Cab Sharing, Free Energy and the Importance of Proximity

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***Abstract*—This paper introduces a multi-disciplinary approach and new paradigm through which to assess the interplay between technological advancements, and their impact on human social structures and cohesion. We promote a paradigm built upon an interdisciplinary analogy which uses experiences from the fields of Physics, Biology, Sociology, Planning, Anthropology, Engineering, Pedagogy, and Communication. We are promoting a paradigm of Social Complex Adaptive Systems (SCAS). This builds upon established ideas of Complex Adaptive Systems (CAS) by emphasizing components of social learning, adaptation and communications for CAS. A seminal point of our argument is the multi-modal and iterative processing of data and stimuli assessments undergone by individuals and social groups (referred to as SCAS), which require experiences and actions undergone within shared spaces that lay the foundational structures upon which trust is built. Were proposing a conceptualization of human communications which surpasses notions of language, economy, and cognitive sensory input. These ideas are embedded with the constructs of complex adaptative systems, and use complex algorithms, including stochastic and chaotic methodologies to develop deeper understandings of the iterative and adaptive processes SCAS undertake, as they adjust to constraining forces. We conclude with a call for greater awareness of the context and limitations in which technologies are being embedded and from which they are emerging, and the need to create meta structures that are responsive to systemic constraints.**

***Index Terms*—Social Complex Adaptive Systems, Systemic Constraints, Social field theory, Globalization, Technology and Social interface, physics, Communications, Big Data.**

I. Introduction

This paper came about because four researchers, each in different disciplines, came together to share a cab for their daily commute to work. The duration of their daily proximity to each other, led not only to the sharing of ideas, but also, a sense of friendship and trust, which resulted in risking new ventures for collaborative research. Trends in globalization and technological advances have facilitated the creation and maintenance of social networks and knowledge by way of virtual experiences and communication modalities.

New technologies are looked-upon and advanced as a panacea for all problems: from poverty to global warming; yet, several studies have pointed to the negative effects resulting from social media, and ineffectiveness of virtual learning experiences, among other issues [1]. However, as engineers and businesses have raced to capitalize on the promises of technological intersection through the exploration and expansion of materials and their structural constraints, there has been an almost concomitant willfulness to ignore human and social constraints. In an era when communications seem unfettered by constraints of geography, time or space, and dystopic imagery of The Matrix, and a world reduced to purely data analysis seems to be lurking just beyond the next technological horizon; it is incumbent that contextual understanding is incorporated into technological meta-structures [2]. Through research in Anthropology, Linguistics, Sociology, Psychology, and Neuro-Linguistics, much has been learned regarding human and social constraints for communication, learning, organization and adaptation.

The model used in this paper is based on a Social, Complex, Adaptive-Systems (SCAS) approach, which, provides a way to understand the human and social dynamics constraining end-user capacity. This model emerged through interdisciplinary work and processes begun by [3] and carried forth by this team; it was introduced in greater detail in another paper. Key attributes to note from this model are that societies are complex adaptive systems, meaning that they have the following traits: (1) They are composed of embedded systems. (2) Those systems engage in chaotic, random, and iterative ways with each other. (3) SCAS engage in group /social learning, which is neither dispersed nor integrated in defined ways.(4) SCAS willfully seek to sustain and organize themselves; thereby exercising agency. (5) SCAS resilience is based on three primary sustaining forces, which are in constant interaction with constraining forces. (6) Social groups are comprised of individuals, which are in turn complex adaptive systems, onto themselves. (7) Each individual system has a functional role, embedded within a larger system, which may, or may not conform to higher order functionality. (8) Language and economic exchange processes are primary methods of exchanging ideas, but not the only form of data and sensory exchange among SCAS. (9) SCAS grow, and finally, (10) all adaptive systems have both internal and external constraints at multiple levels. Moreover, none of these processes occur in a single linear fashion, but instead, often happen in opposition to other systems in which they are embedded (e.g. individuals and groups), and these processes run concurrently on multiple platforms.

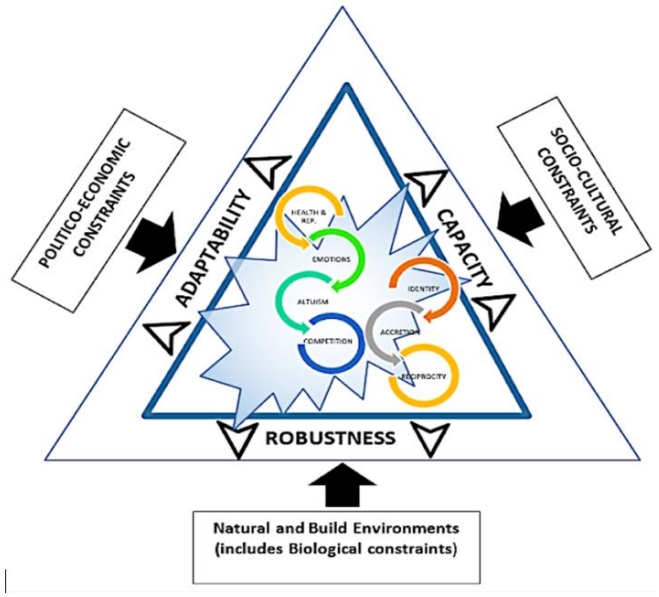

Fig. 1: SCAS Resilience Model.

This paper will focus primarily on using the Social Complex Adaptive Systems (SCAS) model, to provide an holistic approach for analyzing and interpreting how human and cultural constraints interface with technology through iterative and chaotic processes. By being able to visualize how adaptive systems interface, engage, and encompass each other, we hope to provide a new paradigm, which can promote a better understanding of systemic resilience. We want to bring focus to current systems and biological tendencies that rely excessively on reductionists and linear logic as an end measure of systemic function and productivity. Instead we are promoting a model that aggregates knowledge from various fields and focuses on complex dynamics by emphasizing the fact that many issues and concerns are best seen and understood at higher levels of complexity, much like the phenomena of climate change. Conceptualizing dynamic actions and adjustments through this model allows one to understand some of the challenges arising from the increasing data processing demands of new technologies on social structures [4]. These data processing demands equate to additional systemic pressures, and behoove taking into account cultural and biological constraints when developing the next generation of technology and interconnectivity, to address fundamental challenges associated with institutional trust and cohesion. By using the model proposed and focusing on the human constraints, one can see how societal complexity is growing exponentially and is already beginning to overwhelm human capacity for adaptation.

II. PHYSICS AND COMPLEX ADAPTIVE SYSTEMS

Among the primary constraints that regulate human interaction and learning are a tendency for heuristic thinking, and a predisposition for desiring and recognizing predictable patterns and rhythms [5]. These processes often lead to creating manichaeistic world views, especially in times of stress. Humans consistently exhibit an avoidance of change, a preference for visual information, a focus on the present, and a need for social interactions [6], [7]. These concepts refer to human tendencies to learn and understand the world by creating shared meanings based upon past experiences, categorizing knowledge and beliefs into dichotomous and opposing propositions, and having a temporal orientation for the present. Change or loss, especially when it is unanticipated, is normally resisted, often, even, when the initial conditions promoting the change were sought [8], [9]. Culture, which refers to all learned and shared behaviors and beliefs, can ameliorate some of these tendencies, but does not substantially change them. This means that technological innovations should account for human and cultural constraints when creating the infrastructures and mechanisms for disseminating innovations, which inevitably become agents of change.

The Social Complex Adaptive Systems (SCAS) model we are advocating can be used as both a method for devising and analyzing societal adaptation to technological changes. Taking inspiration from biology and physics we are proposing a new way to conceptualize the roll-out and development of 5G technologies and the next generation of innovations. This approach breaks from the traditional way of conceptualizing technological advancement as unidirectional; to one that promotes systemic resilience and adaptation, by understanding and recognizing the forces that both sustain and constrain all systems, as shown in Fig. 1. The model is based on the assumption derived from field theory that recognizes field dynamics from the quantum to astro-scales. We believe all human life and dynamics are also subject to those same forces, but have always been studied through different paradigms and hence have used different concepts for explaining dynamic actions. We use the same five fields identified in Physics, and add two additional molecular fields, since we believe they function at higher energy levels. These fields are the primary impetus driving motion and action for all SCAS [7].

III. FIELD THEORY MEETS CULTURAL NORMS

The SCAS models presented, herein, provide a more holistic image of energy transfer, involving ideas of iterative and chaotic actions, which incorporate greater levels of complexities and the scales of analysis increase. The fields proposed for SCAS and their respective bosons have been identified through parallel functional equivalences [10]. They are as follows (bosons [in brackets]): (1) Strong field= Social identity/bonding [synchronicity], (2) Weak field= emotions [positive/negative/neutral sentiments], (3) Electromagnetism = Communication [reciprocity], (4) Gravity = Accretion [yearning], (5) Higgs = substance or Matter [attention]. The two additional MOLECULAR fields are (6) Autopoiesis [organization and fertility] and (7) Competition [parity and dominance]. These seven fields permit the transfer of energy, power, and resources between institutions, individuals and our environment. They have driven human, social history and our relationship with the physical and built environments, but as in quantum physics, not all subcomponents will engage with each field equally.

Biology is unique because of its ability to propagate and auto-adapt to external stimuli, but it is not exempt from the laws of physics [11]. Therefore, the social world, derived and constructed by humans (i.e. biological beings), is also confined to the laws of physics, and mirrors the physical world. Social constructs, including language and culture, are products of physical and biological entities; thus, the same laws and relationships found in the physical world constrain and support our social world, including the forces described in field theory. Social constructs are embedded within complex adaptive systems, and replicate physical laws, though they have often been described and studied through the prism of a different paradigm. These social structures operate to constrict, direct, and propel energies, in similar ways that mechanical structures function. But, because they are social, they require a collective learning processes, and when engendering change, a cognitive one. Because humans are naturally distrustful of change, such processes also require collective trust, or great pressure for the change to occur on large scales.

IV. SPOOKY ACTION AT A DISTANCE

Physicists from Leo Kouwenhoven to Tim Palmer have began to explore the complex interconnections between matter and human ecosystems, which result in awareness and process evolution. Examples of some of these types of processes have shown that concepts akin to superpositioning, and multi-modal data processing occur within complex adaptive systems, often resulting in forms of knowledge the circumvent normal cognitive processes. These forms of knowing are given terms such as intuition, vibe, feeling and gut reactions. These terms point to ways of data processing or stimuli manipulation that are not based on formalized logic, education, or even consciousness; but which illustrate that SCAS have multiple methods of learning and adapting to constraints. Many of these methods are not well understood, conceptualized nor even formally acknowledged, but are reminiscent of concepts related to superpositioning: from intuition to cultural and educational transmissions to zeitgeist [12]. Everyone has experienced moments in which they have felt a connection or sense of something, or to something, they could not explain. This is one small instance to illustrate how biology and culture have worked to constrain human knowledge.

Due to language limitations, and belief systems those moments are often regulated to epistemologies that do not intersect with daily life. This is particularly true in the West; thus, exemplifying the Manichaeistic tendency to divide experience and knowledge into black and white categories. The West has relegated almost all non-heuristic knowledge to the realm of unscientific and hence not relevant. Moreover, a cultural norm has developed emphasizing only that which can be objectively measured has validity. These two trends have worked to undermine all knowledge and data processing that SCAS undertake which are not directed through cognitive processes. However, recent advances in mathematics and physics has begun to provide proofs of the veracity of knowledge which cannot be experienced, replicated, or measured. The model we are advocating takes from these new concepts to illustrate the dynamic and counter veiling dynamics within SCAS to help conceptualize systemic challenged for the adoption of technological innovations by SCAS.

It is within the realm of common experiences that multiple modes of data exchange processes are undergone by SCAS, and they initially engender the sense of trust. Individuals share information tacitly, biologically, and through shared cultures. Studies within the field of linguistics have pointed to the importance of shared attention for the transference of meaning, and to the limited amount of information actually conveyed through speech [13]. The vast majority of human communication is embedded within biological and para-linguistic structures [14]. Speech is only the tip of the ice berg.

Language allows us to transfer those ideas and information that we have identified as mattering, and it makes possible the ability to develop shared realities and give substance to our experiences [15]. However, communication at this level is restricted to only those bits and pieces of quantum material that have engaged with the Higgs field, and all else is lost. Thus, once again, underscoring the importance of proximity for deeper levels, and more integral communication that surpasses cognition. When there is a shared context, communication is facilitated, social bonding can occur, and the request conditions for trust to emerge are enabled. Trying to transfer all that information becomes an impossibility, and information is lost and often misconstrued without an understanding of the context within which it is being used.

V. AI, 5G, TRUST, AND SOCIAL CHANGE

The SCAS model challenges human capacity for learning and understanding, since it does not provide simple heuristic or linear relationships between systemic functions. The complexities created by embedded systems and stochastic interaction require the use of algorithms and complex mathematics to model simultaneous and higher order systemic adaptations. These type of computations, in essence, run counter to human SCAS tendencies. Much of the work currently done in Artificial Intelligence (AI), Internet of Thing (IOT), Machine Learning (ML), or Computational Linguistics (CL) requires these types of algorithmic computations which go counter to heuristic logic and many cultural norms for learning and understanding. While these new computational modalities allow for enormous leaps of connectivity among processes and materials, their seemingly magical ways clash with human social norms and biological needs to create some type of ecological understanding [3].

Because most people do not understand how data is computed, know how data is acquired, or how it is organized, it falls beyond their experience, and is often something that cannot be trusted, known, or recognized as legitimate. Legitimacy and veracity are qualities given to knowledge and learning based upon only a small number of processes: replicability, experience, inference, reference, and/or authority [15], [16]. Younger generations learn the functional applicability of technology through experiences, and they trust it intuitively, since

they have not known things differently. Older generations of technology users have more to risk when changing or adjusting to new technological innovations, and do not have as much time to replicate processes for the learning of new skills. Thus, new learning techniques and modalities need to be created for them.

Adjusting to and adopting new technological innovations can be facilitated by understanding how humans learn and develop culture. When viewed from a systems perspective, new technologies are the equivalent of introducing new forms of energy into a system. That energy needs to be absorbed by the system, but to make functional use of that energy structural constrains need to exist so free energy can be extracted and utilized. That means social structures (not just physical ones) need to be developed that facilitate the introduction of new technologies. This is the functional equivalent of creating conditions for free energy, but at social scales. Older SCAS need multiple, recurrent ways of having new technologies exposed to them so legitimacy, and ultimately trust, can be conveyed upon them. Hence, it is important to find referential and authoritative mechanism that can be incorporated into different interface mode to reinforce new technological adoptions. These new mechanisms could form part of the social structures that constrain different nested systems.

If we want a SCAS to work, in this case, by adopting new technologies, then structures presented to promote technological adoption should incorporate prior knowledge, reference or sponsorship from contextually appropriate authorities, opportunities for iterative learning, and transparency of the inferential logic linking functionality. Not only do these ideas relate to how new products are introduced, but also the rate at which they are introduced. Until now, technologies have been introduced haphazardly as innovation develops, mirroring random mutations in moments of punctuated evolution. But, the sheer number of these innovations has made it unclear, if new technologies are adapting to human needs; or are humans being asked to adapt to the new technological ecosystem. In true SCAS fashion, there is an interplay between these forces, but to ensure humans stay in control, our limitations must be addressed.

In this new technological ecology, we can see that the patterns and processes being described replicate those in physics, just at different scales. Quantum fields (i.e. Strong, Weak, Electromagnetism, Gravity, and Higgs) can also be used to understand many social dynamics. In physics, gravity is often explained as matter attracting more matter; the bigger the matter, the more power of attraction it has. Humans also exhibit a propensity for accumulation; we call it accretion. This propensity is expressed beyond the obvious examples of greed, and wealth commonly pointed-out. It is expressed through a range of daily interactions: from when we satiate needs, to when people exert their power by obtaining more than they need. And, as happens with heavenly bodies, the more matter one has, the greater the individuals power of attraction. For SCAS, however, matter is achieved through attention; the social boson equivalence of the Higgs. The power of attraction is not relegated to mere physical size, but also cognitive space. This conjures notions of the fungible nature of power, which can be either attractive or repulsive. There is a tacit recognition of this reality as evidenced by common lexicon describing thematic areas of social science and social process research: e.g. power, force, efficiency, leverage, decay, etc. However, there is a general cultural negation of the complexities embedded within the phenomena, in part because, as with regular matter, not everything (or everyone) interacts equally with the various fields.

Western and Scientific cultural norms emphasize linear rationalities and heuristic learning that reinforced, as legitimate, only that which can be measured through either sensory or economic means. This reductionist approach to learning and thinking has led to contradictory notions: science and technology as potentially omniscient, or science and technology as mystical and untrustworthy. In either case, trust becomes problematic since it is based upon multiple platforms of knowing. And since knowledge is power, as technologies become more complex SCAS are relegated to fewer and fewer systems that know. This translates into new technological adoptions becomes a matter of faith. The legitimacy of the new technology is then vested in concepts of authority, creating systemic weaknesses by illuminating redundancies, transparencies and heuristics. Problems and lack of trust arise with the cacophony of confusion, misinterpretations, misapplications, and miscommunications that follow the abundance of technological innovations. The current survivalist processes create an atmosphere which does not promote symbiotic relationships or systemic progressions, but instead focuses on linear relationships based upon loyalties and individual trust. These loyalties, and in turn the authority and trust engendered by them, are built upon common experiences. Though, trust immured to common experiences, can only be diffused through a recognition of familiar processes. This need for familiarity goes counter to economic systems that deters profit making ventures from building upon known formulas by having to pay patent costs, leading to constantly new forms and patterns. However, the richness of varieties, can leads to increased robustness if the diversity is well integrated into the system. One of the challenges with SCAS, is finding the balance between diverse forces so growth will be nurtured, and not become cancerous.

VI. DIFFUSION, ATOMIZATION, AND SOCIETAL DISENTIGRATION

When conceptualizing communication, which is needed for innovation dispersal, most people are only referring to a small portion of actual data exchange and processing between individuals and groups. Albeit, there are layers upon layers of communication happening among and between SCAS; only a small portion is accessible as conscience speech or communication. A well-known example of this is the synchronization of female menstrual cycles, when fertile women spend much time together. Yet, as befalls human constraints, because we are unaware of much (if not all) of the non-verbal data exchanged

when communicating, we do not experience it, and hence discount its existence and importance. By discounting the unconscientious levels of communication, we discount much of that data processing in which our bodies engage, and which form the foundations for trust.

New communication platforms have seemingly negated the constraints of distance and shared experiences, allowing us to communicate instantaneously around the world. However, such communication is restricted to higher order transference of data through language and culture. But, in trying to reduce all communication to only verbal and visual modalities, it means that we are trying to funnel all normal data processing functions between and among humans and the environment through a very small percentage of our capacity. And in the process, we elimitate vast amounts of data upon which trust is normally built. We are simultaneously overwhelming our cognitive abilities by trying to process unfathomable amounts of information through two modalities (vision and hearing); while depriving ourselves of other forms of data that build connection and trust. And, as with matter, the greater the distance between entities, the weaker the connection, and no amount of speech can bridge the lack of data exchange that occurs within shared proximities.

The world we are currently constructing is one akin to a nuclear fallout. We are being bombarded by bits and pieces of data, quantum communication particles from all sides. All these pieces of data are energy packets that have the potential to create new photons, with nothing left to bond to. Those electrons farthest from the nucleus are often sheared off, and what we are experiencing is the atomization of societies. In times of stress, SCAS tend to fight or fly. Those in flight mode shut-out new or untrusted technologies. This is seen evidenced at national levels, like China, to individual levels, like many baby-boomers. Those fighting the system, decry the coercive and harmful effects of technology, and often call for simpler solutions. Both reactions confirm the human tendency for thinking in dualistic fashion.

This isnt to say that technology is bad, or wrong, but instead to highlight the need of providing a better paradigm and metaphor to recognize and acknowledge human and systemic constraints. By first acknowledging the importance of non-heuristic and unconscious processes and the parallel patterning of natural dynamics across all scales of analysis, we can begin to understand the need to design more human-centric technologies and the social structured needed to introduce those technologies in ways that support social cohesion and true, multi-layered, multi-modal communication.

Engineers and scientists have attempted to devise ways of addressing increases in societal complexities by creating efficiencies in communication technologies. However, in so doing, they have actually contributed to the multiplicity of energies invading SCAS. Innovations and improvements in communication technologies have greatly contributed to human creativity, and learning, but have ultimately added higher levels of complexity into human societal units. This mismatch exemplifies and exacerbates human tendencies towards heuristic and manichaeistic thinking, which when propagated through multiple iterative, systemic interactions often result in ideas and actions that obliviate nuances, safe spaces and opportunities for shared experiences. As economic and academic interests continuously focus on technological capacity building, there needs to be a simultaneous focus on the constraints of the ultimate end users.

VII. Conclusion

This is not a call to stop or slow down technological advancements, but instead expand the analogy introduced above to other fields of science, and take inspiration for how organic systems have adjusted to meet constraints when incorporating additional complexities as they developed resilience. By doing this, weve taken concepts of free energy from physics and juxtaposed them with a broad understanding of biological, and social structures to provide a holistic image of the importance of internal structures and systemic interaction in maintaining higher-order systemic resilience and integrity. To date, technologies, policies, and economic pressures have all pushed towards isolating systemic functions, and social groups, in the name of efficiencies; by eliminating internal structures and actually decreasing systemic abilities for work.

Had the opportunity for cab sharing and the primacy of proximity it provided, not occurred; the cross disciplinary and innovative approach to analyzing the interface between technology and social change may never have occurred. Many of the social challenges confronting the new frontiers of the information age, relate back to human evolution and adaptation that relied on sensory input and learning, which cognitively emphasize the visual senses, but is not relegated to only those data processing methods that are codified in consciousness. Yet, as alluded to previously, humans, and all biological creatures, have multiple sensory input methods. This means that humans take-in and process stimuli, though various methods, and have multiple systems functioning simultaneously, but they lack the cognitive awareness and linguistic ability to verbalize the various levels and modes of analysis. The more entrenched one is with the surrounding environment; the more information one can gather. Some of this information is confirmed, shared and transferred with others, setting up systems of reciprocity, which can lead to trust. However, since many of these processes occur through extra-cognitive means, they cannot be conveyed, synthesized or expressed in ways that are easily communicated through language, or virtual communication, not even video. It is the processes of reciprocity, born out of common experiences, shared time and space, which lead to linguistic and para-linguistic communication, and can evolve into trust. In this lies the power of narration.

Because virtual networks and virtual relationships short-circuit non-linguistic and para-linguistic methods of communication, and often even narration, information reciprocity is severely limited, and trust is much harder to build. Many of the basic dynamics underwriting social connections are dependent on multi-modal, data-intake methods forged through shared experiences in time and space. These shared experiences, form

the narratives of ones life and, are moments of synchronicity with others. Interactions of higher intensity (multiple systemic interactions) and longer duration lead to greater synchronicity among individuals and strengthen group bonds. However, this level of connection requires proximity. It is through group bonds that social identity is formed, a cornerstone of SCAS. The function of Social Identity or bonding is analogous to that of the Strong Force within field theory, As societies become more complex and adapt to absorb greater diversity and higher energy inputs through increased densities, the human components undergirding social unity are pushed against biological and cultural constraining pressures, weakening social resistance. The Challenge for emerging communication technologies are how to create communication structures that accommodate human limitations by including multi-modal forms of communications and addressing the diversity of SCAS. Technological advancements and innovations need to be made which will facilitate social cohesion by being integrated into diverse spaces and platforms, while promoting mechanisms for shared experiences and trust building.

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