Stafford Beer and the legacy of Cybersyn: seeing around corners

Allenna Leonard
Cwarel Isaf Institute, Toronto, Canada

Abstract

Purpose – The purpose of this paper is to reflect on the legacy of Stafford Beer and the continuing implications of his work on Cybersyn and the models and tools he used and explored during the project and in his later work.

Design/methodology/approach – Description of Stafford Beer's work on Cybersyn and examples of its present day applicability.

Findings – The values and tools associated with the Cybersyn work in Chile continue to be relevant for the challenges of the present and an example of an approach to management structure and practice that serves both efficiency and humanity.

Originality/value – The value of this work is to contribute to the history and future possibilities of the ideas and tools pioneered in the Cybersyn project by Stafford Beer and others and their broader context in organizational cybernetics.

Keywords Viable System Model, Cybersyn, Organizational cybernetics, Real-time management, Stafford Beer, Team Syntegrity

Paper type Viewpoint

The theme, "From Disruption to Reparation" calls on us to be aware that things are always changing – in more or less dramatic or catastrophic ways. Entropy is a fact of life as it is a fact of physics. We see it in the panarchy cycle in nature as well as in human affairs. It goes from growth to consolidation to collapse to reorganization. The situation in Chile that we reflect upon this week has been analyzed by many but is at a minimum a reminder that local islands of stability and growth can be overwhelmed by external forces. The forces that destabilized Chile were both political and philosophical. Nor were they confined to Chile as Klein (2007) pointed out in her book "The Shock Doctrine."

When we think of repair after disruption, we often think of response to natural disaster. There, a combination of local self-organization and external help leads to recovery. Hurricane Katrina was a good example of that combination and of the role played by self-organization. Its story was told by Rebecca Solnit in her book "A Paradise Built in Hell: the extraordinary communities that arise in disaster." (Solnit, 2009) Political disaster is a different story. Recovery time is usually much longer because of the tensions and fractures in society that led to the disruption. Recovery after political disruption must cope with restructured institutions and communities. The external environment will not have stood still and a return to previous plans and practices is not realistic.

We had an example in the aftermath of Second World War. Much of Continental Europe had suffered loss of life, property and infrastructure. What could be replaced was often rebuilt according to better technology and peacetime uses were found for many wartime inventions. Both physical and social inventions had been developed and were applied with differing levels of emphasis and enthusiasm. But the social

Thanks are due to the World Organization of Systems and Cybernetics for sponsoring the Conference From Disruption to Reparation at which this paper was delivered and to the University of Ibague in Colombia for hosting the Conference.

Kybernetes
Vol. 44 No. 6/7, 2015
pp. 926-934

0368-492X
DOI 10.1108/K-02-2015-0045

inventions had less sticking power and were often put aside as soon as they were no longer seen as necessary.

I had the great privilege of being Stafford Beer's partner and colleague for 21 years. He was one of the young men who came back eager to apply the knowledge of Operational Research he gained as a soldier in Second World War to peacetime activities. He began this work in the British steel industry. Through publications and friendships with people such as Grey Walter and Ross Ashby in Britain and Warren McCulloch and Norbert Wiener in the USA he became aware of cybernetics and its strong neurophysiological connections. These became the basis for his research culminating in the Viable System Model and Team Syntegrity process.

One of the things he found most frustrating was the limited way that the benefits of interdisciplinary collaboration that occurred in the war effort under the rubric of operational research and later cybernetics and systems thinking were carried through into peacetime. Second World War was a situation where the whole country understood the risks and was committed to success. In peacetime, that unity of purpose was hard to come by. Such unity was recalled in the promise exemplified in the Allende government's initiation of Project Cybersyn and the team assembled to carry it out.

Second World War was not, of course, the beginning of cybernetics and systems thinking. The idea of feedback-controlled purposive systems goes back thousands of years. Long ago farmers designed float valves to keep their ponds from either flooding or drying up. The nineteenth century saw the introduction of the Watt Steam Governor that regulated engine speed. You can see a picture of it on the poster for this Conference. In the early twentieth century Cannon and von Bertalanffy (1968) extended the thinking into medicine and biology. However, it was solving problems in Second World War that led to the development of machinery such as feedback-controlled anti-aircraft artillery and the wider use of operational research that brought interdisciplinary thinking into public prominence.

Ashby's Law of Requisite Variety was especially influential. If cybernetics involves the regulation of complex probabilistic systems, then the regulatory model must be able to marshal at least as much variety as the system to be regulated. Stafford began to see the human nervous system as a time tested and evolved means of regulating the interacting processes in the human body. He adapted its structure as a template for diagnosing and designing management functions in human organizations. The Viable System Model was the result.

While peacetime OR was welcomed when the problems it addressed were logistical or production oriented, that welcome cooled as soon as its sights were turned on executive decision making and the status quo. The benefit to the whole took second place to the (often short-term) benefit to owners and shareholders and interdisciplinary collaboration was too often replaced by internal turf battles.

Stafford became an advocate of these new methods and later a critic of governance structures that took little notice of the opportunities and risks inherent in post-war technical and political developments. His concerns about the effects of automation and the threats to privacy – to name two – echoed those of others. Norbert Wiener's arguments in "The Human Use of Human Beings" (Wiener, 1954) are still relevant today. Ashby, Von Foerster and most of the other first generation pioneers also engaged with the larger social issues of the day from the perspective of applied epistemology and of their own specific areas of research.

When the invitation came to come to Chile and help the new Allende government to manage the state-run economy according to these principles, Stafford accepted with

great enthusiasm. He had just written "Brain of the Firm" (Beer, 1981), the first of his books on the Viable System Model, and brought the manuscript with him when he went to Chile.

The Viable System Model is a powerful tool for exploring and understanding the governance of an organization by looking at its management functions, their communications channels and their appropriate and evolving balances. These balances include: between the operation and its environments; between the focus on the present and on the future; between horizontal autonomy and vertical authority; and between the system and the meta-system. As we will hear much more of VSM in this Conference, I would like to concentrate on its context.

It is crucially important when building any organizational model to begin by questioning basic assumptions. Questions such as "what are our environments?", "whom do we serve?", "what business are we in?" and in "what formal and informal structures and networks are our activities embedded?" should be asked. But, it is difficult to do so unless a formal procedure is used. This helps to identify some of the corners we might want to "see around" as they are likely to escape our notice otherwise.

We might start by looking at the contractual and contextual environments of the system and trying out several scenarios and their likely effects. Any system has the potential to be buffeted by changes in its environments. These include the natural, social, technical, economic or political environments as well as internal changes in leadership or philosophy.

A next step is to look closely at our System 1 activities that produce what we offer. How many ways can distinctions be made among them? Many will be irrelevant but at least three should be explored. It is probable that the chain of recursion levels will be somewhat different for each. That is another crucial exploration. It is a good idea to at least sketch them out as far as they might usefully go. Schwember (1977) identified 11 different levels in the Cybersyn project.

The basic journalistic questions: who, what, when, where and why are a good start. A technique called "the four whys" is a good way to confirm assumptions. It asks "why" four times to get a look at – and perhaps change – the framework under study.

When the choice is made as to the "system-in-focus", it is customary to model one level of recursion up and one down for the sake of consistency to see where local autonomy can prevail and where decisions need to be taken at a more comprehensive level.

The next stage is to populate the model with specifics: the products produced or services rendered and the main probes exploring the future. Among those that can be identified will be some that can produce consistent time series. Some will be appropriate to name as indices to be measured and monitored in real (or bogus real) time. Most of the variables will be comparable to those that are usually measured – the difference being one of measurement frequency and analysis. Statistical filters are then applied to tell if any new value is one that is unexpected and may represent incipient instability.

Eight or ten indices are usually enough to be reported up the line for each level of recursion although sometimes people want to add indices for use at their own level. This is compatible with George Miller's "Magic number seven – plus or minus two" (Miller, 1956) that described the number of independent distinctions in a variable most people could perceive.

These indices came together in an operations room that was designed to bring a wide range of information together in one place for decision making. In today's operations rooms, some of the information comes from indices but there are also likely to be computer graphics or video, graphs, charts and perhaps physical models of the products

involved. Photographs of the room designed for the Allende government were published on the inside of the dustcover of Platform for Change (Beer, 1975) and in Eden Medina's "Cybernetic Revolutionaries" (Medina, 2011). Modern versions of the operations room have been designed and delivered by Malik Management in Switzerland. Their offerings include other cybernetic tools but the Viable System Model, the Operations Room and the Team Syntegrity process are central to their business.

Technological measurement capabilities have increased markedly since the 1970's when Cybersyn operated with one main-frame computer fed by telex machines. Now, computers, "smart" materials and "the internet of things" record the information although it is an open question how much more wisdom they add to deliberations.

Real-time measures have become easy to install and become commonplace. However, their use may be are detrimental as well as beneficial. Traffic light synchronization and is generally accepted as a good thing. Just-in-time deliveries get mixed reviews depending on the trade-offs between better warehousing efficiency and additional energy usage. But, customer load measures that facilitate just-in-time staffing and zero hours contracts benefit employers and are detrimental to employees, especially where fatigue and safety conflict with efficiency. For example, a majority of the engineers that operate freight trains in Canada have reported going to work already exhausted or becoming exhausted on their shift. This is because the trains are to be sent out as soon as they are loaded and drivers are on call 24/7. The drivers fear reprisal if they decline a run and, not surprisingly, accidents have increased.

Retail and fast food competition that encourages employers to schedule employee hours in short bursts save on wages but attenuate worker purchasing power, educational opportunities and quality of life. In contrast, the Cybersyn project sought to use real-time measures to get ahead of the technology and the ethos behind its design was to benefit both workers and producers.

But, the capacity to engage in real-time measures has also lagged with respect to whether or not they cover sufficient variety. Unlike the Cybersyn design, most are not situated within a holistic model nor are they likely to go beyond one or two recursions. This makes it more difficult to detect incipient instability. Indeed, the recent record suggests that actual instability is often ignored until the effects become catastrophic – either in terms of physical damage or damage to reputation.

The need for real-time integrated monitoring across a wide variety of applications is very real. Recently Alanna Mitchell, a Toronto science journalist, wrote a book called "Seasick" (Mitchell, 2009). She visited individuals and research facilities in ocean science to pull together a comprehensive picture of the threats. This broader picture showed a more serious level of threat than was visible from the perspective of any single area of investigation. It was shocking to many of the scientists because they had not seen the implications of their interacting variables and their additive effects. The cybernetic community was not shocked as interacting and additive effects are the norm outside of a laboratory.

The potential for beneficial real-time measures is huge in many areas that are usually the province of governments. Environmental factors, intra and interstate conflicts, public health and epidemic tracking, infrastructure maintenance, structural employment trends, the impact of tax policies and many others can give early indications that something is going wrong. But, under present circumstances it takes too much time before the information registers and more time still before the will and the resources are assembled to take action. To take a current example, the very first cases of Ebola to be identified late in 2013 should have triggered an algedonic signal that would have had teams on their

way within a matter of days if not hours. Having teams ready to go in an emergency is how fire departments have been organized for a very long time. Sometimes these initiatives are less about seeing around corners than about simply looking ahead.

Part of the Cybersyn work was the effort to design more effective input in both snapshot and deliberative scenarios. The algedonic meter was a simple analogue device to measure the general sense of well-being. It could be used to measure satisfaction levels among the public or could be installed factories so that the management had an ongoing (and anonymous) sense of how people on the shop floor were feeling. A sample of the public might be asked to turn a dial from orange to blue to answer a question like "how are things going?". The interviewer could then report or ask basic demographic questions to be able to analyze differences in satisfaction based on age, gender, location or other characteristics. In the case of a factory, workers could adjust a common dial and their input could be aggregated. The managers would know the reading and the workers would know that they knew.

The other problem area where Stafford Beer's cybernetic thinking was applied was the question of how to access the multiple perspectives of stakeholders and tap the knowledge held by the whole group when a complex problem was to be addressed. Although work was begun on this aspect – and partially written up in an unpublished manuscript – the design to empower infosets was not piloted for another 20 years.

Hierarchy had demonstrated limitations, such as loss of information and low morale in complex situations and was, in any case, not consistent with democratic ideals. Even in the public sphere where there is no formal hierarchy, many remain unconvinced that engaging multiple perspectives is of value. One of our mayoral candidates in Toronto has actually been criticized for being willing to consult with City Council and the public. Apparently "strong leadership" is what is needed – never mind that with one vote on a 45 member Council, no mayor that attempts to move without consultation can get much accomplished.

Proceeding by consultation and consensus also has limitations in that it can be inefficient and/or consume a great deal of time. Various group processes have been used successfully to engage multiple stakeholders in a formal and time constrained process – most often in land use or urban design. But, there is substantial misunderstanding about the role of public participation. The most effective designs have engaged both design professionals and representatives of the user community. Yet some think that this represents a case of "designers getting the public to do their jobs." They do not seem to realize that their position is akin to ordering a house from an architect with only the site and budget supplied.

Stafford had been exploring the work of Alex Bavelas with respect to centrality and peripherality of social networks when he was still in the steel industry. (Beer, 1994) Early versions of what became the Team Syntegrity process were part of this effort. Stafford defined an "infoset" as a group of people who share information about and engagement with a possible outcome. An infoset should contain a good representation of the perspectives on the situation – whether it was an organization, a community or even a loose group of individuals committed to a particular cause. These people would gather together for several days to share their ideas and come to, if not agreement, at least understanding of where others were coming from. It could at best yield a way forward that satisfied almost everyone's priorities and at worst, lower the likelihood of surprise.

Team Syntegrity addressed the questions of centrality vs. peripherality and constraining hierarchy by using a three dimensional geometric solid – the icosahedron – as a framework. It has 12 vertices, and any question worthy of substantial attention

should have at least a dozen aspects to explore. The agenda and the topics of the meeting emerge from individual statements that are discussed in small fluid groups and gradually refined and combined until they are reduced to 12.

Participants are mapped onto the 30 edges of the figure, each with a unique and equivalent position connecting two topics. A well-selected group of 30 people is large enough to represent a wide range of perspectives yet small enough for people to become acquainted over several days even if they had not known each other before. Each participant/edge will be a member of the two teams their strut connects. A group of five team members is small enough for people to keep one another's positions in mind and also for the silence of any member to be noticed. These relations cover the outer skin of the icosahedron.

Yet, further connection was desirable. W. Buckminster Fuller's icosahedral structures used a balance of compression vs tension. (Fuller, 1981) This feature was added to the process by the introduction of the "critic" role that made connections internal to the icosahedron. Each participant has two critic memberships drawn from a next but one removed team. While the team members discuss their issue, the critics would have a portion of the meeting time to make comments that would point out connections or omissions or comment on the way the process was working.

In a Syntegration, it is common for one or two ideas to come up in several topic teams and reverberate around the structure over the three iterations. Such ideas often lead to insight or to an emerging sense of what is important and why. Syntegrations have been used to address different levels of conflict situations. The most relevant one for me was an event sponsored by the Israeli Palestinian Centre for Research and Information. It discussed issues surrounding the West Bank. The participants included Israelis, Palestinians, subject matter experts and a representative of the funding agency. The groups came up with a number of areas where negotiation and compromise were possible including a few where their needs were not, after all, in conflict. Many of the participants had been advising the Oslo Peace Process and hoped to continue in that role. It was not to be. Several weeks after the event, the Israeli Prime Minister, Yitzhak Rabin, was assassinated by an Israeli zealot. That conflict continues and is farther from resolution now than it was in 1995.

Too often the time and cost of holding a Syntegration, Future Search or other group process is an obstacle to resolving conflicts or issues in anything approaching a comprehensive manner. At other times cost is introduced as a limiting factor before the scope of the need has even been determined. This leads to sub-optimal solutions either because innovative approaches were disallowed or because an environment of scarcity leads to interest groups (usually the most powerful) grabbing what they want at the onset.

Sometimes notions of variety – especially channel capacity are – ignored leading to insufficient or insufficiently integrated plans. Also, citizens become understandably frustrated if they are invited to an afternoon's public discourse where the input is fragmented and there is little sense of which, if any, of the recommendations will be acted upon.

However, if such group processes were instituted to repair the civic body after a disruption, natural or political, there would be a better chance of getting it right. Either rebuilding what was not working well in the first place or, worse, in the case of politics, turning the wheel of government sharply in the other direction and excluding a different group of people seldom does more than lay the groundwork for the next disruption. More usefully, processes such as Syntegration, if employed before situations reach a crisis point might pick up emerging discontent before it threatened the stability of the whole.

Governments often try to solve problems by passing new laws or writing regulations. It seems unlikely that legislative bodies can adequately consider the ramifications of their changes unless they engage in extensive exploration and there is seldom time for that. Of course, the engineers lament "never time to do it right, always time to do it over" applies to legislation as well. Engineers have the advantage here because their work is often (and sometimes literally) concrete and problems are more likely to be seen quickly.

Questions such as "who will this affect and how?" "what are the long term implications of this move?" and, most important, "how could this go wrong?" should be on their radar. Stafford would often express disappointment that perfectly obvious implications of a new initiative would be ignored and fixed only after much distress.

Interestingly, a great deal of cybernetics in academia is now being done in schools of design and architecture as well as business schools and schools of computer science. That is no doubt a good thing as architects are used to thinking in terms of whole packages that will be inhabited by people with different needs.

Instead we often hear, after the fact, that lobbyists either drafted, or were instrumental in drafting, the legislation. Or, in the case of Canada, that the government has put everything but the kitchen sink into an Omnibus Bill of hundreds of pages and left it to the courts to fix the errors. Not only does this approach fail to even attempt to look around corners, it actually designs blinders to reinforce advantage and partisan tunnel vision – to say nothing of subverting the work of Parliament.

Stafford often reminded us that "the purpose of a system is what it does." Regardless of its stated goals, all of its consequences, whether intended or part of the design or not, are part of its purpose. It seems that a certain amount of collateral damage, usually to the most vulnerable, is often seen as the cost of doing the government's or a company's business.

Sometimes that type of short-term thinking backfires in a big way. Continuing to install a cheaper part years after reports of fatal accidents led to huge payouts in law suits and a massive hit to the reputation of General Motors. Subordinates risk their careers if they choose to become whistle blowers when their manager makes it clear that he or she does not want to hear it if something has gone wrong.

Debate on the issue of climate change includes a sizable group of deniers who would have to do things differently if they acknowledged strong signals never mind the weak signals that should be enhanced. In the case of people running for office, we hear the dodge of "I'm not a scientist so I can't say." Of course, legislators are no smarter than anyone else and cannot possibly have the level of expertise to make an informed judgment on most of the matters that come before their committees. That is why they have expert witnesses and staff. But, when a political process is awash with hundreds of millions of dollars invested in candidates by special interests, they cannot even claim tunnel vision. Perhaps a better image would be that they have been issued blindfolds. Of course, the very wealthy countries or individuals will not be the ones to pay the costs of rising sea levels and other effects. Those costs will be downloaded to those least able to accommodate them.

Today we face opportunities and threats in a broader context than addressed in the Cybersyn project. These are areas where we must point out what is likely to be around those corners. One threat anticipated by both Norbert Wiener and Stafford is the new capacity to monitor one's physical state. Devices can record blood pressure, sugar levels, heart rate, number of steps taken and brainwaves to name just a few. While it might be useful for individuals and their doctors to have some of this information, does

the same apply to one's supervisor or insurance company? Would there still be any hope of an individual's right to privacy?

Another current example comes from Britain. The Tory government is proposing to give benefit claimants smart debit cards that could only be used in "approved" retail outlets to prevent them from buying alcohol, cigarettes or lottery tickets. Every transaction would announce the person as being "on benefit." But, the list of "approved" outlets is not likely to extend to laundries, pound stores, charity shops or farmers markets. The poor will be punished with higher prices as well as inconvenient and humiliating restrictions. And, as Prohibition demonstrated, if alcohol (or cigarettes) are what people want, they will find a way to get them. Presumably the UK legislators don't ever need or want to use coin-operated machines, make telephone calls from a call box (if they can find one) or buy a coffee from an establishment that does not have a debit machine.

What about the health consequences of stress due to lack of control of one's pace of work? When computers monitored typists' numbers of keystrokes, productivity went down because no typist would want the standard to which she or he was to be held to be at the high end of their range. This program was designed for military use in emergency situations where it could be important to know whether someone could respond in time to deal with a problem. Its transfer to non-emergency civilian life was intrusive as well as counter-productive.

It is already possible to use meta-data to know a great deal about anyone's habits and activities. What effect does this level of surveillance have on the health of both the individual and society? And, what about machines that talk to each other without human intervention once their programs have been set in motion? Such arrangements have already sent stock markets into free fall to say nothing of the housing crisis and its aftermath.

One of the stories Stafford told was about when he was invited to take on a consultancy assignment by a large bank to protect it from unauthorized transactions. He spent a few hours talking to people at the bank and refused the offer. He told them that their system was so riddled with vulnerabilities that it would be impossible to fix them in the context of a consultancy. A few years later a single erroneous keystroke shut down banking services for large segments of the population in Toronto. This was unintentional. Intentional mischief could have caused much more damage and may have done so. If it did happen, it would be unlikely to become public knowledge.

Going forward, from major or minor disruptions to massive or incremental repair, there are lessons to be applied. Paying attention to assumptions, examining initial conditions, looking carefully at feedback loops and the behaviors they reward or sanction and trying to understand the perspectives of all the people involved is a good start. It will give us some tools to look around corners for unintended consequences.

It is possible to use cybernetic concepts to design more human-friendly situations and to bend the arc toward more autonomy and more democracy as was the aim in Chile. It is a severe criticism that no country has since seen fit to seize the opportunity that Allende and his team grasped with both hands.

In closing, I am reminded of the Cybersyn exhibit that Enrique Rivera and Raul Espejo were instrumental in presenting. The overwhelming impression was one of passion to make things work for everyone. We should encourage such feelings and commitment wherever the can be found. The legacy of Stafford Beer and Cybersyn represents a significant step on that path.

References

Beer, S. (1975), *Platform for Change*, John Wiley & Sons, Chichester.

Beer, S. (1981), *Brain of the Firm*, 2nd ed., John Wiley & Sons, Chichester.

Beer, S. (1994), *Beyond Dispute: the Invention of Team Syntegrity*, John Wiley & Sons, Chichester.

Fuller, W.B. (1981), *Critical Path*, St. Martin's Press, New York, NY.

Klein, N. (2007), *The Shock Doctrine*, Metropolitan Books, New York, NY.

Medina, E. (2011), *Cybernetic Revolutionaries*, MIT Press, Cambridge, MA.

Miller, G.A. (Ed.) (1956), "The magical number seven, plus or minus two", *The Psychology of Communication*, Basic Books, New York, NY, pp. 14-34.

Mitchell, A. (2009), *Seasick: the Global Ocean in Crisis*, McClelland & Stewart, Toronto.

Schwember, H. (1977), "Cybernetics in government: experience with new tools for management in Chile 1971-1973", in Bossel, H. (Ed.), *Concepts and Tools in Computer Based Policy Analysis*, Vol. 1, Birkhauser, Basel, pp. 79-136.

Solnit, R. (2009), *A Paradise Built in Hell: The Extraordinary Communities That Arise in Disaster*, Knopf Canada, Toronto.

Von Bertalanfy, L. (1968), *General Systems Theory*, Penguin, New York , NY.

Wiener, N. (1954), *The Human Use of Human Beings*, Doubleday, Garden City, NJ.

Further reading

Ashby, W.R. (1956), *Introduction to Cybernetics*, Meuthen, London.

Cannon, W. (1932), *The Wisdom of the Body*, W.W. Norton & Co., New York, NY.

About the author

Dr Allenna Leonard is a Toronto based Researcher and Consultant in organizational cybernetics who worked with Stafford Beer from 1981 until 2002. She specializes in applications and extensions of the Viable System Model and is a Licensee of the Team Syntegrity Process. Allenna is a Former President of both the American Society for Cybernetics and the International Society for Systems Sciences. She is especially committed to the potential of cybernetics to inform social and environmental policy and is affiliated, through the Cwarel Isaf Institute with Malik Management, the Holder of Stafford Beer's intellectual property rights. Dr Allenna Leonard can be contacted at: allenna@allennaleonard.com