

## The Need for Synthetic Standards in Managing Cyber Relationships

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**Abstract**—This paper considers four strands of thinking emerging from Cambridge University, Engineering Design Centre; Sydney University, Complex Civil Systems Group and the Advanced Research and Assessment Group. It considers the synthesis of the machine and the organization in mechorganics; it examines the Lodestone concept as a means for instrumenting social awareness; it considers the role variety plays in collaboratively influencing complex systems, over time, and coordinating and controlling them, in time. Finally, it examines the needs for assaying information and data as a means of providing the social transparencies needed for real time verification and validation. From this, it posits the needs for simple empirical standards and setting/vetting organizations that encourage good behavior and discourage bad. These standards' organizations provide for the governance and assurances necessary for packet-markets to form where prices can be assured, products verified, exchanges made and fees / taxes abstracted.

**Keywords**—mechorganics; lodestone; instrumenting; packet-markets; governance; metadetics; synthesis; assaying.

### I. INTRODUCTION

Cyber may consist of two sub-systems identified and classified as being “Coordination Rule and Control (CRC)” and “Collaboration and Social Influence (CSI)” [1, 2]. These system attributes provide the necessary and “requisite variety” [3] to enable both control, “in time”, and influence [4-8], “over time”. In this regard, Cyber may consist of two poles:

‘A technologically bounded, largely immeasurable, strongly scientific, stochastic *coordination, rule* and *control* space; comprising virtual-media and the display of data dealing with the *real* communication of *facts*; and the

*conceptualization* of alternative possibilities, themselves capable of generating hard physical and soft more *social* effects and *collaboratively influencing* them’ [9].

“Mechorganics” is postulated to have 1) a thematic *systems* identity (defined by its *networked* disciplines) and 2) a *critical* and *functional* education base [10, 11]. It is not seen either as ‘a reversion of digital data back to an analogue form’ [12] or some form of ‘Golem’ warned of by Wiener [13]. Mechorganics is based on “designing humanity back into the loop” [14, 15] and: ‘the *synergistic* combination of *civil* mechanical *systems* engineering, social network dynamics, ICT and the management of *interconnected* knowledge, information (and data) *infrastructures* in the *designing* and *composing* of *adaptive* (resilient and sustainable) organizations’ [14].

The “Lodestone” concept arose from a concern that the “Cyber-pole” applying Coordination, Rule and Control (CRC) was being emphasized at the expense of the whole and specifically the pole dealing with collaboration and social influence. The result, it was conjectured, was twofold: first, that government was becoming irrelevant to many social-media users and, secondly, that this was creating a vacuum in which less benign influences might flourish. For example, studies of social networking and identity have shown that there is a strong tendency to connect like-to-like [16]. This narrowing focus potentially reduces societal *variety* and makes people less tolerant to alternative ideas and *ontologies* than their ‘non-digital forebears’. They may, in actual fact, become non-democratic, *xenonetworks* (from xenophobia, xenonetworks are ‘social networks with a strong dislike or fear of other networks or ideas that appears foreign or strange to them’) [2], extremely hostile to alternative ideas

(and that they might be wrong). Discussion at the time was focused (as it remains largely today) on finding information ‘keystones’, ‘architectures’, ‘protocols’ or ‘gateways’ not so much to assist people identify good information from bad but to control. A problem with each of these concepts is that they obtrusively and exclusively focus on the stable, static (hence keystone) and ergodic, as opposed to the dynamic and non-ergodic. The “Information Lodestone” concept recalled the semi-mythical lodestones of antiquity that enabled ancient mariners both to determine / ‘fix’ their position and simultaneously steer a safe course. The objective is to design a non-obtrusive, dynamic instrument. In this respect, we are commencing work with Health and manufacturers of sensitive materials, to model and identify data / information flows and the potential for leaks along complicated, sensitive lines-of-communication in which knowledge assurances, e.g., for operating on patients, are essential. Other work is being undertaken to teach life systems management skills to young people, with an emphasis on either *metamatics* (the mathematics of cyber-social and cyber-physical systems) or *metadetics*, as defined in this paper. We consider this to be exciting work, on the cutting edge of our science, essential to enabling the emerging Knowledge Enterprise Economies of the 21<sup>st</sup> Century.

This paper is divided into three sections. In section one, the cyber-system is considered as it relates to the individual and at the social level. In the next section, means for instrumenting the Cyber are posited. Finally, inclusive designs and *standards* to enable people to *sensemake* within new and emerging cyber and synthetic ecologies are posited.

## II. CYBER AS A SOCIAL BEING

The informal motto of the Lodestone Project was suggested as ‘conscius in res’ or “sense-in-being”, relating to Badiou’s [17] understanding of “being”, when he states: ‘what happens in art, in science, in true (rare) politics, and in love (if it exists), is the coming to light of an indiscernible of the times, which, as such, is neither a known or recognized multiple, nor an ineffable singularity, but that which detains in its *multiple-being* all the common traits of the collective in question: in this sense, it is the *truth* of the *collective’s being*’. The idea of *multiple-beings* holds within it the traits of the social being at the heart of most systems and organizations. It is their truths and trusts that “detain the common traits of the collective in question”. When these trusts dissipate or are allowed to wither, the organization may remain as a physical entity (when a building becomes statue) but its essence and being – its “ineffable singularity” – is no longer [18]. It is conjectured that, by dealing with cyber exclusively as an info-techno construct, many organizations lost sight of their “social being”.

Considering the Cyber as two poles, it is suggested that one has more info/techno-socio traits; the other more socio-info/techno, in which, building on work by Harmaakorpi et

al. [19][17], it is posited that: ‘Info-Techno-Socio systems seek to program (as opposed to programme) the relationship between technical *processes* and humans by *digitizing performance fidelity* and coding for repeatable *risk free* procedures in computer-control-spaces so that *data* and *communication* do not [temporally] contradict each other’ [20]. By contrast: ‘Socio-Info-Techno systems stress the *reciprocal interrelationship* between humans and computers to foster *improved shared awareness* for *agilely* shaping the *social programmes of work*, in such a way that *humanity* and *ICT [control] programs* do not contradict each other’ [20].

The two systems are also considered in terms of their signatures, where I-T-S systems are considered as strong-signal systems [21-24], in which: ‘*System Information* and *Communication* are the key variables’, after, Castells [25] and Sokol [26]. And weak-signal S-I-T systems [21-24], in which: ‘*Influence* (through shared awareness) and *Control* (through switching) of *Information* and *Communication* are the key variables’, after Castells [25].

Most of us intuitively know the type of organization we would wish to be working for. Warren and Warren (1977) considered this in terms of “organizational health” and concluded that ‘healthy organizations’ have ‘a critical capacity for solving problems’, [27]. They identified three dimensions of *connectedness* (see also Thibaut and Kelley [28]): *identification* with the organization (they referred to as neighborhood); *interstitial interaction* within the organization and *existential linkages* outside the organization.

Considerations of health apply equally to organizations working with/in the Cyber and their capacity for “problem solving” and so controlling, in time, and influencing, over time. It is contended that successful companies are constantly “balancing” between the *exploitative* (delivered *in time* by coordination, rule and control) and the *explorative* (delivered *over time* through collaborative social influence). The capacity for balancing between coordination & control (the exploitative) and collaboration and influence (the explorative) to keep an organization “in kilter” is known as “ambidexterity” [29]. It is suggested that this ability to *dynamically balance* between the *exploitative* and the *explorative* is indicative of a systems ability to “problem solve” and, therefore, of its health.

As humans learn, it is contended that they develop a critical capacity for problem solving based upon their individual social system model. This capacity for systems and critical thinking can be taught and is seen as a necessary pre-requisite for understanding and dealing with complexity. In this regard, from Lever et al. [30], it is considered that:

**Systems Thinking** may be the ability to determine appropriate options for leading, managing, designing, engineering and modeling complex systems, taking adequate *empirical* account of different system types, configurations, dynamics and constraints, and;

**Critical Thinking** may be the ability to ask the right questions and make useful sense of information that is technically complex, incomplete, contradictory, uncertain, changing, *non-ergodic* and subject to competing claims and interests.

After Dreyfus & Dreyfus [31], it is suggested we all have an individual ‘meta-datum’ that *reference* what is posited as our “metadetic spheroid” [31-33]. This gives rise to concepts of “metadetic-datum”, with similarities to a geodetic datum used to “reference” the spheroidal model of the earth being applied, e.g., World Geodetic System (WGS) 84. Individual metadetic spheroids may be broadly similar. How they are referenced – in other words their datum – is seen to affect how humans’ process information and what they perceive. A metadetic-spheroid is an individual’s model (no matter how incomplete) of the sociodetic-spheroidal “beings” / organizations they inhabit; see Fig. 1. The meta-datum achieves the best “fit” of an individual’s metadetic-spheroid to what may be described as its “sociodetic-spheroid” describing the overall model of the related social system.

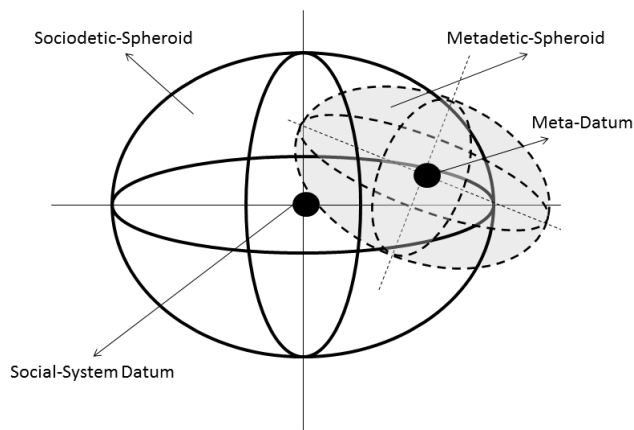


Figure 1. Sociodetic / Metadetic Spheroids and Datums

Bunge [34] maintains that ‘perception is personal; whereas knowledge is social’. An individual’s perception of their “sociodetic spheroidal system” is incomplete. Only by “collaboratively connecting” with “others” metadetic spheroids may an individual begin to “map” the sociodetic spheroidal whole. It is this process of “collaborative sensemaking” that moves what is effectively static, positional information and data to the social and dynamical knowledge of “being”.

Markov chains applied within Bayesian Belief Networks [35] were considered by Logan and Moreno [36] in terms of ‘Meta-State-Vectors’ referenced to ‘Meta-Data’ [31-33]. Meta-State-Vectors (MSVs) relate to the idea of some information containing “indicators” that will be identified immediately against an individual’s metadetic-datum without the need for preamble / additional processing. MSVs are therefore distinguishable from serial information; from

which ‘expert’ human processors ‘can form diagnostic hypotheses and draw rational conclusions from system patterns [and] *critical* reflection of their own meta-datum’ [31]. In terms of collaboration and shared awareness, this should enable individuals to ‘make better use of one another’s expertise’ [37], particularly if ‘authenticated’ [38], validated and verified.

In a social system, there also exists the risk of knowledge blindness or “blind knowledge” [39, 40]. Models of “info/techno-socio exchange” and “socio-info/techno knowledge capture” therefore need to differentiate ‘between the active physical and technological capture of data and information’ [41, 42] and the socio-info/techno exchange of knowledge [43-48]. To understand how the best “fit” is to be achieved between the info/techno-socio “machine” and the socio-info/techno organizational “being”, it is necessary to identify the system’s ecology and its purpose / role within it. If an organization’s purpose is to problem solve, then how it maps its sociodetic spheroid and positions its datum will determine its health and future fitness judged by its ability to ‘test for both success and failure’ [49].

### III. INSTRUMENTING THE CYBER

At the turn of the millennium, the old UK Defence Research Agency (DERA) was undertaking trials of networked soldiers at the British Army Training Unit in Suffield (BATUS), Canada. Soldiers had all been issued with GPS. As reported to the first author, the result was “digital” in terms of the troops’ movement, which was recorded as being “stop and go”. Troops would stop, find out where they were, report their position and then move. The researcher removed GPS from the soldiers and caused them to return to map and compass. The result was dramatic. Soldiers began to interpret their datum against the map and to use their senses to determine progress. They used the compass to provide analogue direction and their bearing to dynamically align their datum.

After the Heisenberg principle, Price [50] suggests that ‘it is impossible to determine simultaneously both the position and momentum of a particle with any great degree of accuracy or certainty’. This led the first author to surmise a potential metaphor for the modern age: ‘that we *know* precisely where we are but we no longer *know* where we are going’. Although causality is hard to attribute [51], it may be possible to apply the Heisenberg principle as a useful rule-of-thumb when designing dynamic (non-ergodic) systems by suggesting that:

‘the more precisely one measures a position, the less able one may *identify* change, over time, and vice versa’[18].

This has specific implications for system designs noting the predilection in recent years to emphasize metrication and the setting of targets / goals etc. for managing organizations. Reported separately [18, 52], instead of improving shared

awareness, the excess of information and targets required as a form of control can detract from work [53] and so collaboration and shared awareness. This suggested that reducing collaborative and shared awareness impacts negatively an organization’s ability to problem solve. *Ipsa facto*, these *exploitative* type organizations become unhealthy and potentially, even, risky places to be.

In addressing the failures of government and collective (collegial) intelligence prior to 9/11 and the Iraq War, the US 9/11 Commission [54] and the (Lord) Butler Enquiry [55] in the UK identified the failure of governance specifically in terms of the *digital ecologies*, then in existence. What they saw was that essential information existed, but that it was being missed, mislaid and, critically, not *shared*. Furthermore, they saw confusion between data, information and communication networks (essentially ICT) and what was being identified and abstracted in terms of *knowledge* and actionable intelligence that could be appropriately *shared* and *used* across government, in real time. Busy Secretary’s of State, Ministers, government officials / business / industry / financial leaders and project / programme directors, managers, administrators, users, agents and other consumers of *actionable intelligence* were being overwhelmed in a deluge of data and information technology, process and methodology that was quite literally *blinding them* to what was vital; what was strategic; what was operational; what was routine; what was base level knowledge (against which change and perturbations might ‘show up’ (be *envisioned*)) and what was simply background *noise*. Organizational structures had not simply atrophied but had become ‘tuned out’ – no longer able to select between the vital *weak-signals* of innovation, adaptation and change (as threat or opportunity) and the *strong-signals* of method and process [21-23, 56, 57]. Recommendations arising from 9/11 [54, 55] and the Global Financial Crisis were three fold: firstly has been to require greater transparency e.g., between the banks, investors, borrowers and governments; secondly, has been to demand greater regulation and thirdly, to move away from the need to know control model towards what has been described as the three needs model – need to know; need-to-share; need-to-use (3NM) [42].

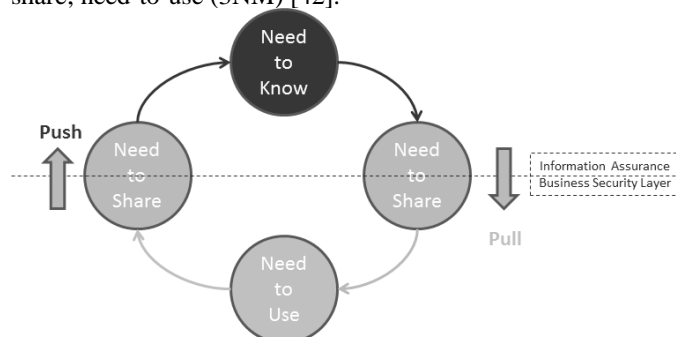


Figure 2. Three Needs Model (3NM)

*Knowledge blindness* [40] was also seen in the run-up to the Global Financial Crisis (GFC), when public and private organizations / individuals capable of identifying alternative *futures* were no longer able to communicate / be listened to: ‘It is remarkable that the advanced research and assessment group...put the danger of a global financial collapse into the [UK] draft national security strategy [in 2005/6], but were told to take it out, presumably for political reasons, before it occurred’ [58].

In this respect, Szilard’s warning that ‘information is expensive to acquire and use’ [59] and Bunge’s recognition that ‘knowledge was social’ [34] had been potentially lost in the *noise* of new IT, methods and processes. The Lodestone project was conceived from this confusion and a recognition that ‘today’s economy and society is totally reliant on technology as an enabling force for all economic and societal activities’ [60]. It identified the potential of societal cascades in which ‘a failure of a very small fraction of nodes in one network may lead to the complete fragmentation of a system of several interdependent networks’ [61]. The series of cascades considered at the time (2009/10) included UK strategic failure in Iraq and Afghanistan [62] and the global financial crisis. Significantly, an undermining in binding societal trusts and assurances were seen simultaneously to be occurring / had the potential to occur, such as the UK MPs honors and expenses scandals; connecting to the phone hacking scandal that implicated media, police and politicians; to the failure of the BBC to protect young and vulnerable people; to the 2010 UK student riots and the 2011 “London” riots. Each of these cascades began / was exacerbated in the Cyber as, potentially, they will also be resolved.

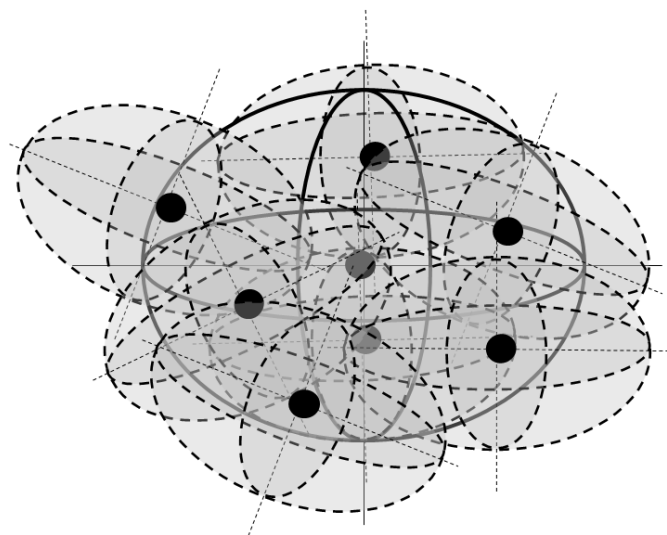


Figure 3. Multiple Meshed Sociodetic / Organisational System Model

Consequently, it was seen as being necessary ‘to protect...information infrastructure technologies...a strategic

core [of] which must be maintained i.e., the Critical National Infrastructure (CNI) / Critical Information Infrastructure (CII)'. It was recognized that 'small incremental changes and / or large-scale modifications can drastically shape and reshape both the economy and its society with known and often unknown consequences, due to ever-increasing interconnectivities and growing complexities ... especially, the information technologies that have come to pervade virtually all aspects of life' [63] – hence “societal cascades”. This led to the development of an ‘Assurance Case Approach methodology for individual CII assets to input into the larger Business Information Environment’, ‘the development of a *Mesh* case that can be visualized as the 3-D atomic structure of a molecule’ and which ‘provides a lateral approach for interdependencies between individual assurance cases’ [60]. The “multiple” mesh envisioned represents the sociodetic spheroidal “being” described by Fig. 3 and relates to both interdependencies and assurances to provide overarching confidence in the system whole. Protecting the system whole and providing for resilience and responsiveness required a flexible, adaptive and *ambidextrous* CSI ‘approach over time and real-time’, CRC mechanisms for interacting directly with ‘dynamic information ecosystems’ [60], in time.

#### IV. SETTING CYBER STANDARDS

Regulations and controls can be antithetical to creating a shared aware and collaborative ecology and enabling the necessary transparencies for encouraging good behavior and discouraging bad [52]. The three needs model aims to create an information assurance / business security layer between the user (pull) and the knowledge (push) custodian [42], see Fig. 2. There are significant challenges to the managing of information and data allowing for successful, inclusive means for identifying / testing when information and data has been tampered with, changed, added to or where leakage points may occur. Examples include the loss (probably through accounting errors and multiple packet switching) of sensitive materials, e.g., in the explosives industry for products that have to be accounted for to the milligram. Similarly, limited information and data tracking (including asset tracking) e.g., in the health service, means that safety critical equipment can become mislaid or misapplied; so placing patients at risk. During the recent Europe-wide meat scandal an inability to track information and data and test / verify it for validity at key stages of the supply chain, enabled graft and fraud to take place across the whole.

Throughout history, successful economies have been based upon the accurate and reliable “assaying” of materials, such as metals (gold) and food. These social transfer points also became the opportunity for reliable trade and pricing moments and so taxation. Scales and weights were regularly tested and subject to daily public scrutiny – they created *transparencies* for encouraging good behavior and identifying bad. Similar open-social “assaying standards”

that can be used to assess information and data in terms of its goodness, purity and proof are harder to find. And there is not a simple and readily available *instrument* such as a “scale and weights” or “map and compass” that can be applied unobtrusively at different stages of often complex supply chains to verify and validate information & data flows and leakages. This does four things: it limits transparencies; so encouraging graft / crime; consequently reducing the opportunities for legitimate business / taxation and discouraging good behavior.

In his theory of the firm, Coase [64] argues that the reason for firms forming is to enable ‘employer and employee relations with regard to cost’, which ‘were necessary to understanding the working of firms and organizations’. He suggested that ‘governance is chosen in a cost effective degree to infuse order, thereby to mitigate conflict and realize mutual gain’ [64]. It follows that regulations and controls that fail to ‘mitigate conflict and realize mutual [collaborative] gain’ create unhealthy ecologies by limiting organizational problem solving capacities [52]. In his Law of Requisite Variety, Ashby [3] maintains that ‘only variety can *control* variety’ and that ‘for every control one needs a controller’. Reported separately [18, 52, 65], ‘organizations under control, may never be more shared aware than the sum of their links’. By contrast, organizations that enable collaborative social influence can ‘generate, on average, 12.5% more [linkages] than formally specified’ [18]. Furthermore, these organizations can adapt, over time, to different levels of control. In other words, these ‘new’ linkages also provide the ‘variety necessary to *control* variety’ – so meeting Ashby’s Law of Requisite Variety.

#### V. A NEW METADETTIC

In setting Cyber Standards, the issue appears two fold. First, to create inclusive standards through ‘the *synergistic* combination of *civil* mechanical *systems* and the management of *interconnected* knowledge, information (and data) *infrastructures* in the *designing* and *composing* of *adaptive* (resilient and sustainable) organizations’ [14], that readily encourage openness and transparencies and can be easily *assayed*. Secondly, is for these standards to encourage collaborative shared awareness, from which new controls and pricing opportunities and markets may emerge. Thus, inclusive standards for information / data “packet-switching” may create opportunities for “packet-marketing” and so for pricing and taxation. This returns to *standards* acting as social *instruments* that, through their very “being”, can *synthesize* the info-techno and socio to create opportunities both for collaborative *exploration* and *exploitative* control – or *ambidexterity*. It is suggested that creating socially inclusive and acceptable *standards* for *assaying* the goodness of information and data enables this *synthesis*. This leads potentially into a third area to do with the synthesizing of Cyber Standards, introduced in Section III and by Figs. 1 and

3. It is suggested that how social reference-standards are designed to be inclusive of the machine and the organization and are best “fitted” to their organizational (sociodetic) systems, may potentially be considered as the subject of “metadetics”.

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