Our Heritage of 'Whole/Integral System' Organization Design

A. THE DEVELOPMENT OF OUR "HERITAGE"

The Tavistock Institute of Human Relations (London, England) is itself an innovative organization that came into existence in 1946 in response to critical problems in society after major upheavals of the industrial age and two world wars – a time of societal chaos and conflict – resulting in a society that was puzzled, bewildered, intrigued and frightened by this scope of change to many aspects of life. Tavistock members saw this as a time of transition where people could reconnect to untapped possibilities in order to imagine more relevant future structures because the current societal paradigm – hierarchy and centralization, clear, predictable cause-and-effect relationships and efficiency – no longer worked effectively.

The state of knowledge in many disciplines seemed inadequate to respond to the challenges so the tolerance of different viewpoints became the norm at Tavistock and it functioned as a mediating institution. The members of the various disciplines held together through participation in common research tasks in an action frame of reference later called "action research". By learning each other's perspectives, knowledge and skills, they became what Trist called a "composite work group" of disciplines that included psychology, anthropology, sociology, economics, education and mathematics. Their collective experience generated a "whole/integral" organization design approach.

During what has been described as a "pioneering" phase of action research (1949-1959), they worked in settings such as British coal mines and Indian textile mills. Then, in a "classical" period (1959-1971), they led experiments in Norwegian paper, metal, and chemical industries. What emerged was a "**basic shift in organizational paradigm**" that was contrary to previous paradigms (Scientific Management: Taylor, 1911; Human Relations: Mayo, 1933) that had emphasized *either* the technical *or* the social aspects of an organization--in the Tavistock approach, *both* factors were "integrated as…components of one single socio-technical entity" (van Eijanatten, 1993).

Post 1971, when this new organizational paradigm was applied in expanded socio-economic contexts, "modern" Socio-Technical Systems Design (STSD) evolved with "amendments". Different development trajectories emerged (in Australia, the Netherlands, Scandinavia, and North America). Languages and concepts differ in these various "schools" of STS Design. Yet, all of these approaches are still "rooted in the Tavistock tradition" (de Sitter, 1994), with a focus on achieving organizational excellence in both technical performance and the quality of people's lives (van Amelsvoort, 2013).

Now in the **new millennium**, we believe the core Socio-Technical Systems Design (STSD) paradigm is still relevant. However, the theory and design process need to be reinterpreted to better navigate and prosper in a digital, hyper-connected, and time-compressed world. **The SmarT Organization Design Global Network** hopes to accomplish this reinvention of our heritage AND grow our network of Open Socio-Technical Systems Design (STSD) adherents. We aim to connect with yet another wider 'universe' of others who share our ideals in action research. We want to learn from each other's practices and enlarge the ecosystem of practitioners and theorists who believe that "humanism and effectiveness can and must be thought of as linked together in the design of work and work systems" (Pasmore, 1995).

2. THE TAVISTOCK APPROACH – ACTION RESEARCH THROUGH THREE INTEGRATED PERSPECTIVES

The origin of the Socio-Technical Systems Design (STSD) paradigm is closely linked to the methodology of inquiry and discovery process practiced by scientists at the Tavistock Institute. The intention of the Tavistock Institute was to actively relate the social sciences to the needs and concerns of society through a practice called 'action research'. The ambition was to tap into the social imagination of the people doing the work – who were' in the action' – supported by the social science knowledge of the researchers. Action Research embodies a philosophy, an organizing model, and participative methodology. These elements were intentionally not fully codified so that both theory and practice could evolve.

Action Research is a dialectical theory development process that has the ability to hold two seemingly contradictory elements together: (1) research's evidence-based models that give everyone the benefit of collective intelligence of what is the 'right' paradigm/principles for social thriving AND (2) dialectical logic that embraces the idea that human living is full of contradictions and varying contexts. Consequently, action research is a process of learning to encourage people to develop confidence in their own independence of mind and spirit, to play with new ideas, to challenge accepted knowledge, and to resist all efforts by others in their social contexts to bring their thinking to closure without their consent. Thus, it requires the direct participation of all those who are key stakeholders in the system to be changed. It is a form of research which can be undertaken by people in any context, regardless of status or position. It involves everyone in a system thinking carefully together about what they are doing, so it can also be called a self-reflective practice.

As well as tacitly embedding direct participation as a key feature of the Socio-Technical Systems Design (STSD) paradigm, Tavistock's action research evolved and was strongly influenced through three distinct "**perspectives**" or ways of knowing and "engaging" with the world. These perspectives are all linked and related to comprehensive organization design (Trist, Emery & Murray, 1990-1997)).

Initially, the formulation of concepts was conducted through the lens of a psycho-analytical orientation based on the work of Klein, Bion, and Lewin, much of it related to group dynamics and field theory. Soon thereafter, Emery and others at Tavistock were inspired by systems thinking, particularly von Bertalanffy's work on open-systems in physics and biology. And, eventually, the Tavistock researchers needed to extend their systems framework drawing on the work of Chein, Sommerhoff, Angyal and others to create a third perspective—the socio-ecological--focused on systems *and* their environments.

Developed during the 'pioneering' and 'classical' phases of Tavistock's action research in organization design, these three perspectives—**socio-psychological perspective, socio-technical systems perspective, and socio-ecological perspective**—were elaborated continuously during the 'modern' period. These perspectives constitute the conceptual foundation of the Socio-Technical Systems Design (STSD) paradigm--linking the individual to the group, the group to the organization, and the organization to its environment—with an integrating participative design process that combines innovative design principles with most valuable local experience and knowledge.

3. PARTICIPATIVE DESIGN

Direct participation in design was tacitly present in the action research process itself during the 'pioneering' phase of Tavistock's development of the Socio-Technical Systems Design (STSD) paradigm. It became more explicit in the 'classical' phase (especially in the 'Industrial Democracy' project led by Fred Emery and Einar Thorsrud in Norway, 1962-69).

Very soon thereafter following his return to Australia in 1969, Emery and his wife Merrelyn developed the first comprehensive participative approach. Eventually, in the 1990's, this became known as the "two-stage model" of design, beginning with a Search Conference (SC) building a directive correlation between the system and its environment, and then, the Participative Design Workshop (PDW) building a directive correlation between people and the work. The PDW helps workers to see their world using three key concepts—open systems theory, psychological criteria for healthy work, and a choice of design principles 1 (bureaucratic) & 2 (adaptive/ complex) for coordination and control—and provides a thinking space for collective deliberation in which co-creation can occur.

Later in the 'modern' period of Socio-Technical Systems Design (STSD), there emerged other large group participative design processes such as the program of "Democratic Dialogue" developed in Norway and Sweden (Gustavsen et al., 1991) for intra-organizational and inter-organizational learning and co-creation between management and workers at all levels and areas of an enterprise, and beyond. Similarly, in North America, Dick and Emily Axelrod developed a "conference model" (1998), seeking to "move beyond the few who design for the many and engage significant portions of the organization" in system-wide design. (Other North American forms of large group processes of "whole-scale" design were also developed in the 1980's and 1990's (Dannemiller; Lytle; Mohrman & Mohrman) to address simultaneous needs for more effective diffusion of innovation and accelerated implementation of change.)

The link between a participative process and the content of Socio-Technical Systems Design (STSD) was further strengthened by the work of Albert Cherns (1976), who distilled the writings of Tavistock researchers (Trist, Emery, Herbst, et al.) in a set of nine "Principles of Socio-Technical Design". The first principle is "Compatibility", the requirement that for construction of a participative organization, a necessary condition is that "people be given the opportunity to participate in the design of jobs they are to perform". Cherns also proposed principles of 'Incompletion' and 'Minimal Critical Specification', advocating that design identify what is absolutely essential (and no more) so that options remain open to address the needs of future job-holders and future contingencies.

Even though Modern Sociotechnical Theory (MST) as developed in The Netherlands has its own distinct set of "design rules", Ulbo de Sitter (1994) advocated for a view similar to Cherns' principle of "compatibility", as expressed by de Sitter's fellow countryman, Hans van Beinum (1993) that "organization design can only be authentic and effective under the condition that the very process of design shows the same features as the desired final state, i.e. participation, self-regulation, and local autonomy". Indeed, all variants of 'modern' STSD practice some form of *participative design*, which involves data gathering by stakeholders, their reflection on the action as it is presented through the data, their generating evidence from the data, and making claims to knowledge based on conclusions drawn from validated evidence.

Fundamentally, design arises from different visions of people. One vision of design says that one person may observe another and make judgments about their practice. This view assumes that ordinary people are not able to speak and act for themselves, and need to be guided by experts and their tools.

Another vision says that all people, including 'ordinary' people, are capable of running their own lives and making judgments about the quality of their relationships with others. This means not only honoring the right of people to speak and act on their own behalf, but also of creating opportunities for them to do so in community – this is the true meaning of participative design. This is what was espoused by the Tavistock Institute, especially by Emery and Trist who undertook research to help them learn how to create "social hope"—(Eric Trist wrote about "New Directions of Hope")--so as to take action to try to realize the hope in terms of social evolution.

Social change begins in people's minds as they make choices about which values to espouse and how to live in the direction of those values. Such choices are not easy as people live in an existing organizational environment, which acts as a 'filter', defining a framework of options and constraints. The participative design process illuminates that filter to allow the collective to acknowledge their choices so as to avoid disappointing illusions in the process and maintain their hope.

Kurt Lewin's model of action research defined participative design practitioners as reflective practitioners who conduct their own self-study and hold themselves accountable for their own influence. Other core skills are essential, such as a collaborative approach to problem-solving, ideally with an understanding of group dynamics, and an ability to combine advocacy with inquiry. By definition, participative design is about finding ways of accommodating multiple values, disciplines, and perspectives. This requires self-aware organization design practitioners to care about diversity of viewpoint, to invite multi-disciplinary thinking, and to make the effort to recognize and suspend their own prejudices so as to understand the other's point of view.

Participative Design is vital for people to achieve a holistic, whole system view of the work done in each of the perspectives and levels of designing the organization. The process integrates the work of the perspectives — harmonizing the three perspectives with each other as each leverages the other — reinforcing whole system design of micro, macro, and meta levels. People work primarily at one level and are not purview to the other levels and how they function, so participative design is vital for them to see all three levels as a whole and thereby make their own choices coherent with the whole.

Finally, participative design helps participants transition from perspective to perspective so they can process what they have become aware of in each lens and prepare for the whole transformation experience in the most optimized manner. The process is dynamic and able to shift as participants decide how to transform and adapt to a continuously changing environment. The goal is not to design only one worthwhile intervention in one perspective, but to design a flow of worthwhile interventions woven into a meaningful and uplifting transformational journey — a sum that is greater than its parts.

4. THREE INTEGRATED PERSPECTIVES

The three perspectives in simple terms are outside-in (socio-ecological), inside-out (socio-psychological), and structural (socio-technical) lenses that were widely adopted in the last fifty years as methodologies by many disciplines. However, they were rarely integrated in a holistic participative organization design process. The three perspectives are interdependent, yet each has its own focus or lens. The only way to successfully design a new social paradigm in a turbulent, complex world is to understand each perspective at the micro/work system, macro/organization and meta/ecosystem & societal levels. This presents the unique pattern of the context you are designing for and gives everyone clarity of the whole.

A learning culture is a resilient culture. It's about building the muscles people and teams need to respond differently to workplace stressors, even the unexpected ones. That requires working with the stressor rather than avoiding it, and leveraging the learning—making it part of how the team operates—so the team is more adaptable when the next stressor comes along. The three perspectives at the three levels are those muscles. When the perspectives are integrated and aligned, the result is a truly potent synthesis of social imagination capable of navigating a white-water world.

A. Socio-Psychological Perspective

The Socio-Psychological Perspective is about what individuals need for agency to thrive as a group, with culture as the 'bridge' in the dynamic relations between the individual and the social entity.

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. These concepts were developed during war-time and immediate post WWII projects in Social Psychiatry and Leadership Selection processes; Group Process in primary groups; Family Studies; Transitional Communities, and dynamics of Organizational Change.

One of the fundamental sources was the work of Bion (psychoanalytic object relations theory) in his study of the Experience of Groups and what he termed the "group mentality," and the way in which it might express itself as the "group culture". Bion's further experience revealed patterns of behaviour that gripped the group into a specific group mentality in opposition to the work/task activity—Bion named these patterns "basic assumptions" (of dependence, of fight/flight, and of pairing).

Lewin's seminal work in 'field theory' was on group decision making and the dynamics of social change. His dictum, that the best way to understand a system was to change it, gave prime importance to action research. Lewin and Bion played central roles in the foundation of the "Group Relations" program that became part of the "Tavistock tradition" in which insight into the conscious and unconscious dynamics of groups was seen as a prerequisite for development of viable institutions (M. Sher, 2013).

One of the most important concepts to emerge from this action research (particularly in the Tavistock coal mining studies) was the work of Trist, indicating how "psychological forces, unconscious and

conscious, at the level of the group, interacted with structural forces to bring into existence a "field" with dynamic patterns of behavior specific for a given social situation". In the paper, "Culture as a Psycho-Social Process", Trist recognized the point that Asch (1952) was to spell out two years later that the relation of the individual to the social group is "a type of part-whole relation unprecedented in nature. It is the only part-whole relation that depends on the recapitulation of the structure of the whole in the part". Culture had to be the bridge, the active process of recapitulation. *"Culture represents the means, however imperfect, at the disposal of the individual for handling his relationships. On it he depends for making his way among, and with, other members and groups belonging to his society."* (Wilson, Trist et al., 1952)

In the era of full employment after WW II, Trist studied the formation of an "absence culture" in British coal mines, where "temporary withdrawal" by individuals from work was a function of stress in the person/work relationship *and* the tolerance of a firm based on its need to maintain an enduring employment relationship. By comparison, Trist showed that in a select few mines where restructuring of jobs enhanced the quality of individuals' work experience, absentee rates were so significantly lower that an "absence culture" was virtually non-existent.

"Always, the actual existence of culture is in personal versions (Sapir, 1927), however close such versions may be to each other. It is this personal quality that allows culture to impart vitality to a society and the culture-carrying individual to function as an agent of social change." (Trist, 1950). The culture is out there and endows social relations with their objective "demand" qualities; how individuals respond depends on how far the culture is also within them.

The Netherlands Modern STS has a similar view to Trist's work as stated by Jac Christis that "culture of an organization refers to the subset of **fact and value premises that are taken for granted**—these "rules of the game" structure what we feel, think, and do". Furthermore, Niklas Luhmann, one of the most important German sociologists and social theorists of the twentieth century who developed a highly original form of systems theory, refers to these premises as "behavior expectations".

Later, Edgar Schein in the USA developed extensive theory on the dynamic relationship between "Organizational Culture and Leadership"—highlighting the role of leaders in culture creation, and in later stages, how leaders embed and transmit culture. Culture was never viewed as monolithic; for example, in Schein's view, leaders must mesh organizational sub-cultures by evolving common goals, language, and procedures.

Nevertheless, in this earlier period of conceptual development of the socio-psychological perspective, cultures were fairly homogeneous and relatively stable. We will need to re-examine these concepts as we navigate our turbulent times.

B. Socio-Technical Systems Perspective

The Socio-Technical Systems Perspective is about organizing for work/value creation through development of structures and processes that jointly optimize both the social and technical aspects in an integrated system

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. 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, particularly in the coal-mining industry. The second project included the technical as well as the social system in the factors to be considered and postulated that the relations between them constitutes a new field of inquiry.

What was discovered in the Haighmoor coal mine gave to Ken Bamforth and Eric Trist a first glimpse of the "emergence of a new paradigm of work" where the technological imperative could be disobeyed, with positive economic as well as human results-- the new paradigm entailed a shift in the way work organizations were envisaged. Under the old paradigm, engineers would prescribe whatever organization the technology seemed to require. However, the detailed findings on outcomes like production performance, safety, and absenteeism documented in the Bamforth and Trist study (1951, 1963) of two very different ways of "organizing" work at similar longwall mining operations indicated there is "organizational choice" in how to organize the social arrangements with any given technology for positive economic and human results.

Based on these coal mining studies, with respect to internal coordination and control of work processes, a key tenet of Socio-Technical Systems design became the embedding of many coordination tasks within a multi-skilled primary work group that self-regulates a 'whole' task system—what Trist's Tavistock colleague, Emery referred to as Design Principle 2, with a consequent redistribution of power from traditional control roles in the hierarchical, bureaucratic Design Principle 1. (This new paradigm of work encounters unconscious processes of keeping in place current identities and existing power systems that results in *socially structured psychological defenses*, which is where the socio-psychological perspective helps to understand and develop group responsible autonomy and self-regulation.)

Later, David Herbst (1976), a Norwegian colleague who at one time held a staff position at Tavistock, introduced an even wider variety of organizational alternatives, many of them non-hierarchical, including semi-autonomous work groups, matrix, and network structures. Clearly, "organizing" does not require a fixed and stable hierarchy. What is critical in Herbst's view is that "people can arrange themselves at will depending upon the demands of the situation" (Pasmore, 1995).

This was a transformation from top-down bureaucracy (first design principle, redundancy of parts) to emergent nonlinear organizing **(**the second design principle, redundancy of functions (Emery 1967). The notion of one narrowly skilled man doing one fractionated task being replaced by that of the multi-skilled work group that could exchange assignments in a whole task system was also promoted in the Netherlands Modern STS by Ulbo De Sitter in his (1990) paper "Simple Organizations, Complex Jobs: the Dutch socio-technical approach**"**.

Some of the principles Emery (and others) described were as follows:

- The work system, which comprised a set of activities that made up a functioning whole, now became the basic unit rather than the single jobs into which it was decomposable;

- Correspondingly, the work group became central rather than the individual jobholder;
- Internal regulation of the system by the group was thus rendered possible rather than the external regulation of individuals by supervisors;
- A design principle based on the redundancy of functions rather than on the redundancy of parts characterized the underlying organizational philosophy which tended to develop multiple skills in the individual and immensely increase the response repertoire of the group. This principle valued the discretionary rather than the prescribed part of work roles (Jaques, 1956);
- The new paradigm of work treated the individual as complementary to the machine rather than as an extension of it (Jordan, 1963); and,
- It was variety-increasing for both the individual and the organization rather than variety-decreasing as in the bureaucratic mode.

From the beginning, the socio-technical concept has developed in terms of **systems**. It is concerned with interdependencies. In terms of **open system theory**, socio-technical concepts are concerned also with the environment in which an organization does regular commerce in input-output exchanges of materials and products or services, all the while the enterprise must actively maintain a steady state. It was significant that Von Bertalanffy's (1950) paper on "Open Systems in Physics and Biology" along with the emergence of cybernetics and the work of Ashby (1956) occurred at the same time that the socio-technical concept was being formulated.

In conjunction with the Norwegian Industrial Democracy project (led by Einar Thorsrud and Fred Emery, 1962-1969), Emery reformulated the matching ("goodness of fit") between the technological component and the work relationship structure as *the joint optimization of social and technical systems.* The technical and social systems are *independent* of each other in the sense that the former follows the laws of the physical sciences, while the latter follows the laws of the human sciences and is a purposeful system. Yet they are *correlative* in that one requires the other for the *transformation* of an input into an output.

Emery's paper on "Characteristics of Socio-Technical Systems" outlined a socio-technical systems concept as a frame of reference with three stages in the **analysis of the enterprise**:

- The analysis of the component parts to reveal the way each contributes to the performance of the enterprise and creates or meets the requirements of other parts. The first components to analyze are:

1. the technical **processes** of conversion of inputs into outputs, and
2. the "work relationship **structure**" and its occupational roles.

- The analysis of the interrelation of these parts with particular reference to the problems of internal **coordination and control** thus created.
- The detection and analysis of the **relevant external environment** of the enterprise and the way the enterprise manages its relation to it.

During the 'modern' period of Socio-Technical Systems Design, "amendments" were developed to many of these 'pioneering' and 'classical' concepts and methodologies. One of the most significant innovations was the way that the Dutch version of "Modern Sociotechnical Theory" (MST), namely, "Integral Organizational Renewal" (IOR) chose a different way to "see" integral design. In the Dutch

variant, "the original socio-technical ideal of integrating social and technical aspects remains" (van Eijnatten, 1998), but with different concepts, for example, of organization "structure".

Dutch MST substituted the definition of a work organization (i.e. sociotechnical system) as an interdependent set of social and technical (sub)systems, with the concept of an organization as an interacting network of people executing tasks and roles, using technological instrumentation, tools and machines. In the Dutch version of MST, people are therefore the primary "elements" of the system, with technology as "attributes" (in addition to materials and information used as means by the human actors to perform the required operations and transformations).

It is significant that the Dutch concept of "Integral Organizational Renewal" (IOR) was developed in the 1970's at a time when economic forces were calling for more flexible production and service delivery. Hence, IOR applied control theory and the work of Ashby to design "a new architecture of structure" for an organization to "improve its controllability under turbulent environmental conditions" (de Sitter, 1990). The design starts with sorting customers into customer families or product families which have different demands. For each family different work processes may be mapped (de Sitter, 1986, 1994). Having streamlined the production structure, IOR then considers the control structure and particularly, the "control capacity" of the system to reduce "interference" (or variance).

One of the central features of the Dutch concept of control capacity is the ability of people to exercise discretion to control "interferences", very similar to the earlier concept of "responsible autonomy" used in other STSD approaches. Distinctive to the Dutch version of STSD, though, was the link to the work of Karasek (1979) whose research has shown that autonomy (control capacity) and workload can be effective predictors of human stress and absenteeism.

Elaboration of this link between the character of work processes and psychological effects has been a key feature of the 'classical' and 'modern' periods of Socio-Technical Systems Design. In their Norwegian projects, Thorsrud and Emery (1969) first wrote of "a limited number of general psychological requirements" of work as principles for task redesign. In his later innovation of Participative Design Workshops in Australia, Emery (1974) refined these values into a set of 6 psychological requirements for jobs in a work organization: "elbow room, learning, optimal variety, mutual support, a socially meaningful task, and a desirable future".

More broadly, Thorsrud, Emery and colleagues didn't only develop the most efficient and worker friendly organizational design – they wanted to build democracy (starting on the shop floor). In practice, Thorsrud and Emery developed projects concentrated on democratization of work supported by "The Norwegian Confederation of Trade Unions" and "Confederation of Norwegian Enterprise" (the business organization). The results of the program quickly found their way into a new work environment Act (1977) and into the basic agreement between the social partners, legitimating collaborative union-management relationships in both camps.

At the same time, an American mechanical engineer and professor of management who had been a colleague of Emery & Thorsrud in Norway, Lou Davis returned to North America and founded a program at UCLA that over a decade educated thousands of managers, union leaders, academics, and consultants on the principles and techniques of sociotechnical systems design as a key "enabling condition for enhanced Quality of Working Life". As an engineer, Davis (along with his UCLA social

psychologist colleague, Taylor; 1972, 1975) was uniquely qualified to address "technology effects on jobs" and effectively asserted that "psychosocial assumptions" are built into production technology-- "Take something as simple as deciding whether to place a meter on a particular machine; to make this decision, the designer must answer questions [like]…does the operator require this information, how important is ease of physical availability and timeliness?"

Therefore, based on a "technology assessment" of effects on working life (including analysis of variance and potentially harmful technical constraints or interferences affecting human action), Davis (and his student Berniker) advocated for the concept of "technological choice", a requirement that "at least two alternative ways of doing something be provided by the technology designers".

With the development of automated process technology, technological choice, in Davis' view, became even more significant. Davis argued: "advanced technology presents us with new opportunities to develop more humane organizational forms" because new technology "possesses unrecognized flexibility". Secondly, new technology "increases the dependence of the organization on…more individual commitment" and more sophisticated "mental-perceptual-decision-making skills" of workers to control unpredictable events.

Indeed, automation and the increased use of microelectronics in factory and office equipment were a key part of transforming a growing percentage of the workforce into "knowledge workers". Automation replaced humans in many areas of routine (and often manual) work. At the same time, the largest growth in the economy and employment was in non-routine, unprogrammed tasks, particularly in professional and service work. The new work systems were described as "nonlinear" involving multiple, concurrent, non-sequential processes for conversion of data/information inputs to information/knowledge outputs.

This expansion of knowledge work provoked a call for "renewal" of STS Design. In the words of Cal Pava, a graduate student of Eric Trist during his professorial tenure at The Wharton School in Pennsylvania, USA:

> "*The nature of nonlinear work systems impedes conventional STS design…*
> *The STS approach originated in an era of long-linked, mechanized technology…*
> *Thirty-six years later, information systems are in the vanguard of innovation…*
> *A new technological epoch appears imminent, one in which isolated, 'dumb'*
> *tools are replaced by integrated, intelligent systems…*
> *The new stock of tools is also triggering a shift in the function of labor…*
> *Knowledge-based contributions previously defined as tertiary will become*
> *an ongoing, everyday priority for maintaining a competitive advantage…*
> *To summarize…to make it more suitable for nonlinear work systems,*
> *STS design must itself be redesigned*." (Pava, 1986)

Indeed, at the close of the 'modern' period of STS Design, others were calling for a "revival". DeSitter (1990) pointed to the need for better integration of the "information aspect". Another Dutchman, Hans Van Beinum (1990) predicted a shift from socio-technical to socio-ecological design. In the USA, Pasmore (1982, 1995) advocated building on Pava's thinking about non-routine work, while also paying more attention to the need for organizations to learn, "and probably most important…to pay closer attention to the development of technology and to better understand its impacts on behavior".

After the late 1980's and 1990's when many companies emphasized cost-cutting and chose methods such as lean production and business process engineering, Enid Mumford, British computer scientist and professor of organizational behavior at Manchester University saw "opportunities for a socio-technical revival" in the new millennium when "commercial success in tomorrow's world [will] require motivated work forces (2000). Mumford viewed the most important contribution of STS Design to be its "value system", "the socio-technical principles of quality of life and personal control".

C. Socio-Ecological Perspective

The Socio-Ecological Perspective is about understanding both the unity of the organization and its environment as well as their respective underlying dynamics, thereby enabling design of strategies, relationships, and processes for future opportunity.

This concept was announced publicly in a paper that Trist and Emery published in Human Relations (1965a/Vol.III), "The Causal Texture of Organizational Environments" that was born of a series of overlapping case studies *(of large organizations in serious efforts to define new viable missions in international markets)*. As a result of this case study work, Trist and Emery confronted a challenge to develop further their notions of **open systems thinking.**

At the time, people were theoretically bogged down in how to represent the permeability/rigidity of boundaries. Von Bertalanffy's concept replaced the boundary problem with the graspable, and much more measurable, transport equation deriving from the inputs and outputs between a system and its environment. However, we were now dealing with cases where the broader environment -- the customers, labor force, legislators etc.-- was developing and changing the task environments. These broader environmental changes were acting to change the input/output equations.

There was need to theorize about the evolution of the environment and development of **"**environmental connectedness". Though Bertalanffy's formulation of open systems enables exchange processes between the organism, or organization, and elements in its environment to be dealt with, it does not deal at all with those processes in the environment itself, which are among the determining conditions of the exchanges. Adding to this understanding were Sommerhoff's concept of directive correlation and Ashby's notion of goal-directedness, i.e. the ability to achieve a goal-state under variations in the environment. Both stated that system definitions are relative to the boundaries determined by goals, i.e. created by people.

To provide a comprehensive understanding of organizational behaviour, Trist and Emery built on the model formulated by Andras Angyal (1941) that requires knowledge of **4 different processes, each with particular lawful (L) relations:**

- **L11** refers to lawful relations (processes) within the organization--the area of internal interdependencies;
- **L12 and L21 refers** to exchanges between the organization and its environment--the area of transactional interdependencies—L12 is output to the environment and L21 is input to the organization; and
- **L22** refers to processes through which parts of the environment become related to each other, i.e., its causal texture--the area of interdependencies within the environment itself.

Based upon these processes, Trist and Emery postulated the existence of environments with four types of "causal texture"; I) placid; randomized; II) placid, clustered; III) disturbed, reactive; and IV) turbulent field. Each type of environment requires a different organizational response; for example, in placid clustered, strategy becomes key; in a disturbed reactive, operations become key, including practices of merger and absorption.

As the most complex type of environments, turbulent fields (Type IV) contain dynamic processes that arise not only from the interaction of the component organizations, but also from the field itself—the "ground" is in motion. Contributing to the emergence of this (Type IV) causal texture is the growth in size of organizations, so that collectively their actions are strong enough to induce processes in the overall environment itself. (An analogy would be a parade of massive military vehicles crossing over a shaking bridge.) Another trend identified by Trist and Emery was the "deepening interdependence between the economic and other facets of society". In conclusion, Trist and Emery asserted that, for all organizations, "these trends mean a gross increase in their area of relevant uncertainty".

Therefore, what becomes precarious under Type IV conditions (turbulence) is organizational stability. In these environments, individual organizations, however large, cannot expect to adapt successfully simply through their own direct actions. However, Emery (1977) identified "indications of a solution" to this challenge—"the emergence of ideals that have overriding significance for all members of the field". Any problem needs to be situated within a larger 'socio-ecology' to understand the socio-political and socio-economic dynamics that influence organizations and their responses.

The culmination of Fred Emery's work on the socio-ecological perspective was a definition (developed with his wife, Merrelyn) of a version of open systems theory, "OST(E)", a socio-ecological systems theory that includes socio-technical (and socio-psychological) systems. Thus, the unit of analysis is the "system-in-environment". The main stated purpose of OST(E) was/is "to promote and create change toward a world that is consciously designed by people and for people, living harmoniously within their ecological systems, both physical and social" (M. Emery, 1997, 2000). To create this environment populated by active organizations, the Emery's developed a two-stage model of active adaptation, combining an adaptive planning process, the Search Conference, with the Participative Design Workshop that aligns people and the work they do in organizational systems.

Before the close of the 'modern' period of STSD, other conceptual developments presented related but very different visions about the next phase of STSD. First, based on a "hunch" of Emery and others that increasingly maladaptive responses to environmental turbulence will lead to a new organizational environment having the dynamics of a "vortex", Oguz Baburoglu, an action researcher, professor of management, and Turkish graduate from The Wharton School conceptualized a Type V "Vortical" environment characterized by stalemate, polarization, and dogmatism (Baburoglu, 1988).

By contrast to this rather pessimistic vision of a world out-of-control, Trist conceived of ecological frameworks ("inter-organizational domains") in which a range of organizations sharing interests in particular societal problems could be encouraged to work together to match the scale and complexity of issues. To enable this meta-systems approach to organizational change, Trist (1983) postulated the need for mediating or "referent" organizations. In fact, Trist applied his ecological frameworks successfully in a variety of challenged, threatened communities: Craigmiller, Scotland; Jamestown, New York; and Sudbury, Canada—as documented in his article on "New Directions of Hope" (1979).

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This document has been developed in the spirit of the STS Roundtable, a network of business leaders, researchers, trade unionists, academics, managers, consultants, and students—who share the values, theory and practice of sociotechnical systems (STS) design. The STS Roundtable's central purpose is to be an open learning community advancing knowledge and practices that create healthy and powerful organizations and communities. Our 'big idea' is to collaborate on and discover the next generation of organization design technology that can match the speed and dimension of our complex digitized, VUCA world. As long-time members of the STS Roundtable, Carolyn Ordowich and Bert Painter have contributed primary authorship of this document. However, the writing has also been the product of the 'collective intelligence' of colleagues within and outside of the STS Roundtable and in our Global Network for SmarT Organization Design, who have offered insightful comments and substantial improvements for what is still a 'work-in-progress'.

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