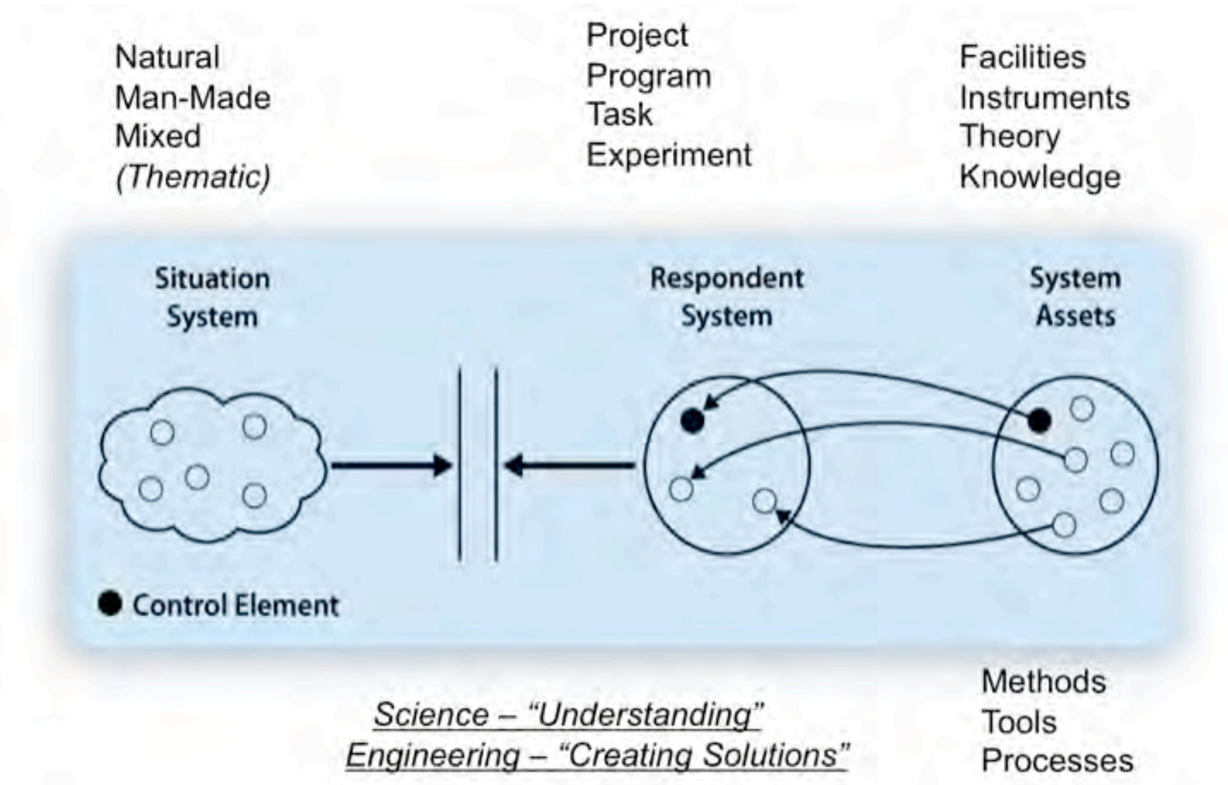
SE seeks solutions to the world's problems but must consider the wide range of factors and scopes that this solution could entail. Hitchins (1993) describes the scope of a system as dependent on which layer it principally resides in: product, project, business, industry, or society. SE also needs to consider more than merely the technical aspects of a problem or solution, which can be represented by the PESTEL factors: Political, Economic, Social, Technological, Ecological, and Legal. This has been expanded by some to STEEPLED by adding the factors of "Ethics" and "Demographics".

Science seeks 'truth' whereas engineering is seeking solutions to the world's problems using the truth found by science. As shown in the figure at right, science seeks to understand and describe properties and relationships of things in the world while engineering strives to understand these properties and relationships in order to apply them to solutions to engineering problems. Engineering then will create new properties and relationships in their designed artifacts, properties including such things as behavior, functionality, performance, structure, economy, practicality, and so on.



These complementary roles for science and engineering can also be seen in the system coupling diagram paradigm below. (Lawson, 2010)

A situation can be examined as a "system" (the so-called Situation System) and, from an understanding of this Situation System, a Respondent System can be devised that seeks to either exploit an opportunity identified therein or solve a problem caused by that situation. The Respondent System can be composed of system assets, either preexisting or needing to be designed and developed.[6]



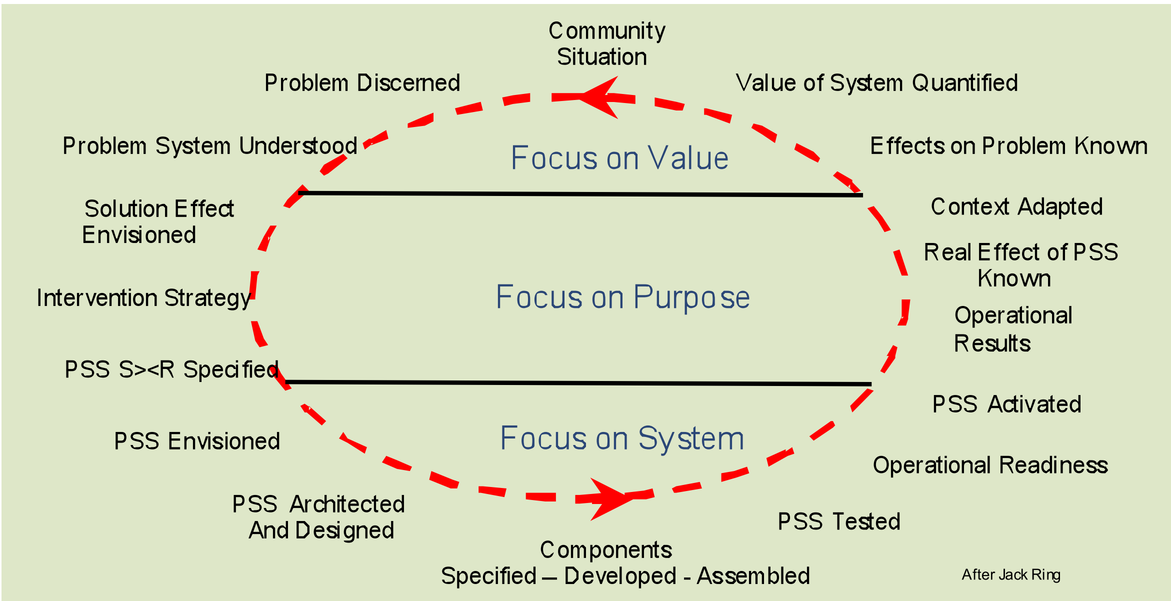
Source: Lawson (2010); reprinted with permission

[6] See B. Lawson's "Paradigms to promote thinking and acting in terms of systems" available in http://ifsr.ocg.at/world/files/$12f$Magdalena-2012-supp.pdf

The systems coupling diagram is among the system concepts, principles and paradigms that Bud Lawson has successfully used for several years to convey the essence of systems thinking, change management and systems engineering to interdisciplinary course participants. These elements have contributed to “learning to think and act in terms of systems”—key components of systems praxis.

2.6. Systems praxis and Jack Ring’s “Value Cycle”

We also found that the concept of systems praxis was embodied in the Value Cycle developed by Jack Ring. The cycle starts with an understanding of value, i.e., what the community of stakeholders believes is important to them individually and collectively in the community situation. A problem is discerned from this focus on value and this can lead to an understanding of the “problem system”. The effect a solution might bring to bear on the problem is envisioned and an intervention strategy is devised. This strategy is translated into solution elements in the form of a problem suppression system (PSS). The specific attributes of the PSS are defined and the total solution is envisioned, architected, and designed. The PSS components are specified, developed, and assembled into the complete PSS, and finally tested to determine its fitness for purpose. The effect on operations is determined and these effects on the problem situation are noted, and then the cycle repeats.



Source: Ring (1998); reprinted with permission

2.7. Key concepts that came up repeatedly in discussions

- Recursion
- Emergence
- Boundaries (especially purpose-dependent selection of boundaries), …
- Patterns and Affordances
- Dualities
  - Hard/Soft
  - Product/Process
  - Holistic/Reductionist
  - Positivist/Constructivist
  - Subjective/Objective
  - Potential/Actual
  - Hierarchy/Holarchy.

3. CATWOE analysis for the "Common Language for Systems Praxis" project

On the fourth day, we used Checkland's CATWOE[7] approach (customers, actors, transformation, worldview, owners, environment) to synthesize our insights into an overview of the usage, context and constraints for any common language for systems praxis. (The elements are presented below in a "TACWOE" sequence since we found that order to be more helpful in developing understanding.)

- Transformation: We want practitioners to be able to use a "common language" (core concepts, principles, patterns, and paradigms) in an integrated systems approach in order to work with stakeholders to achieve a successful and sustainable transformation of a problem situation into an improved situation through an appropriate set of interventions.
- Actors/Stakeholders: Primary actors and stakeholders are those who work in the fields of Systems Science, Systems Thinking, and Systems Engineering, and the stakeholders who are critical to their success. Benefits: Practitioners, systems integrators, consultants, and their employers will find it easier and faster to work successfully across multiple communities of practice to achieve common purpose. Students will find it easier to integrate a systems perspective into their learning and discipline practice. Managers will have a reduction in their cognitive load due to reduced project complexity. And policy makers will benefit from clarity of exposition of complex systems issues.
- Customers: We think primary customers for this work are system practitioners, and possibly tool developers.
- Worldview: We want the "common language" to be useful to practitioners and other stakeholders concerned with problem situations that call for solutions involving hybrid systems including Social, Technical, Economic, Environmental, Political, Legal, Ethical, Demographic (STEEPLED) aspects.
- Owner(s): We want the common "language" to be adopted and owned by "The Systems Community" (practitioners, researchers, and educators). Initially it will be owned and curated on their behalf by the group that started this work at the IFSR workshop in Linz in 2012.
- Environmental Constraints: The language will be used by humans and machines accustomed to different languages, "symbol systems", standards, and with different mental models, culture, experience, roles, seniority, status (power relationships), learning styles, neuro-linguistic programming (NLP) modalities, gender, education (scope, discipline, level), belief systems, and paradigmatic silos. Teams using the common language will be multidisciplinary; multi-site; multi-organizational; multi-national; suffering from spread-think and group-think; working under management pressure and complex legal, infrastructure, institutional constraints; sharing (or not) narratives and success stories, inertia, not-invented-here, collaborative/competitive behaviours. Systems Praxis will use knowledge from diverse disciplines, including Thermodynamics, Informatics, Biomatics, Teleonomics, Human Social Dynamics, Economics, Ecology, and many more. Systems developed will need to satisfy constraints from the natural environment (hazards, pollutants, resources); social environment (social requirement, public acceptance, increase in population); and engineering and design environment (laws, specifications, codes, new built & maintenance, intended lifetime, transition strategies, …).

4. Developing a summary "systems praxis" diagram

With our CATWOE checklist as context, we turned to producing a summary diagram to capture insights we had gained into what might be involved in unifying systems praxis across 'tribes'. We started from a preliminary version of the diagram below, which proposed an "Integrated Systems Approach" that incorporated 1) systems thinking for "understanding systems in a human context"; 2) systems science for the "theory of systems"; and 3) systems engineering for "making choices about how to create and adjust a new system or modify an existing one to better achieve a purpose".[8]

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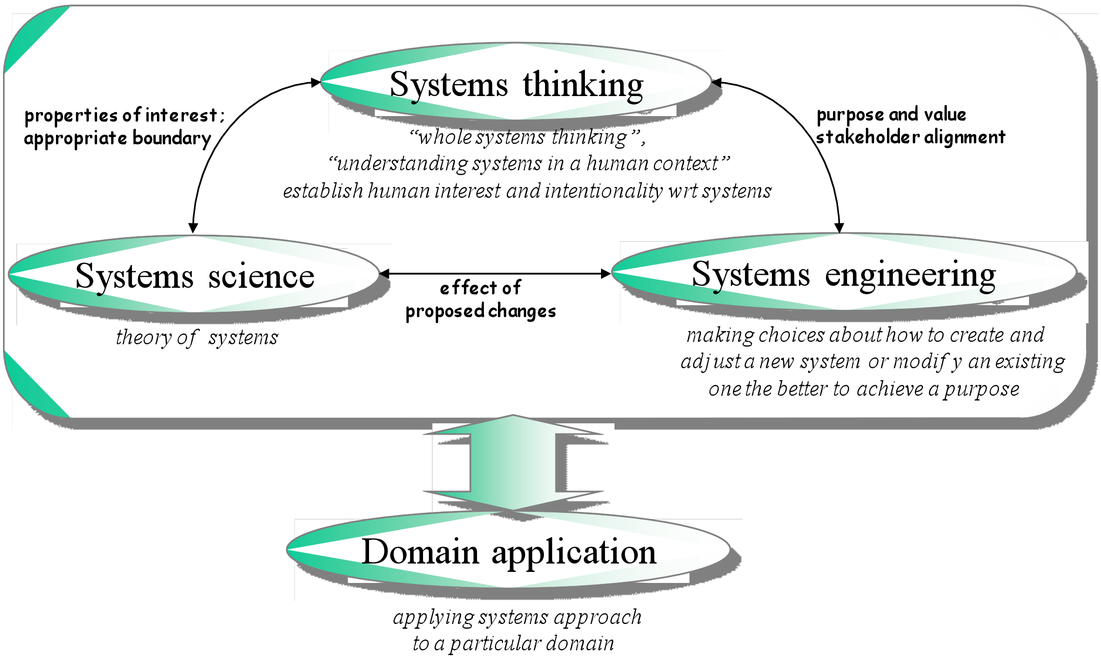
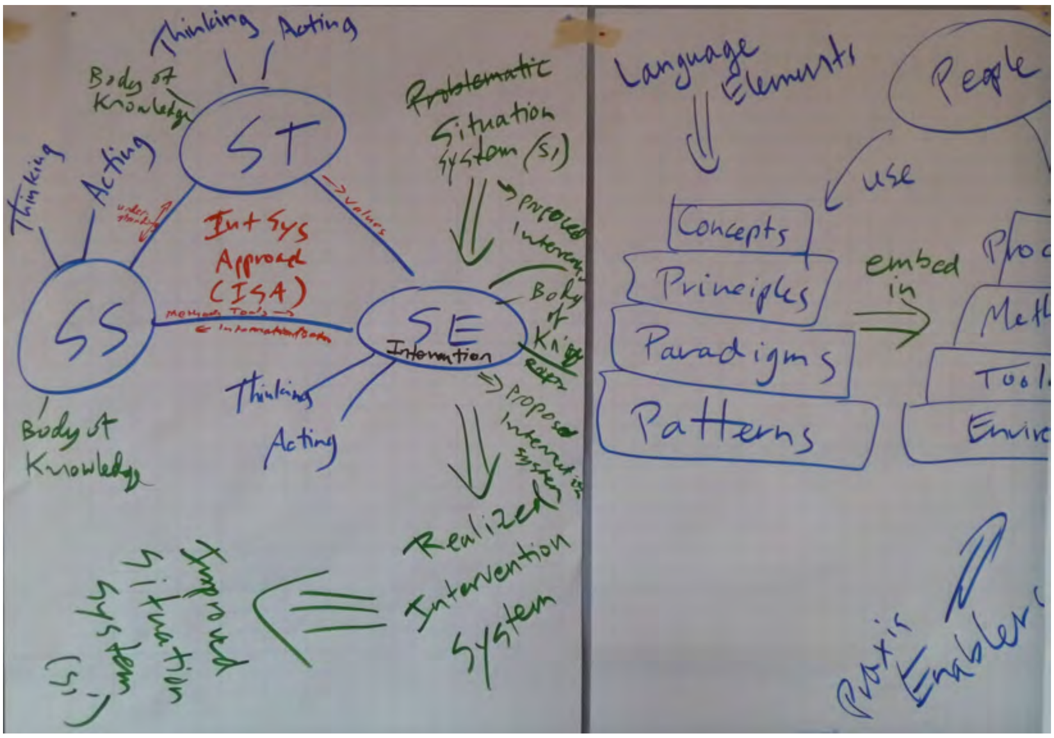
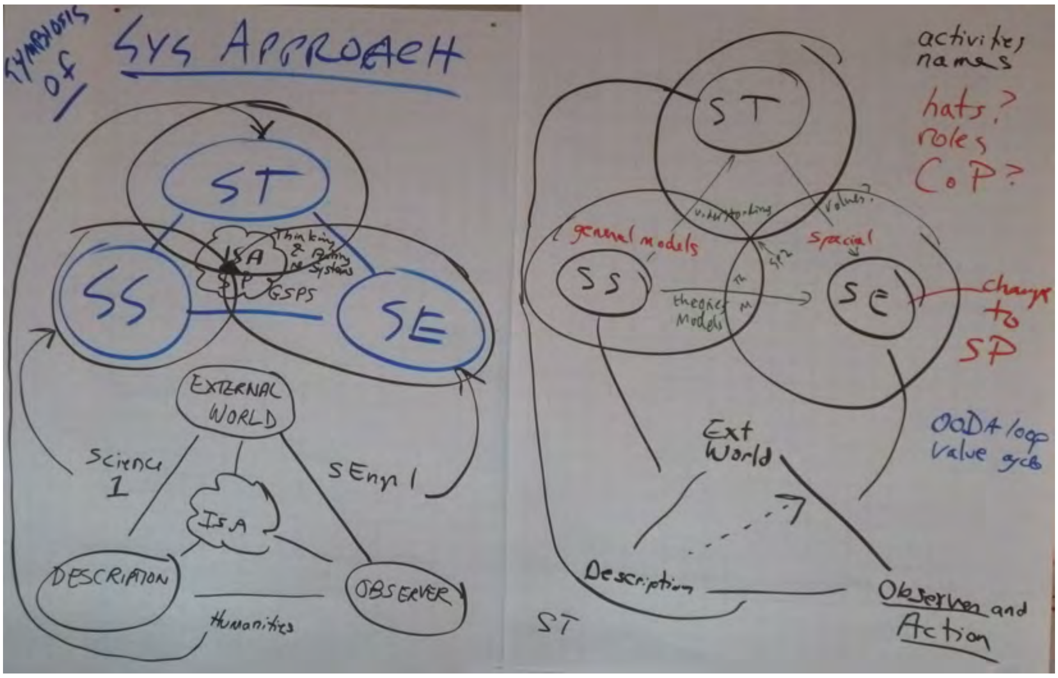
[7] Checkland (1985). See also http://en.wikipedia.org/wiki/Soft_systems_methodology#CATWOE
[8] See H. Sillitto's "Integrating Systems Thinking, Systems Science and Systems Engineering" available in http://ifsr.ocg.at/world/files/$12f$Magdalena-2012-supp.pdf



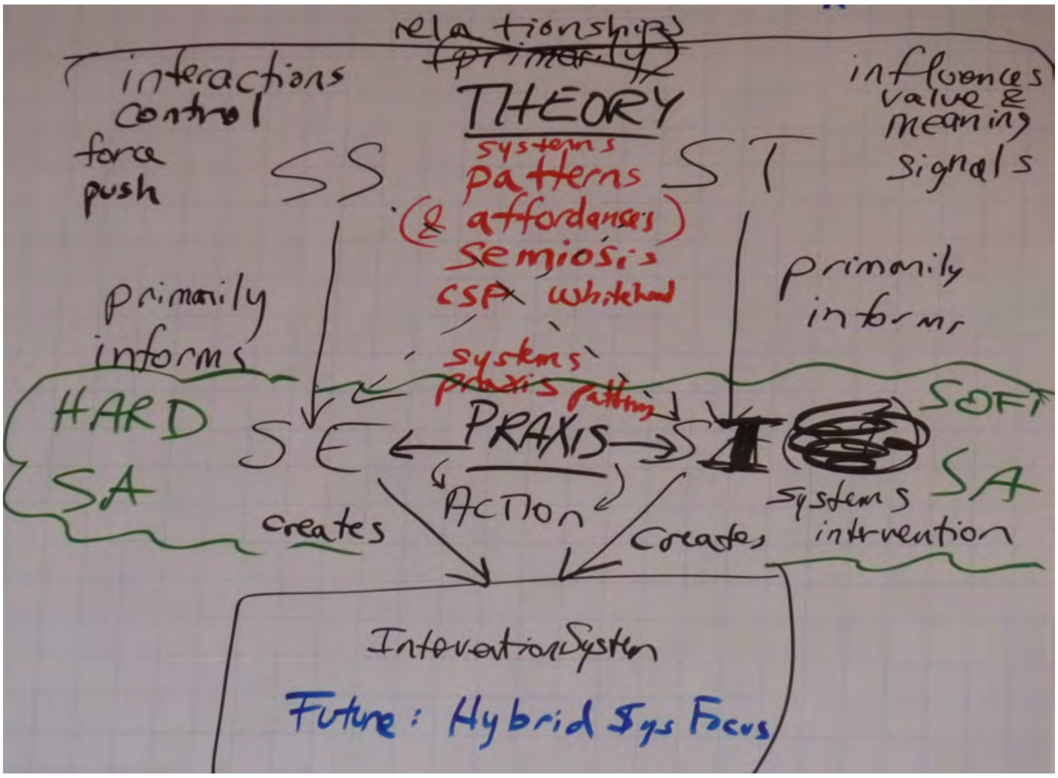
Source: Sillitto (2012); reprinted with permission

We made a number of attempts to combine the above diagram with insights from the week's conversation into a single framework, including, e.g., core systems concepts, principles, and patterns; the nature of systems praxis; the "three cultures"; the breadth of existing systems fields; and thinking and acting in terms of systems. At this point, we did not expect to be able to identify the specific attributes of common language that could be shared between SS, ST, and SE in an integrated systems approach. We wanted, at a minimum, to identify the outlines of a vision of systems praxis that could provide foundation and context for future work on questions of common language, ontology, etc.

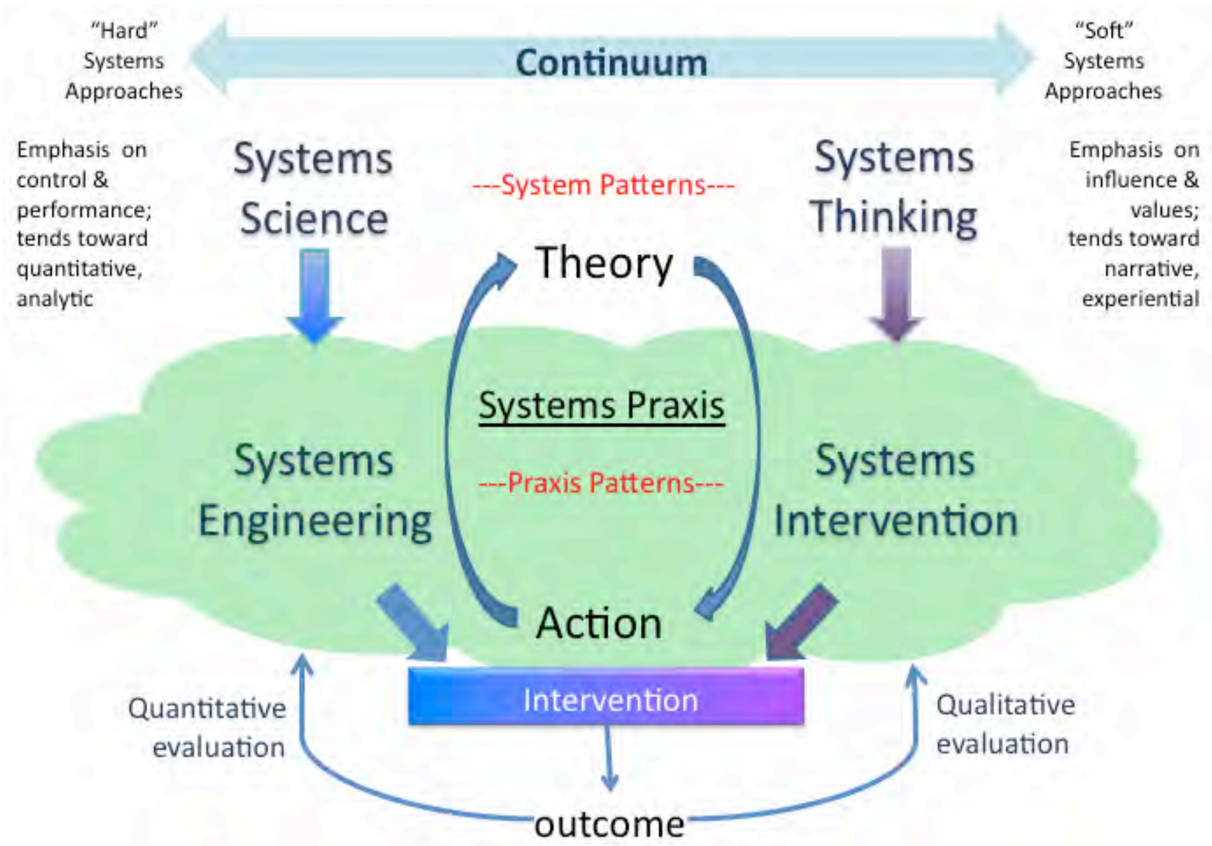




When we took the step of adding a top-level category for social-systems-oriented "Systems Intervention" (SI in our diagram) to cover systems approaches to practice outside of Systems Engineering, we started to find useful dimensions and symmetries that illuminated the relationships we were interested in. These allowed us to develop a diagram showing how a "Unified Systems Praxis" could put theories from Systems Science and Systems Thinking into action through the approaches of technically-oriented Systems Engineering and socially-oriented Systems Intervention.



The culmination of the week's effort is below. This diagram depicts Systems Praxis in terms of a cycle between Theory and Action, where Systems Science and Systems Thinking sources of theory feed into a "cloud" spanning System Engineering and Systems Intervention sources of action. Quantitative and qualitative evaluations of the outcomes from interventions feed back into the cloud. A continuum of systems approaches ranges from "Hard" (emphasizing control and performance, and tending toward quantitative and analytic methods) to "Soft" (emphasizing influence and values, and tending toward narrative and experiential methods). We did not reach a definitive conclusion regarding how to relate the Hard-Soft continuum to Systems Science and Systems Thinking. We did discuss how future systems praxis integration efforts—including work on common language, core concepts, etc.—could relate Systems Science and Systems Thinking via systems patterns, and Systems Engineering and Systems Intervention via praxis patterns.



We learned that the best medium for communication across different tribes is patterns, and that a common language for Unified Systems Praxis could use system patterns and praxis patterns to relate core concepts and principles across paradigms, allowing stakeholder silos to more effectively work together. By using a neutral language and not "boxing in" the domains, we were able to "separate the people from the problem." The result was a step towards a common map that each tribe could use to explain its own narrative, worldview, and belief system, as well as to appreciate how the various worldviews and belief systems complement and reinforce each other within systems praxis.

Following the conclusion of the IFSR Conversation, some team members continued developing the above diagram to resolve issues that had not been fully addressed during the week and to further realize the integrative potential revealed in the original. The resulting *Systems Praxis Framework*, which is presented as an addendum to this report, will be in the INCOSE Guide to the Systems Engineering Body of Knowledge (SEBoK) at http://www.sebokwiki.org/1.0/index.php/Systems.

References (for the week)

Checkland, P. (1983). O.R. and the systems movement: Mappings and conflicts. *Journal of the Operational Research Society*, 34(8), 661–675.

Checkland, P. (1985) Achieving 'desirable and feasible' change: An application of soft systems methodology. *Journal of the Operational Research Society*, 36(9), 821–831.

Cross, N. (1982). Designerly ways of knowing. *Design studies, 3*, 221-227.

Henshaw, M., Lister, P., Park, E., Ilminster, S., Harding, A., Kemp, D., et al. (2011). Capability engineering—an analysis of perspectives. In *Proceedings of the 21st Annual International Symposium of the International Council of Systems Engineering*.

Hitchins, D. (1993). *Putting systems to work*. John Wiley & Sons, Inc.

Hybertson, D.W. (2009). *Model-oriented systems engineering science: a unifying framework for traditional and complex systems.* Auerbach Publications.

Ing, D. (January, 2012). Science, systems thinking, and advances in theories, methods and practices. Available from http://coevolving.com/blogs/index.php/archive/science-systems-thinking-and-advances-in-theories-methods-and-practices

International Institute for Global Systems Studies. (2001). *Some Streams of Systemic Thought*, originated in 1996 by Dr. Eric Schwarz, Neuchâtel, Switzerland. Available from http://www.iigss.net/files/gPICT.pdf

Kast, F., & Rosenzweig, J. (1972). General system theory: Applications for organization and management. *Academy of Management Journal*, 15(4), 447–465.

Lawson, H.W. (2010). *A journey through the systems landscape.* College Publications.

Metcalf, G., Ring, J., Hybertson, D., Lawson, H.W., Wilby, J., Troncale, L., et al. (2011). Systems science and systems engineering white paper. Available from http://bit.ly/St00FI

Praxis (process). In Wikipedia. Retrieved February 8, 2012, from http://en.wikipedia.org/wiki/Praxis_(process).

Ring, J. (1998) *Engineering Value-seeking Systems*, *IEEE-SMC Conference Proceedings*.

Sheard, S. (1996). Twelve systems engineering roles. In *Proceedings of the 6th Annual International Symposium of the International Council of Systems Engineering*.

Sillitto, H. (2009). On systems architects and systems architecting: some thoughts on explaining and improving the art and science of systems architecting. In *Proceedings of the 19th Annual International Symposium of the International Council of Systems Engineering*.

Sillitto, H. (2010). Design principles for ultra-large-scale (ULS) systems. In *Proceedings of the 20th Annual International Symposium of the International Council of Systems Engineering*.

Sillitto, H. (2012). "Integrating Systems Science, Systems Thinking and Systems Engineering: understanding the differences and exploiting the synergies". INCOSE International Symposium, Rome. (Draft)

Sowa, J. (2001). Signs, processes, and language games–foundations for ontology. In *Proceedings of the 9th International Conference On Conceptual Structures*. Available from http://www.jfsowa.com/pubs/signproc.htm

Sowa, J. (2006). The challenge of knowledge soup. *Research Trends in Science, Technology and Mathematics Education*, 55–90. Available from http://www.jfsowa.com/pubs/challenge

Troncale, L. (2006). Towards a science of systems. *Systems Research and Behavioral Science*, 23(3), 301–321.

Von Bertalanffy, L. (1972). The history and status of general systems theory. *Academy of Management Journal*, 15(4), 407–426.

Wilkinson, M., King, P., James, A., Emes, M., & Bryant, P. (2010). Belief systems in systems architecting: method and preliminary applications. In *5th International Conference on System of Systems Engineering*.

Yearworth, M. (2010). Thinking about systems thinking. (Unpublished)

Yearworth, M. (2012). Systems practice in engineering. Available from http://www.slideshare.net/mikeyearworth/my-130710

Addenda (following in this volume)

The Systems Praxis Framework
D. Hybertson: Comparison of Team 4 position paper themes and concepts
H. Lawson: Systems paradigms and praxis
J. Martin: Four thought patterns in support of the systems approach
R. Martin: Obstacles to a unified systems praxis ontology
J. Singer: An empirical taxonomy of modeling approaches (excerpt)

Supplement materials available at http://ifsr.ocg.at/world/files/$12f$Magdalena-2012-supp.pdf

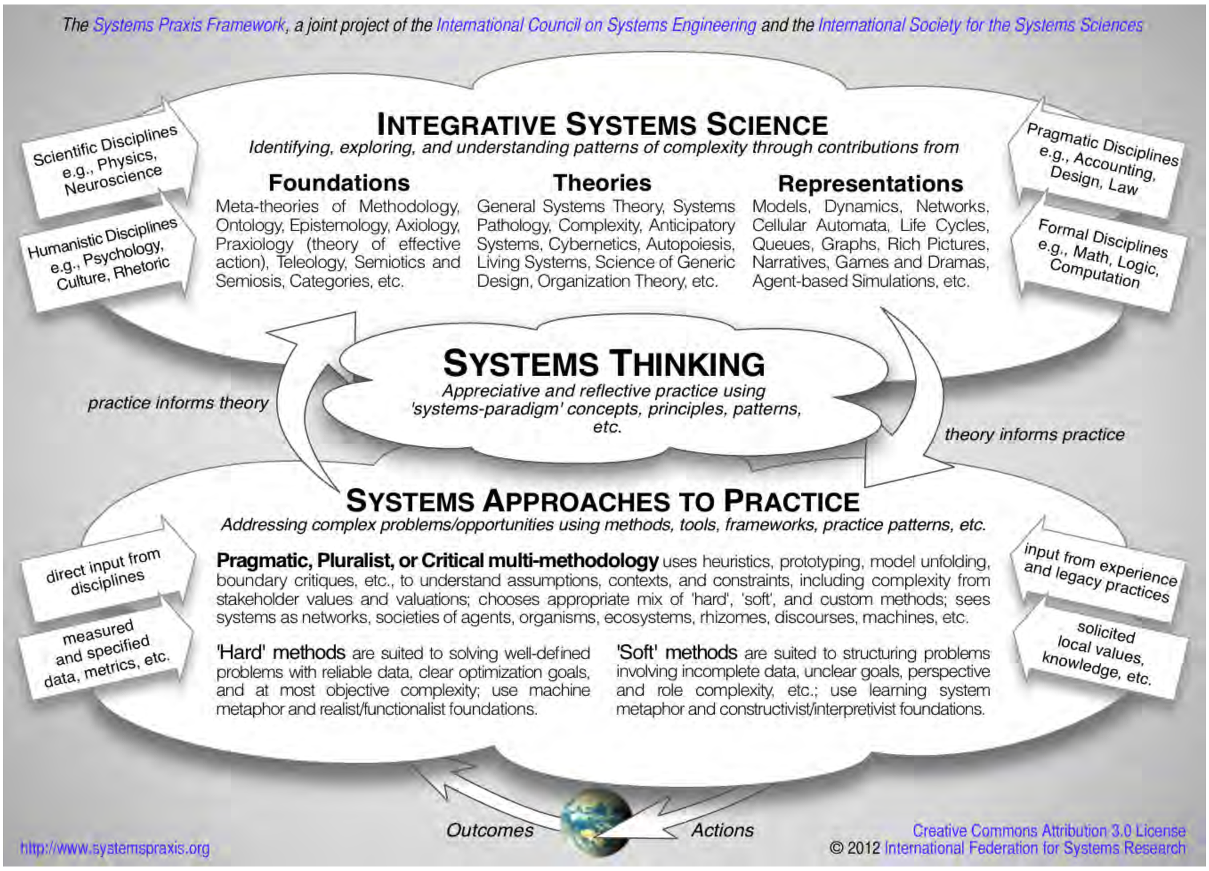
Notes from the Team 4 Conversation: Towards A Common Language for Systems Praxis
H. Lawson: Paradigms to Promote Thinking and Acting in Terms of Systems
H. Sillitto: Integrating Systems Thinking, Systems Science and Systems Engineering
T. Tatsumasa: Experienced Theory and Praxis of Human Activity
T. Tatsumasa: Common Languages: Natural Languages and Invented Languages

	The Systems Praxis Framework building on the April 2012 Team 4 Conversation (October 2012; credits below)

The challenges of complex systems require people to work together across disciplines. To work together, we must first communicate; and to communicate, we must first connect. Systems theorists and people who work with systems can connect through appreciating their synergistic roles in systems praxis.

Praxis is "integrating theory and practice". **Systems Praxis** refers to the entire intellectual and practical endeavor of creating holistic solutions to complex system challenges. Systems concepts, principles, and methods are designed to be integrative across traditional domain boundaries. However, multiple dimensions of complexity (social, technical, environmental, etc.) may require a blend of approaches and techniques from disparate systems traditions. Terminology for the various systems domains, scales, and types may appear similar; but assumptions underpinning worldview, culture, and success criteria are not necessarily shared. The result is that systems practitioners and theorists are apt to find that, while they all are focused on "systems", numerous subtle differences result in their being "divided by a common language".

The following **Systems Praxis Framework** gives systems theorists and practitioners a common "map" wherein they can recognize and appreciate the complementary roles played by all participants and stakeholders in the complex process of systems praxis.



The Systems Praxis Framework (pdf available at http://systemspraxis.org).

Systems Thinking is the core integrative element of the framework. It binds the foundations, theories and representations of systems science together with the pragmatic, "hard", and "soft" approaches of systems practice. In systems praxis, there is a constant interplay of theory informing practice and outcomes from practice informing theory. Systems thinking guides this ongoing activity, reflecting on and appreciating systems and contexts, in order to choose appropriate adaptations.

Integrative Systems Science has a very wide scope and is grouped into three broad areas:

- **Foundations**, which help us to organize knowledge, learning, and discovery;
- **Theories** about systems, identifying patterns abstracted from and applicable across domains and specialties;
- **Representations** that allow insight into, and communication about, systems and their contexts, by describing, exploring, analyzing, making predictions, etc.

Systems Approaches to Practice aim to produce desired outcomes while being mindful of unintended consequences. No one branch of systems science or practice provides a satisfactory explanation for all aspects of a typical system "problematique", so practice needs to involve the range of knowledge appropriate to the system of interest and its wider context.

- A **Pragmatic** (also called Pluralist, Critical, or multi-methodological) approach judiciously selects a mix of "hard", "soft", and custom methods, tools and patterns, drawing from different foundations and systems-specific and domain-specific traditions as appropriate to the situation. The approach is open to whatever is useful for gaining sufficient insights to address the issues at hand and achieve desired combinations of emergent properties. Heuristics, "boundary critiques", "model unfolding", etc., allow assumptions, contexts, and constraints to be challenged and understood, uncovering hidden sources of complexity, such as from different stakeholders' values and valuations. Systems may be viewed as hierarchies, networks, societies of agents, organisms, ecosystems, rhizomes, discourses, machines, etc.
- **"Hard"** methods are suited to solving well-defined problems with reliable data and clear goals, using analytical methods and quantitative techniques. Strongly influenced by "machine" metaphors, they focus on technical systems, objective complexity, and optimization. They are based on "realist", "functionalist", and "positivist" foundations.
- **"Soft"** methods are suited to resolving or structuring problems and opportunities involving incomplete data, unclear goals, or open inquiries using a "learning system" metaphor. They focus on communication, subjective and intersubjective complexity, interpretations, and roles. They are based on "constructivist", "interpretivist", and "humanist" foundations.

Systems Praxis is part of a wider ecosystem of knowledge, learning, and action. Successful integration with this wider ecosystem is the key to success with "real-world" systems. Systems science draws on and integrates insights regarding complex problems from the differentiated disciplines, including "hard" scientific disciplines such as physics and neuroscience; formal disciplines such as mathematics, logic, and computation; humanistic disciplines such as psychology, culture, and rhetoric; and pragmatic disciplines, such as accounting, design, and law. Systems approaches to practice depend on: measured data and specified metrics relevant to the problem or opportunity situation and domain; understanding of local values and knowledge; and pragmatic integration of experience, legacy practices, and discipline knowledge.

In summary: **Integrative Systems Science** allows us to identify, explore, and understand patterns of complexity relevant to a problematique; **Systems Approaches to Practice** draw on integrative systems science to address complex problems and opportunities; **Systems Thinking** binds the two together through appreciative and reflective practice using systems-paradigm concepts, principles, and patterns; and, finally, observing the results of systems practice enhances both practice and theory.

Credits: diagram lead Janet Singer; narrative lead Hillary Sillitto; team members Johan Bendz, Gerhard Chroust, Duane Hybertson, Harold "Bud" Lawson, James Martin, Richard Martin, Michael Singer, Tatsumasa Takaku. Thanks also to Rick Adcock, Billy Dawson, David Ing, Ray Ison, Gary Metcalf, Gerald Midgley, Jack Ring, and Jennifer Wilby.

Comparison of Team 4 Position Paper Themes and Concepts

Duane Hybertson

Themes that emerged from the Team 4 position papers submitted pre-conference:

- Goal of Team 4 not clear or not consistent among group members
- Single common language is historically problematic [but single common ontology is also historically problematic]
- Contrast single common language with domain specific languages; systems praxis is multi-lingual, multi-domain (even within a given system)
- Suggest focus on concepts or ontology, not language
- Suggest shared understanding, shared knowledge, shared vision
- Importance of views; models

From these themes we can pose possible goals for the Conversation:

No.	Ultimate goal	Conversation goal this week
1.	Define and adopt one common language	Clarify the attributes of one common language
2.	Define and adopt one common ontology	Clarify the attributes of one common ontology
3.	Define and adopt a small core common language	Clarify the attributes of a small core common language
4.	Define and adopt a small core common ontology	Clarify the attributes of a small core common ontology
5.	Define and adopt a set of common ontology views	Clarify the attributes of a set of common ontology views

The table below selects excerpts from position papers of Team 4 members and relates them to a common set of systems science and systems engineering concepts described in the book *Model-Oriented Systems Engineering Science*[1], referred to here as MOSES. The purpose of the book is to define a science foundation for an envisioned systems engineering of the future that expands beyond its traditional scope of application domains to include more complex problem areas such as social systems and public policy issues. This science foundation is built substantially from general systems science and complex systems theory, but also from other disciplines including physics, biology, psychology, sociology, economics, law, and organizational theory. The book describes the general relation between science and engineering, and then focuses on the elements of the sciences that are useful for the practice of systems engineering. The model-oriented treatment of these topics in the book revolves around the position that it is useful and clarifying to regard the artifacts of science (such as theories) and engineering (such as requirements and design) as forms of models, and that these models can be organized in a multi-dimensional model space. The model space not only facilitates the understanding of the models and their relations and interactions, but also in a larger sense serves as a large virtual structured container of the body of knowledge of the relevant systems science and engineering disciplines.

This Team 4 Conversation, and the mapping table below, focused less on the model-oriented aspects of the book and more on the basic concepts of the sciences and systems engineering, and

[1] D. Hybertson, *Model-Oriented Systems Engineering Science: A Unifying Framework for Traditional and Complex Systems.* Auerbach Publications, 2009.

the relations between them. The first two columns of the table represent a selective synopsis of the position papers, while the third column provides a MOSES perspective on each position concept.

Person	Position concept or facet	Concept or response from MOSES view
Bendz	a holistic approach to enterprise development and governance was required	Agree. Systems science; model space; collective actualization space
Bendz	poorly reflected notions of systems and architecture hamper the development of both technologies and skills	Agree. Concepts of system, mosaic, world; relation of architecture to internal model
Bendz	the way to go about achieving such an increase in the precision and formalism of the use of system concepts is through an ontological approach, ultimately shaping a consensus-based belief-system which would provide a “lingua franca” for systems theorists and practitioners alike	Agree. system and connection concepts; shared understanding as specification; belief system as view or defined world
Bendz	there is a suboptimal understanding of the potentially important role of architecture … the core contribution of architecture is the understanding of the fundamental principles of the system … a.k.a the system concerns	Architecture as general internal model; concerns as views
Bendz	Incentives	Big factor in (purposeful) complex systems
Chroust	One of the keys to a successful systems engineering project is an orderly process to conceptualize, design and build the intended system. This process has to be defined, enacted and often even enforced.	Partially disagree. Agree that certain elements have to be controlled and enforced (e.g., configuration management). But it is important to distinguish between controlled aspects and the actual problem solving (design, engineering…)—which is opportunistic, messy, and disorderly. Keys to problem-solving are allowing the disorderly process and using knowledge of systems and system patterns acquired in a domain (as opposed to knowledge of processes and process patterns beyond the controlled aspects)
Chroust	Iterative, opportunistic, incremental; human aspects of process models	Yes, agree: these are more natural problem-solving concepts. But we need to allow them to happen, not prescribe them; the focus is still on the system and system artifacts and patterns
Chroust	Formal – exposed inconsistencies	Precise
Hybertson	The statement of the problem indicates a belief that a common language would improve systems praxis. Do we assume we need a common language or a common ontology? I suggest we need a common shared set of concepts, and we need to pay some attention to a common ontology as a basis for a common language.	Conceptualization of systems: language, ontology
Hybertson	The scope of the common language or ontology benefits from being limited to systems of interest to systems engineering (“SE systems”), not all systems. The field whose province is all systems is general systems science. I suggest the field whose province is all SE systems is SE science.	Scope of MOSES is systems engineering science

Hybertson	Position: Our IFSR Theme 4 group activity is supporting Systems Engineering Problem-Solving System (SE PSS, which is Systems praxis) by doing Systems Engineering Science Problem-Solving System (SES PSS) and producing—or at least working towards—a common language or ontology (the SE Science Solution System or SES SS) that is the language/ontology of SE Solution Systems (SE SS).	The SES PSS and SE PSS occur in the (MOSES) Collective Actualization Space, and the SE SS exists in the model space, solution space, and is ultimately deployed in the problem space.
Hybertson	Position: the language we are producing is (or should be) the language of SE solution systems, more than the language of SE PSS (systems praxis). Stated differently, the position is that the best way to help the SE process is not by focusing on (languaging) the SE process, but by focusing on (languaging) what that process produces, i.e., solution systems.	Conceptualization of systems: language, ontology
Hybertson	Position: we need to expand from the traditional mechanistic models of solution systems to include the organic models of complex solution systems. The language or ontology that we produce needs to reflect that expansion.	The focus of MOSES is on defining a science that supports this expansion of SE.
Hybertson	I offer an interrelated collection of concepts and definitions [based substantially on concepts expressed in the book Model-Oriented Systems Engineering Science] that include the following: 1. Core SE concepts in the form of an informal but reasonably precise set of terms and definitions for the language: a. Primary concepts of things: world, system, mosaic, model, region… b. Primary concepts of connections among things: interaction, action, party, activity, service, disservice, effect… 2. Concept of process and its environment: SE world, defined as collective actualization space (position paper Figure 2) 3. Organizing construct for capturing the most important knowledge for systems praxis: multi-dimensional model space of solution systems (Figure 2) 4. Characteristics of solution system models that go beyond mechanistic to organic 5. For those who need some process assistance: Characteristics of SE process models that go beyond mechanistic to organic.	Core system concepts; Collective actualization space

Lawson	one can question what is meant by "language"? Are we talking about an ontology of concepts expressed as terms and relationships?	I have the same question and suggestion
Lawson	development of mental models and shared vision is related to the usage of paradigms (defining this as patterns based upon models) that express central concepts	Agree. Mental models and shared vision matches MOSES concept of shared understanding and the relation between model and specification (p.67-70 of book). Paradigm matches MOSES concepts of pattern and defined world
Lawson	How are paradigms that relate concepts and principles expressed as models? Models have several forms (textual, mathematical or graphical). Every form of model is an abstraction of some part of portraying reality from a perspective as well indicated in the ISO/IEC 42010 standard. It is this plurality that establishes the basis for discussion and dialogue that leads to understanding (individually and collectively).	Agree. Plurality of perspective matches MOSES concept of view (Chapter 10 of book)
Lawson	… the title of this Theme 4 … should be something like: Towards paradigms for improving systems praxis or Towards establishing a shared vision of systems praxis. … focus on multiple, but a small number of paradigms in the form of understandable and applicable system related models	Agree.
Lawson	Complexity…	Essential vs accidental complexity
Martin J	Since there are an infinite number of variables and constants associated with any one thing or collection of things, then it does not make sense that the "system" is all of these attributes. You must choose which attributes are of interest, which is another way of saying that we have a "system of interest."	MOSES view: A system of interest to an observer is a system designated, and under consideration, by the observer. There are an infinite number of variables and constants associated with any one thing or collection of things; it makes sense that the "system" is all of these attributes. But most of them we do not know about, or care about. You must choose which attributes are of interest for your system of interest.
Martin J	PICARD: parts, interactions, context, actions, relationships, and destiny	These are very similar to MOSES concepts of system and especially connection in Chapter 3.
Martin J	7 samurai--systems: context, intervention, realization, deployed, collaborating, sustainment, competing	Similar to MOSES collective actualization space (problem space, model space, solution space…)
Martin J	PMTE: process, methods, tools, environment	Related to MOSES actualization. But MOSES emphasizes <u>system</u> information (common problems, common solutions, patterns, models, conventional designs, body of system knowledge…) over engineering <u>process</u> information. In 7 samurai terms: MOSES emphasizes intervention system (and context system) patterns over realization system. In terms of Hybertson position paper: It emphasizes

		solution system over problem solving system
Martin J	Knowledge pyramid: signals, data, information, knowledge, wisdom	Agree, useful structure for information systems, including solution systems that process information, and describing problem-solving systems such as SE praxis
Martin J	“Systems are Imaginary”	Agree in the following sense: Systems may be physical or conceptual; but no system exists inherently as a system. A car, or tree, or atom, or solar system, or company, may exist; but whether any of these is a <u>system</u> is a <u>designation</u> made by an <u>observer</u> or group of observers.
Martin J	Metaphors [Mac as toaster; Bud: software circuit (as hardware)]	Story, interpretation, machine vs organism metaphor
Martin, R	Two aspects of these [previous] efforts are revealing: 1) none appear to be used by authors or editors of new works to actually reuse definitions across domains with few providing reuse even within domains; and, 2) most terms have several, sometimes conflicting, definitions. Given these observations, why might we expect that an effort to understand "the attributes of a language that most interested parties could adopt and employ … in the system praxis field" may yield substantive results?	Good question. Response: Are the prospects any better if we aim for a set of concepts or an ontology of systems that could be used in system praxis?
Martin, R	However, we should be able to focus on those 'attributes of language' that do enable more productive communication and yet provide for suitable contextualization of use for specific terms and phrase. Toward that end, we have examined several efforts to formalize expressions of ontology associated with both an "upper level" for use across all domains and domain specific works.	1. Agree – more focus on concepts and ontology 2. Distinction between general (“upper level”) and domain-specific concepts is important. Suggestion: We need a range of concepts from most general to narrowly defined domain-specific—perhaps a concept pyramid.
Martin, R	Process Specification Language (PSL); Descriptive Ontology for Linguistic and Cognitive Engineering (DOLCE); ISO 15926 Industrial automation systems and integration; WordNet. … Are these taxonomies already over-specialized for the breadth of the SE domain? Does adding more terms and relations among them move us toward more general application of the terms to SE and SS or toward more specialized use of the terms where selected portions of the taxonomy can be applied to sub-domains? <u>To move toward a Unified Ontology of any kind, we must focus not on the uses of terms common to our discourse but rather we must focus on the qualities we want those terms to bring to that discourse.</u>	Agree.
Ring	Praxis prescribes system implementation from Day 1 and continual improvement through Year N.	Both for an individual person, and for a community, improvement [maturation] dominates initially, then adaptation

Ring	Praxis prescribes system implementation from Day 1 and continual improvement through Year N. Praxis must provide for continual assessment and adaptation of praxis as knowledge occurs.	Both for an individual person, and for a community, improvement [maturation] dominates initially, then adaptation [evolution] dominates
Ring	Praxis must be consistent with the extent, variety and ambiguity of both the problem system and the competencies of those who develop the intervention system. Praxis consists of a fusion of an algorithm and the human activities that execute it. Praxis must foster quality, parsimony and beauty in the resulting system.	Agree on desired qualities of an intervention system. But those qualities are achieved more by understanding and applying system patterns than by understanding and applying praxis algorithms
Ring	Praxis produces errors both obvious and unobvious and unintended consequences.	Agree. But the errors and (negative) unintended consequences can be reduced significantly by understanding and applying system patterns (more than by improving and applying a praxis algorithm)
Ring	People are key. The language of praxis will consist of many local dialects whose users are both purposeful and adept at interoperability.	Agree. But again, a language of (intervention) systems is more useful for engineering intervention systems than is a language of praxis.
Sillitto	systems science as an objective “science of systems”	Yes, agree.
Sillitto	systems thinking as concerned with “understanding systems in a human context” – so ST establishes the “purpose” and “value” that drive systems engineering	Understanding is part of SS; all science is a human activity Establishing purpose is part of SE.
Sillitto	systems engineering as “creating, adjusting and configuring systems for a purpose”	Yes, SE – assuming “creating” includes analyzing problem situations, defining capabilities, conducting tradeoffs, modeling, developing/applying architectures…
Sillitto	the “correct” choice of system boundary for a particular purpose depends on the property of interest. This choice seems to belong in the domain of “systems thinking”	Deciding the most <u>useful</u> boundary for a designated system of interest is part of <u>SE</u>; not necessarily an issue of “correct”
Singer J	gain insight into modeling as an activity that generates knowledge, and into models as the contexts within which knowledge is interpreted and used…. implications for the design and use of modeling tools and knowledge bases	Agree. Matches MOSES concept of model space as capturing and organizing the explicit aspects of a body of knowledge—in our case, the SE and SS body of knowledge
Singer M	Caution: “System” can be hyped to where it comes to mean everything; we want to aim for a mature bounded concept/definition	… that is what happened to “architecture”. It is a pattern very much like the Gartner hype cycle.
Takaku	Zipf’s law, Pareto Principle: Applying power law distributions to language word usage	This analysis might be of interest in analyzing and comparing different system or praxis languages—for example, to find key terms and how they differ in frequency of use in different communities. But would it be useful if we focus on concepts or ontology more than language? Not sure; the approach seems limited in that it does not address relations between entities (other than frequency order) or context of

Systems Paradigms and Praxis

Harold "Bud" Lawson

One can question whether the development of a "language" is the right or only approach to improving systems praxis. Further, one can question what is meant by "language"? Are we talking about an ontology of concepts expressed as terms and relationships?

As Peter Senge (1990) points out in respect to a learning organization, it is personal mastery, mental models, shared vision and team learning based upon systems thinking that are routes to improvement.

In particular the development of mental models and shared vision is related to the usage of paradigms (defining this as patterns based upon models) that express central concepts.

An ontology identifying (labeling) concepts and relationships between concepts such as the Cmap portrayal being developed under the leadership of Jack Ring in the SSWG is one paradigm. While useful an ontology of this form needs to be complemented with additional paradigms that provide deeper insight into the concepts, collections of concepts as well as underlying principles.

If there are too many concepts as in many of the currently well-known architectural frameworks, the mind boggles. Individuals and teams have a hard time understanding and even agreeing upon what the framework provides.

In my personal experience finding a "limited" (perhaps 5 +/- 2) driving set of concepts that form mental models and provide a basis for shared vision has been a key to improvement of systems praxis.

I would suspect that this is why the ISO/IEC 15288 standard is attractive for systems engineers. It is based upon limited number of level-wise reusable concepts in a system breakdown that individuals and groups can get their mind around. Due to this fact, the concepts remain in the mind while the details are there when needed. The document describes system related processes in a mere 40 pages.

I have often point to what I call "The Arms Length Test". That is if you take a printed copy of a standard (could also apply to other documents like architectural framework descriptions) and can hold it at arms length for one minute then it might be a useful document to read and to utilize. Is this a useful principle?

I suggest that the most important aspect of improving systems praxis is developing personal mastery and group (team) competence and capabilities in learning to think and act in terms of systems. I further suggest that this is best accomplished by multiple paradigms that not only portray an ontology of concepts that guide thinking but also convey concepts and underlying principles that guide action Lawson and Martin (2008).

How are paradigms that relate concepts and principles expressed as models? Models have several forms (textual, mathematical or graphical). Every form of model is an abstraction of some part of portraying reality from a perspective as well indicated in the ISO/IEC 42010 standard. It is this plurality that establishes the basis for discussion and dialogue that leads to understanding (individually and collectively).

So, I would suggest that the title of this Theme 4 is not correct. It should be something like:

- Towards paradigms for improving systems praxis, or
- Towards establishing a shared vision of systems praxis.

If we really want to revolutionize the perspective of systems praxis, it will require the use of multiple paradigms (not just a “language” based upon an ontology). This perspective that is applicable to science and is as well applicable to engineering was stated quite clearly by Kuhn (1962):

> ”a scientific revolution is defined by the appearance of new conceptual schemes or ‘paradigms.’ These bring to the fore aspects which previously were not seen or perceived, or even suppressed in “normal” science, i.e., science generally accepted and practiced at the time.”

My perspective in conveying multiple paradigms has been presented in the book “A Journey Through the Systems Landscape” Lawson (2010). My personal experience in conveying these paradigms have led to significant results for others in respect to collaboration, co-learning and co-evolving.

In conclusion I suggest that it is vital to focus on multiple, but a small number of paradigms in the form of understandable and applicable system related models in improving system praxis. This perspective will be supported during the discussions of this theme.

Reference

Kuhn, T.S. (1962). *The Structure of Scientific Revolutions*, Chicago, University of Chicago Press.

Lawson, H. and Martin, J. (2008). On the Use of Concepts and Principles for Improving Systems Engineering Practice, INCOSE International Symposium, Utrecht.

Lawson, H. (2010). *A Journey Through the Systems Landscape*, College Publications, Kings College, UK.

Senge, P.M. (1990). *The Fifth Discipline: The Art & Practice of The Learning Organization*, Currency Doubleday, New York.

Four Thought Patterns in Support of the Systems Approach

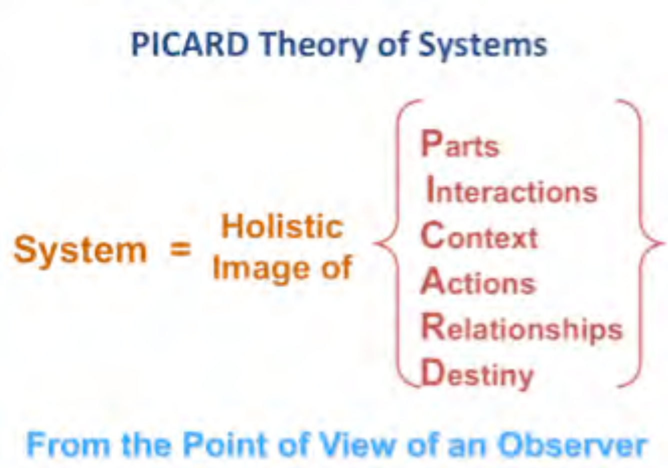
James Martin

I have a strong interest in characterizing the "nature" of systems to facilitate the creation of systems for the betterment of mankind. I have developed four thought patterns (or frameworks, if you will) to assist in the characterization of systems:

1. PICARD Theory
2. 7 Samurai Framework
3. PMTE Paradigm
4. Knowledge Pyramid

Each of these is summarized below. These have been found helpful in creating more successful systems since they enable better systems thinking about the problem situation and corresponding potential interventions in the problem space.

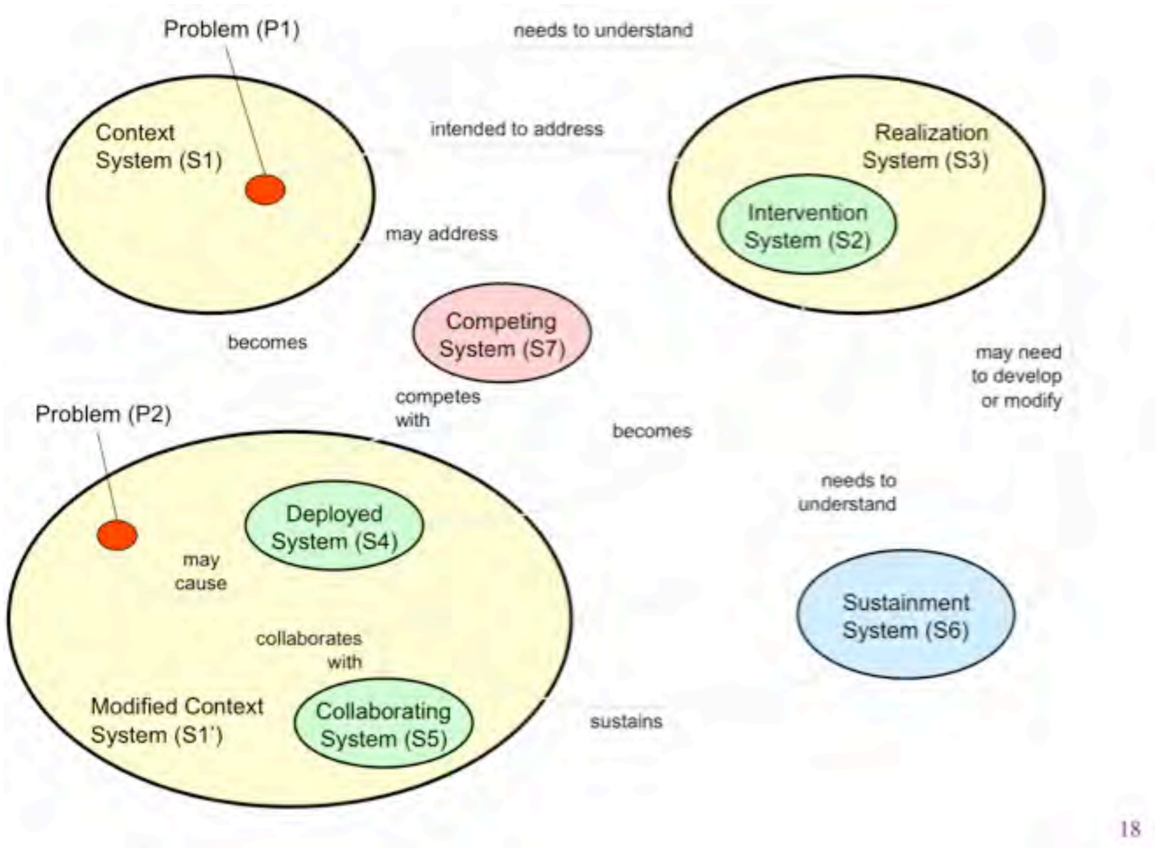
1. PICARD Theory. Systems might be composed of things that are real, but this does not necessarily mean the system itself has a reality of its own. The system is a particular set of attributes of a collection of things that interact or relate to each other in some manner. Since there are an infinite number of variables and constants associated with any one thing or collection of things, then it does not make sense that the "system" is all of these attributes. You must choose which attributes are of interest, which is another way of saying that we have a "system of interest."



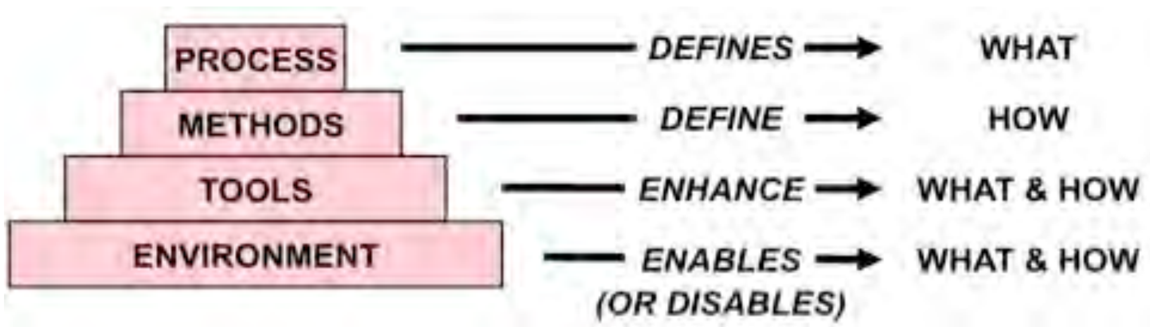
The choice of appropriate attributes to consider in the SOI entails the use of systems thinking. The PICARD theory (or systems thinking framework) is a way to characterize the different categories of "stuff" that can make up a certain system of interest. PICARD stands for parts, interactions, context, actions, relationships, and destiny, as illustrated above. (Martin 2007)

2. The 7 Samurai Framework. There are seven categories of systems that interact with each other as shown below. The main system to be engineered is the Intervention System (S2) that will be designed to solve a real or perceived problem. The Intervention System will be placed in a Context System (S1) and must be developed and deployed using a Realization System (S3). (Martin 2004)

The Intervention, when installed in the Context, becomes the Deployed System (S4) which is often different in substantial ways from the original intent of the Intervention. This Deployed System will interact with Collaborating Systems (S5) to accomplish its own functions. A Sustainment System (S6) provides services and materials to keep the Deployed System operational. Finally, there is one or more Competing Systems (S7) that may also solve the original problem and will compete for resources with your Deployed System. All seven systems must be properly reckoned with when engineering a system. The 7 Samurai framework can lead to a more holistic application of SE process, methods and tools.

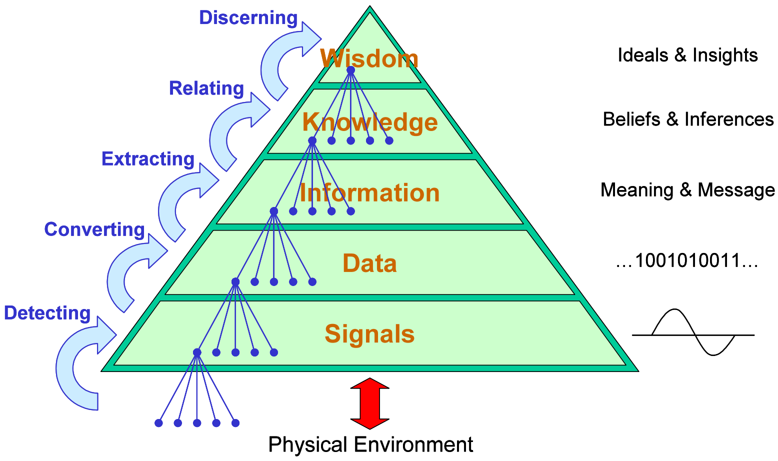


3. PMTE Paradigm. There is an intimate, supporting relationship among the PMTE elements shown below. These elements must be consistent with each other, and must be well integrated and balanced to achieve the greatest benefit from systems engineering practice. A process is executed using methods suitable for each process step. In turn, each method can be supported by one or more tools. A tool must be supported within a particular environment.



When the PMTE elements are not well balanced with each other this can often lead to “misfires” in the system creation effort. When introducing changes to any layer it is often necessary to make adjustments in the other layers of the PMTE stack.

4. Knowledge Pyramid. Many systems exist to help us increase our knowledge of the world in one way or another. Systems engineering needs a better way to understand how systems help or hinder the creation of knowledge. The Knowledge Pyramid was developed as a reference model to facilitate systems analysis with respect to signals, data, information and knowledge. (Martin 2006) Some systems do all their work at one level while other systems might span several levels. This pyramid has been especially helpful in understanding how to engineer enterprise systems since enterprises tend to operate in the upper half of pyramid. Technological systems usually operate in the lower half of the pyramid. (Martin 2006)



Summary. These four “thought constructs” have been found to be helpful in doing more complete, consistent and correct systems thinking. These are useful additions to any SE toolbox alongside other common tools and principles like the Zachman framework, GERAM (generalized enterprise reference architecture and methodology), STEEPLED (social, technological, economic, environmental, political, legal, ethical, and demographics), POSIWID (purpose of a system is what it does), IWKIWISI (I will know it when I see it), DOTMLPF (doctrine, organization, training, materiel, leadership, personnel, facilities), etc.

References

Martin, J. (1994). “The PMTE Paradigm: Exploring the Relationship between SE Process and Tools,” INCOSE Symposium.

Martin, J. (2004). “The Seven Samurai of Systems Engineering: Dealing with the Complexity of 7 Interrelated Systems,” INCOSE Symposium.

Martin, J. (2006). “Using the Knowledge Pyramid to Characterize Systems,” INCOSE Symposium.

Martin, J. (2007). “Systems are Imaginary—Systems are Not Real: On the Nature of Systems Thinking,” INCOSE Symposium.

Obstacles to a Unified Systems Praxis Ontology

Richard Martin

IFSR 2012 Team 4 topic: "Participants will seek to clarify the attributes of a language that most interested parties could adopt and employ and that proves necessary and sufficient for collaboration, co-learning and co-evolving in the system praxis field."

In 2003, ISO TC184/SC5/WG1 began an effort to consolidate the formally defined terms from the International Standards adopted by TC184/SC5 related to automation systems interoperability and related works of other IEC and ISO groups. The purpose of this effort was to allow those involved in the drafting, adoption, and revision of International Standards an opportunity to examine existing term definitions before they created new definitions. That effort culminated in a glossary published by ISO TC184/SC5 as N994 in 2010 that contains 327 different terms from 29 documents including 15 TC184/SC5 International Standards.[1] Definitions are annotated with the usage context and reference, and preferred definitions are identified for reuse where possible. All of these standards are related to various system engineering aspects of industrial automation systems.

The authors of the TC184/SC5 work conducted a stakeholder survey and analysis of term use in an attempt to better understand the difficulty authors and editors have with technology term reuse. Two additional publications resulted. The first was the ISO/TC 184/SC 5 N895 Vocabulary Study Group Final Report (2006) and the second was an IKSO 2006 Conference paper titled The Integration of Standards for Knowledge Organization in the Domain of Manufacturing Enterprises.[4] Both of these describe analysis and survey efforts associated with the preparation of the final glossary.

In about the same time frame, the IEEE Computer Society in conjunction with ISO/IEC JTC1 conducted a similar activity for the work products related to Information Technology identifying a Software and Systems Engineering Vocabulary that now is included in the IEEE Standards Dictionary of 29,000 terms.[2] Some of these IEEE related standards are also included in the TC184/SC5 N994 document. A distinguishing feature of this effort is the automated search interface that is provided online, now a common feature for dictionaries.

Another effort by ISO for its entire catalog of defined terms from 18,000 International Standards was launched in 2009 as the ISO Concept Database.[3] This online database of defined terms is similar in function to the IEEE work product in that keyword-based inquiry yields term definitions but in this case it is all definitions containing the keyword.

Two aspects of these three efforts are revealing: 1) none appear to be used by authors or editors of new works to actually reuse definitions across domains with few providing reuse even within domains; and, 2) most terms have several, sometimes conflicting, definitions. Given these observations, why might we expect that an effort to understand "the attributes of language that most interested parties could adopt and employ and that proves necessary and sufficient for collaboration, co-learning and co-evolving in the system praxis field" may yield substantive results?

We can observe that the three efforts above are addressing specific term use in a particular context. A technical term is to be defined whenever the use in a particular context, like an International Standard specification, deviates from the 'common meaning' of the term. The fact that most terms have several 'common meanings' tends to exacerbate the proliferation of specialized definitions. Even when pruning the potential meanings to the one chosen for use in the document, the tendency is to further embellish the term's definition and thereby specialize the specialization.

In addition, while the standard does specify a particular meaning for a term or phrase in the work, readers often re-interpret that same word or phrase when encountered in the text because there is no means for distinguishing the particular meaning when it appears – defined terms are not tagged in the text. After reviewing a technical specification for several hours and 70 pages or so deep into the specification, it is almost impossible to retain the special meaning intended for a particular word or phrase defined at the beginning of the document, especially if your practice ascribes a different meaning. We also note that writing style and translation idioms creep into the mix both for non-English speaking authors/editors and eventual users of the English or French text (most International Standards are published only in English unless they also are adopted as National Standards by a member Body of ISO or IEC).

The use of terminology in engineering disciplines is influenced by training, practice, and regional factors. The same can be said of terminology used in scientific disciplines. We are not going to 'standardize' term use precisely because of the need to communicate contextualized knowledge among people with very diverse backgrounds. Distinguishing terms in context is essential to knowledge transfer. However, we should be able to focus on those 'attributes of language' that do enable more productive communication and yet provide for suitable contextualization of use for specific terms and phrase.

Toward that end, we have examined several efforts to formalize expressions of ontology associated with both an "upper level" for use across all domains and domain specific works. An example of the later is the ISO 18629 series for a Process Specification Language (PSL). The underlying language used for PSL is KIF (Knowledge Interchange Format).

> "ISO 18629 specifies a language and ontology for the specification of processes, that is focused on, but not limited to the realm of discrete processes related to manufacturing, including all processes in the design and manufacturing life cycle. Business processes and manufacturing engineering processes are included in this work both to ascertain common aspects for process specification and to acknowledge the current and future integration of business and engineering functions."

PSL servers as a precise interface specification language, which machines can process for the exchange of process relevant information between those machines. PSL is a meta-language for the processes that are communicated across the interface. The ontological aspect of its specification helps to assure that the language is complete with respect to the domain that it serves.

At the other end of the spectrum for formalized ontology are several works, beginning with the early Greeks and continuing today. Upper-level ontology, i.e. those intended to serve all or at least most domains of discourse, have seen extensive efforts over the past 40 years. Of particular interest in the manufacturing domain is the work centered on the DOLCE effort at the Laboratory For Applied Ontology in Trento, Italy.

> "Developing foundational ontologies is not simple at all. We decided to describe first a core set of key ontological assumptions, focusing on the needs of other projects we were involved in, and reflecting our own choices and intuitions… This was the origin of DOLCE, whose acronym (Descriptive Ontology for Linguistic and Cognitive Engineering) reflects what we have called a cognitive bias. Since its first development, DOLCE was not intended as a candidate for a “universal” standard ontology, but rather as a reference module, to be adopted as a starting point for comparing and elucidating the relationships with other future modules of the library. Indeed, the public availability of DOLCE - since its first release – stimulated other research groups working on formal ontology to make their own ontologies available in the library as independent modules, although linked to DOLCE according to the WONDERWEB philosophy."

The attractiveness of this work is that it has focused on two domains of interest to system engineers. The initial DOLCE effort was sponsored by the WonderWeb research project funded by the IST Programme of the Commission of the European Communities with a focus on web services technologies.[5] The final project deliverable has an expression of DOLCE in KIF as well. An extension of the DOLCE effort focused on a series of workshops titled Formal Ontologies Meet Industry. These workshops examined the application of ontologies to a wide variety of industrial applications with an understanding that it is the domain specific use of an upper-level ontology that yields the value of that ontology. Like PSL, DOLCE identifies relationships among concepts with formal semantics suitable for application within domains, including inference.

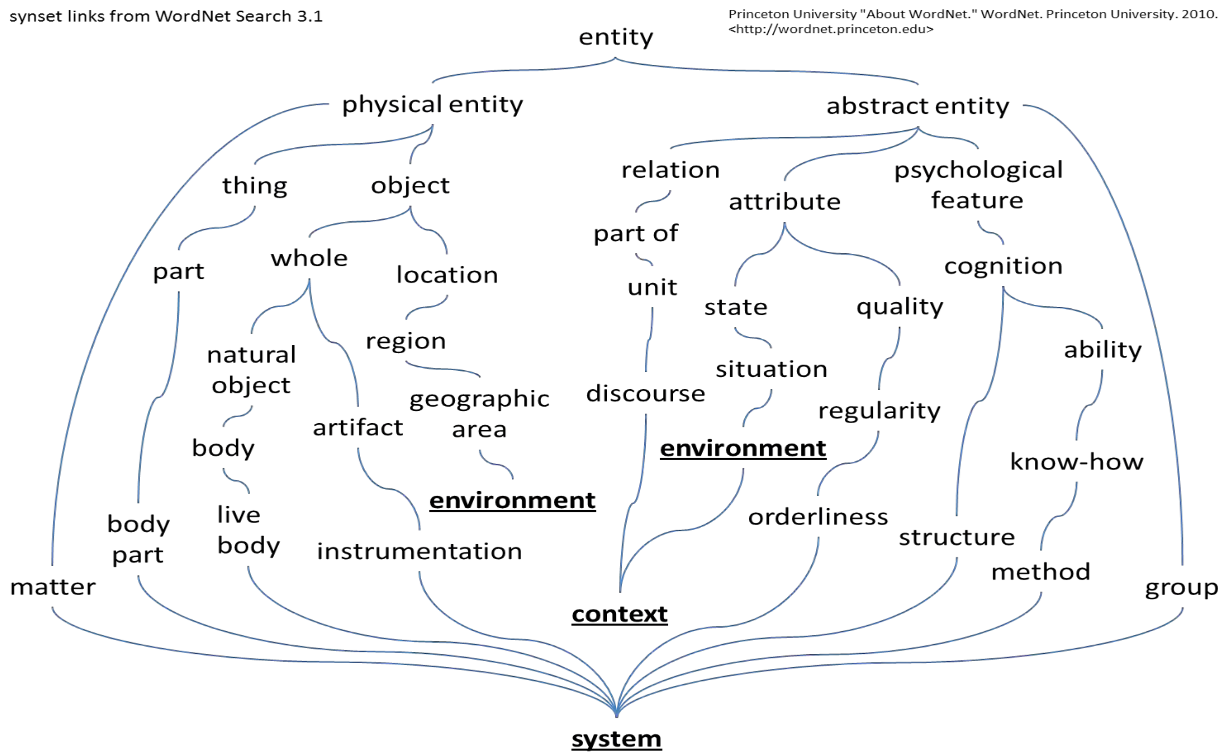
One other ISO effort is worth mentioning as an 'upper-level' formal ontology. The ISO 15926 Industrial automation systems and integration — Integration of life-cycle data for process plants including oil and gas production facilities series of International Standards specifies with formalization in the Express Language, standardized in ISO 10303-11, the ontology for use among a large industrial domain with a wide variety of sub-domains.

> "ISO 15926 is an International Standard for the representation of process plant life-cycle information. This representation is specified by a generic, conceptual data model that is suitable as the basis for implementation in a shared database or data warehouse. The data model is designed to be used in conjunction with reference data, i.e. standard instances that represent information common to a number of users, process plants, or both. The support for a specific life-cycle activity depends on the use of appropriate reference data in conjunction with the data model."

While the work is characterized as a 'data model' it is in fact an 'upper-level' ontology for use in defining application level data models for use within the industrial domain. Of particular note is the ontic commitment to what is often called a 4D approach that explicitly considers all physical things in both space and time. This approach is consistent with the DOLCE foundational ontology as described below:

> "In general a 3D option claims that objects are: a) extended in a three-dimensional space; b) wholly present at each instant of their life; c) changing entities, in the sense that at different times they can instantiate different properties (indeed, one could say When I was out in the balcony my hands were colder than now). On the contrary a four dimensional perspective states that objects are: a) space-time worms; b) only partially present at each instant; c) changing entities, in the sense that at different phases they can have different properties (My hands during the time spent out in the balcony, were colder than now)."

Finally I want to examine one last ontological effort that is helpful in making my closing cautionary comments. WordNet is a project maintained by Princeton University that is a lexical database of English with nouns, verbs, adjectives and adverbs grouped into sets of cognitive synonyms, which results in a network of meaningfully related words and concepts.[6] Below is one of those networks emphasizing the words 'system', 'environment', and 'context'. These words were chosen to relate because of their importance to system engineering and system science.



When we talk about the 'context of a system', to which of the 4 paths from 'system' are we referring or are we referring to a different path altogether? Or are we referring to one of the 5 paths from 'context' to 'system'? The triple depicted on the System Cmap is <System, bounded by, Context>. Notice that according to WordNet, context must be an abstract entity rather than a physical entity but I am certain that many system engineers consider 'context' to be a physical attribute of 'system' – a path not found in WordNet. Which of the terms above should we ascribe to the phrase 'bounded by' in our Cmap?

Each of these 'upper-level' examples does not specify the terminology of the domain but does specify likely classifiers and relationships among those terms that users should investigate. Most often the result of that investigation is not a formal domain specific ontology but rather a loose taxonomy of terms and phrases with associated definitions that are domain relevant. It is in this direction that the System Sciences Working Group project Toward a Unified Ontology for Systemists has proceeded. The five conceptual maps (Cmaps) presented at the INCOSE IW2011 workshop represent the current state of our understanding of the five primary terms System, System_Engineering, Praxis, Model, and Fault_Detection_and_Correction.

Are these taxonomies already over-specialized for the breadth of the SE domain? Does adding more terms and relations among them move us toward more general application of the terms to SE and SS or toward more specialized use of the terms where selected portions of the taxonomy can be applied to sub-domains? To move toward a Unified Ontology of any kind, we must focus not on the uses of terms common to our discourse but rather we must focus on the qualities we want those terms to bring to that discourse.

References

[1] http://isotc.iso.org/livelink/livelink?func=ll&objId=8838827&objAction=browse&sort=name

[2] http://dictionary.ieee.org/dictionary_welcome.html

[3] http://www.iso.org/iso/concept_database_cdb.htm

[4] Loehrlein, A., Martin, R., Robertson, E. (2006). The Integration of Standards for Knowledge Organization in the Domain of Manufacturing Enterprises in Budin, G., Swertz, C., Mitgutsch, K. *Knowledge organization for a global learning society: Proceedings of the Ninth International ISKO Conference* (Vienna, Austria, July 4-7, 2006). Advances in knowledge organization, no. 10. Wurzburg: Ergon.

[5] Masolo, C., Borgo, S.,Gangemi, A., Guarino, N., & Oltramari, A. (2003). Wonderweb deliverabled18. Available at http://www.loa-cnr.it/Papers/D18.pdf.

[6] http://wordnet.princeton.edu/wordnet/

An Empirical Taxonomy of Modeling Approaches

Janet Singer

People who work with models at the metalevel—whether to develop knowledge bases or to design tools that help people do modeling—require a systematic, unified framework within which they can operate. This framework should encompass informal as well as formal, and qualitative as well as quantitative, modeling approaches. It should facilitate the development of systems such as modeling resources that can support a user throughout the modeling process, from the earliest exploratory stages through the highest levels of specialized analytic techniques.

The use of knowledge requires the use of models, but we lack a coherent understanding of the relationship between the two. There is no general agreement on what a model is. To many scientists, the word "model" refers specifically to a computer simulation. To a mathematician, a model is a system of equations. To a logician, a model of a formula of a language is an interpretation of the language for which the formula comes out true. According to the O.E.D., a model is "a representation of structure" or "something that accurately resembles something else."

Standards of terminology, method and evaluation criteria for modeling are well developed within certain narrow domains. These domains are determined by such factors as formal characteristics of the model (linear v. nonlinear, etc.), domain of application (econometric v. ecological, etc.), and techniques of analysis (regression v. linear programming, etc.). Yet there are no standards that hold across these domains, and there is no framework that indicates how the standards that do exist relate to one another.

It has not been possible to bridge the gulfs between these domains to construct a unified framework that showed the relationships between the formal, functional, structural and behavioral characteristics of models and modeling approaches.

A unifying framework can be provided by seeing models as the results of the modeling activities of situated rational agents. The formal characteristics of the models, their domains of application, and the techniques used to analyze them are then seen to be the results of decisions made by the agent during the modeling process (consciously or not). The presence or absence of these features is therefore dependent on the factors which influenced those modeling decisions. The fundamental basis of a comprehensive and unified taxonomy of modeling approaches across domains should be those features of situation, motivation, and resource constraints which influence modeling decisions.

Questions To Be Considered

Theoretical questions:

- What is a model?
- Are all representations models?
- Is a measurement a model?
- Is a metaphor a model?
- What are the syntax, semantics, and pragmatics of modeling?
- Are the syntax, semantics and pragmatics of modeling necessarily domain dependent, or can they be defined in a way that is (for all practical purposes) domain invariant?
- How are speech acts related to modeling acts?
- How is knowledge related to models?

- Is it possible to use knowledge without relying on the context of one or more models (e.g., a “world” model)?
- Does knowledge originate in any way other than through modeling?
- Does a collection of facts and rules in a knowledge base somehow “induce” one or more models?
- How are exact models related to fuzzy models?
- How are formal models related to informal models?
- How are implicit models related to explicit models?
- Is an explicit model always understood within the context of one or more implicit models—within a hierarchy of nested models?

Empirical questions:

- Under what conditions of situation, motivation and resource constraints do people generate and use models?
- What phenomena do they model?
- What are their motivations and objectives—implicit as well as explicit?
- What kinds of tradeoffs do they make to meet their objectives?
- What language do they use to discuss modeling?
- What kinds of representations do they use?
- What are their methods for model generation?
- What are their methods for model transformation and analysis?
- How do they use the results of their modeling activities?
- What are the decisions/choices that they make during modeling and what are the criteria that they use to make these decisions?
- What are the criteria they use to evaluate the results of their work?

Practical questions:

- How do the evaluation criteria identified in the taxonomy (accuracy, reliability, maintainability, efficiency, usefulness, controllability, observability, robustness, stability, sensitivity, specificity, significance, etc.) relate to features of situation, motivation, and resource constraints?
- How does the model of modeling behavior implicit in the taxonomy evaluate as a resource for designing modeling tools and knowledge bases according to the above evaluation criteria?
- What are the consequences of different kinds of errors (sampling, sample design, biased measurement, non-conformable measurement, data handling, classification, formulation, logical, procedural, random, deliberate, etc.) for the types of models identified?
- Under what conditions is it meaningful/useful to use the output of one model as the input to another?
- Under what conditions is it meaningful/useful to use intermediate results from one model as the input to another?
- What kinds of conditions/assumptions make models incompatible or compatible?
- How do the results of this study relate to current controversies in statistical meta analysis?
- If the design of a knowledge base entails the design of implicit models, what design criteria should be followed to ensure that these models are optimally suited to the intended uses (and users) of the knowledge base?
- What information regarding the origin of a particular item of knowledge should be encoded in a knowledge base to ensure that if it is used in modeling, the kinds of errors for which that modeling activity has low tolerance are not compounded?
- What information regarding the origin of a particular item of knowledge should be encoded in a knowledge base to allow for the optimal intelligent use of the knowledge base, and how should users be trained to this end?
- When is knowledge most robust to variation in modeling conditions and how can knowledge representations be designed to enhance this robustness?
- How can resources be developed to help users make good modeling decisions in all types of situations?

Appendix: What is the IFSR?

The Founding of the IFSR

Global conflicts like World War I and World War II, the related economic and social crises, social unrest, global interaction of powers, and the fragmentation of science made far –thinking scientists aware that a new paradigm for analyzing, understanding and hopefully ameliorating world problems. Scientists such as Ludwig von Bertalanffy, Norbert Wiener, and their colleagues found a response to these problems: holistic rather than fragmented, linear thinking, decision-making, and acting. They established two sciences to support humankind in the effort of meeting this end as a promising alternative to local and worldwide crises. These sciences were *Systems Theory* and *Cybernetics*. System was and is the word characterizing this new paradigm: Considering the whole and avoiding one-sidedness in order to survive.

From this combination most modern approaches, most modern knowledge in all spheres of human activity, solutions to environmental problems, etc., most of the existing problems can be ascribed to a lack of systemic thinking this combination, and there are many around that can hardly be solved without systems thinking and creative co-operation of diverse specialists. Our responsibility for the future obliges us to try to improve the current situation and not to leave an excessive burden to future generation.

In the early 50's of the past century few scientists and societies were explicitly working in the field of Systems Sciences and Cybernetics. It was decided to interlink these societies and all groups of system thinkers around the world in order to try to find answers to some of the pressing problems of the world.

On March 12, 1980 during the 5th EMCSR-Congress in Vienna the then three important societies in the area of Systems Research, the *Österreichische Studiengesellschaft für Kybernetik*, the *Systemgroup Nederland*, and the *Society for General System Research* founded the *International Federation for Systems Research.* The key persons were: Robert Trappl, George J. Klir, Gerard de Zeeuw. They became the first officers of the IFSR (see IFSR Newsletter vol. 24, no. 1 (nov. 2006), [http://www.ifsr.org/newsletters]).

Strong support came from the then Austrian Ministry of Science and Research in the person of Norbert Rozsenich who gave strong encouragement and provided financial support. F. de P. Hanika accepted the responsibility of Editor-in-Chief of the Newsletter of the IFSR.

Aims and Goals of the IFSR

The constitution of the Federation states:

The aims of the Federation are to stimulate all activities associated with the scientific study of systems and to co-ordinate such activities at the international level by:

- co-coordinating systems research activities of private persons and/or organizations;
- organizing international meetings, courses, workshops, and the like;
- promoting international publications in the area of systems research;

- promoting systems education;
- maintaining standards and competence in systems research and education; and
- any other means … [to] serve the aims of the members.

The first Board Meeting in June 1980 defined the Federation's goals:

- **Social Learning Goal**: Strengthen the programs of member societies by their involvement in the program and network of IFSR.
- **Membership Development Goal:** Facilitate (encourage) the development of Systems science in countries in which such programs do not yet exist or are now developing.
- **Synergetic Goal:** Develop – implement – evaluate IFSR-level programs to meet the purposes of IFSR to advance systems science.
- **Resource Development Goal:** Identify an inventory of system science relevant resources, acquire those and make them accessible to member societies.
- **Global Mission:** Make contribution to the larger (global) scientific community, be of service to improve the (global) human condition, and enrich the quality of life of all.

Officers of the IFSR

The current officers (2012 -2014) of the IFSR are:

Dr. Gary S. Metcalf	InterConnectionsLLC, USA	gmetcalf@interconnectionsllc.com
Prof. Dr. Yoshihide Horiuchi	Shibaura Institute of Technology Tokyo, Japan	horiuchi@sic.shibaura-it.ac.jp
Mag. Stefan Blachfellner	Stefan Blachfellner Consulting, Austria	stefan@blachfellner.com
Prof. Dr. Gerhard Chroust	J. Kepler University Linz, Austria	Gerhard.chroust@jku.at

IFSR Activities

The IFSR pursues successfully numerous activities:

- The *International Academy of Systems and Cybernetics,* founded in 2010 by the IFSR, with Robert Trappl as its current president provides a forum for persons professionally excelling in research and teaching of Systems Sciences and Cybernetics (http://www.iascys.org/).
- *Systems Research and Behavioural Science (*ISSN 1092-7026), the official scientific journal of the IFSR, edited by Michael C. Jackson, published since 1984 (http://eu.wiley.com/WileyCDA/WileyTitle/productCd-SRBS.html).
- *International Series on Systems Science and Engineering*, IFSR's book series, established in 1985, edited by George J. Klir, now published by Springer, New York (http://www.springer.com/series/6104).
- The yearly *IFSR Newsletter*, the informal newsletter of the IFSR (hard copy: ISSN 1818-0809, online: ISSN 1818-0817), published once or twice a year since 1981, edited by Paul F de. P. Hanika (1981-1985), Robert Trappl (1985), Steven Sokoloff (1986 – 1994), and Gerhard Chroust (since 1993), see http://www.ifsr.org/newsletters.
- The I*FSR* web-site (http://www.ifsr.org) informing the world about the Federation's activities
- *The IFSR Conversations,* taking place every other year since 1982 (initially held in Fuschl near Salzburg, Austria) convene 30 systems scientist from around the world to discuss systemic issues relevant for the mankind, society and the environment, http://ifsr.org/node/33.
- Support for other events (e.g. the EMCSR-conference in Vienna every second year)
- Sponsoring a bi-annual Ashby-lecture at the European Meeting on Cybernetics and Systems Research (EMCSR)

Future Plans

More than ever Systems Sciences are seen as a basis for balancing the divergent needs and interests between individuals and society worldwide, between ecology and economy, between nations of various levels of development and between differing worldviews.

The IFSR commits itself to increase its contributions answering the needs as expressed in its original aims and goals. Some new activities, in line with the needs and the challenges, have already been started:

- The *Bertalanffy Library*: In cooperation with the Bertalanffy Center for the Study of Systems Science (led by W. Hofkirchner) the IFSR will both help to preserve, revive and disseminate systems concepts and knowledge in general and L. v. Bertalanffy's ideas and work on General Systems Theory in particular.
- *The International Encyclopaedia of Systems and Cybernetics b*ased on Charles Francois' seminal International Encyclopedia of Systems and Cybernetics. This work will be continued, supplemented electronically as an attempt to clarify and reduce

inconsistent terminology and semantics in the field.

- *Systems. connecting matter, life, culture and technology: In cooperation with* the Bertalanffy Center for the Study of Systems Science the IFSR supports the establishment of an international peer reviewed open access journal as a vital node to foster the sytems movement, accessible for free to all members and everyone interested in systems research. Many member organizations are involved in this project as associate editors, for more details visit http://www.systems-journal.eu/about/editorialTeam (work in progress)
- *Supporting our member societies* in organizing conferences and workshops.
- *Fostering the outreach of the IFSR and our member organizations* with the relaunch of our website, a new digital newsletter and several social media activties.
- *Fostering the decision processes of our members and jointly working for* the establishment and maintenance of a collaborative e-democracy tool to meet the Social Learning and Synergetic Goal.
- *Developing new services for our members* to meet the Resource Development Goal, to identify an inventory of system science relevant resources, acquire those and make them accessible to member societies.
- *Developing an enhanced business model* aligned to the IFSR services.
- *Promote the IFSR as the global umbrella organization* of the systems movement and attract new members to the Federation to meet the Membership Development Goal.
- *Develop and support the global dissemination of the systems conversations* to curate the conditions that will support the Global Mission of the IFSR.

Past Officers of the IFSR

Many prominent system scientists have been officers of the IFSR since 1980

starting	***President***	***Vice-President(s)***	***Secretary/Treasurer***
1980	George J. Klir	Robert Trappl	Gerard de Zeeuw
1984	Robert Trappl	Bela H. Banathy	Gerard de Zeeuw
1988	Gerrit Broekstra	Franz Pichler	Bela Banathy
1992	Gerard de Zeeuw	J.D.R. De Raadt	Gerhard Chroust
1994	Bela H. Banathy	Michael C. Jackson	Gerhard Chroust
1998	Michael C. Jackson	Yong Pil Rhee	Gerhard Chroust
2000	Yong Pil Rhee	Michael C. Jackson	Gerhard Chroust
2002	Jifa Gu	Matjaz Mulej Gary S. Metcalf	Gerhard Chroust
2006	Matjaz Mulej	Jifa Gu, Gary S. Metcalf	Gerhard Chroust
2008	Matjaz Mulej	Yoshiteru Nakamori Gary S. Metcalf	Gerhard Chroust
2010	Gary S. Metcalf	Kyoichi Jim Kijima Amanda Gregory Leonie Solomons	Gerhard Chroust
2012	Gary S. Metcalf	Yoshihide Horiuchi Stefan Blachfellner	Gerhard Chroust

Member societies of the IFSR

The IFSR has shown a healthy growth with respect to the number of members. Currently it has 39 member societies, representing scientists from 24 countries on most continents [in brackets the membership number]. For the most recent list see http://ifsr.ocg.at/world/node/3.

ASC: American Society for Cybernetics [no. 7]

GESI: Asociacion Argentina de Teoria General de Sistemas y Cibernetica [no. 5]

ALAS: Asociacion Latinoamericana de Sistemas [no. 38]

AMCS: Asociacion Mexicana de la Ciencia de Sistemas [no. 37]

Asociacion Mexicana de Sistemas y Cibernetica [no. 19]

AFSCET: Association Francaise des Sciences et Technologies de l'information et des Systemes [no. 11]

ANZSYS: Australian and New Zealand Systems Group [no. 33]

BCSSS: Bertalanffy Center for the Study of Systems Science [no. 41]

BSSR: Bulgarian Society for Systems Reseach [no. 30]

BS-LAB: Business Systems Laboratory [no. 48]

CHAOS: Centre for Hyperincursion and Anticipation in Ordered Systems [no. 28]

HID: Croatian Interdisciplinary Society [no. 44]

GfK: Deutsche Gesellschaft fuer Kybernetik [no. 34]

GWS: Gesellschaft für Wirtschafts- und Sozialkybernetik [no. 12]

GIFT: Global Institute of Flexible Systems Management [no. 32]

Greek Systems Society [no. 14]

Heinz von Förster Gesellschaft [no. 42]

HSSS: Ελληνική Εταρεία Συστημικών Μελετών (Hellenic Society f. Systemic Studies) [no. 36]

IAS: Instituto Andino de Sistemas [no. 26]

IIGG: International Institute Galileo Galilei [no. 45]

IIIS: International Institute of Informatics and Systemics: IIIS [no. 39]

INCOSE: International Council on Systems Engineering [no. 46]

ISSS: International Society for the Systems Sciences [no. 3]

ISKSS: International Society of Knowledge and Systems Science [no. 35]

RC51: International Sociological Association , ISA-RC51 on Sociocybernetics [no. 40]

ISI: International Systems Institute [no. 4]

JASESS: Japan Association for Social and Economic Systems Studies [no. 31]

MSSI: Management Science Society of Ireland [no. 29]

META PHORUM: Metaphorum Group [no. 47]

OSGK: Oesterreichische Studiengesellschaft für Kybernetik [no. 1]

Pentagram Research Centre Private Limited [no. 43]

PSS: Polish Systems Society [no. 23]

SDSR: Slovenian Society for Systems Research [no. 25]

SESGE: Sociedad Espanola de Sistemas Generales [no. 13]

SGN: Systeemgroep Nederland [no. 2]

SESC: Systems Engineering Society of China [no. 21]

The Cybernetics Society [no. 9]

KSSSR: The Korean Society for Systems Science Research [no. 22]

The Learned Society of Praxiology [no. 16]

The aim of the Sixteenth IFSR Conversation in 2012, held in St. Magdalena, Linz, Austria in April 2012, was to continue the tradition of Conversation that had been established in 1980, stressing face-to-face discussions on the chose topics.

The overarching theme for the conversation was how to reposition systems thinking in a changing world both with respect to scientific research and practical applications, in view of historical roots and the precarious situation of our environment.

The deliberations of the 4 teams supported the over-all theme in different ways:

- Revisiting the socio-ecological, social-technical and socio-psychological perspectives
- Science II - Science Too!
- Designing Learning Systems for Global Sustainability
- Towards a common language for systems praxis.

The Conversation was able to build on previous and ongoing work within the member organizations of the IFSR. The outcome of this Conversation, while at a high conceptual level, also supports and encourages further practical applications through individual member activities.

The Conversations essentially followed the successful scheme used in earlier Fuschl Conversations as devised by Bela H. Banathy in 1981. 30 renowned systems scientists and systems practitioners from 9 countries took part in this 5-day cooperative effort. The outcome of the conversation is summarized in 4 team reports plus several contributed papers. A short description of the IFSR's activities completes the proceedings.

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