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AUGMENTED AI-KNOWLEDGE DRIVEN INTELLIGENT SYSTEMS FOR ADVERSARIAL-DYNAMIC UNCERTAINTY AND COMPLEXITY

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SISTEMAS INTELIGENTES CONDUZIDOS POR CONHECIMENTO DE IA AUMENTADA PARA INCERTEZA E COMPLEXIDADE DINÂMICA ADVERSARIAL

Resumo

Objetivo: A ISO 31000 Risk Management (RM) recentemente redefiniu o risco como o efeito da incerteza na capacidade de uma organização de atingir os objetivos. Anteriormente, definia o risco como uma combinação da probabilidade e do escopo das consequências (previstas). O ISO Risk revisado avança para além de um mundo estático guiado por previsão e predeterminação com base em dados históricos para um mundo dinâmico caracterizado por incerteza e complexidade focado em resultados de negócios sobre entradas de dados. Nossa P&D de Gestão do Conhecimento (KM) adotada por organizações globais como a Nasa e Big Banks é prontamente aplicável para fornecer uma vantagem inicial de 25 anos para organizações com evolução de risco acima da ISO. **Resultados:** Nas últimas duas décadas, desenvolvemos estruturas teóricas e aplicadas para o mundo dinâmico caracterizado pela incerteza e complexidade, com resultados de negócios como impulsionadores de desempenho em tempo real, em vez de entradas de dados. Nossa antecipação voltada para o futuro do foco surpresa de KM impulsiona a futura adaptação organizacional, sobrevivência e competência em face da mudança ambiental descontínua em organizações como a Goldman Sachs. Nosso foco em KM gerencia a mudança, a incerteza e a complexidade como alvos primários (resultados), em contraste com as abordagens baseadas em dados (entrada). Seu foco na incerteza dinâmica é complementado pela incerteza adversária do ambiente ciberadversário. **Originalidade | Valor:** A incerteza quântica – encapsulando os dois tipos de incerteza – e a complexidade do espaço-tempo de ambientes cada vez mais não determinísticos e estatisticamente não normais e não lineares são o foco de nosso desenvolvimento de P&D de KM de mentes quânticas. Nossas práticas mais recentes de IA-Cybersecurity KM estão avançando no futuro dos sistemas de gerenciamento de batalha C4I-Cyber-Command-Control-Advanced do Pentágono e da computação em nuvem ágil e resiliente centrada na rede da AWS.

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Palavra-chave: Engenharia de agilidade e resiliência cibernética, Mentes quânticas e sistemas complexos autoadaptativos, Incerteza quântica e complexidade espaço-tempo, Práticas de gestão de risco Líder, ISO 31000, Padrões de gerenciamento de risco

AUGMENTED AI-KNOWLEDGE DRIVEN INTELLIGENT SYSTEMS FOR ADVERSARIAL-DYNAMIC UNCERTAINTY AND COMPLEXITY

Abstract

Goal: ISO 31000 Risk Management (RM) recently re-defined risk as the *effect* of *uncertainty* on an organization's ability to meet the *objectives*. Earlier, it defined risk as a combination of the *probability* and scope of the (predicted) *consequences*. The revised ISO Risk advances beyond a *static* world guided by *prediction* and *pre-determination* based on *historical data* to a *dynamic* world characterized by *uncertainty* and *complexity* focused on *business outcomes* over *data inputs*. Our Knowledge Management (KM) R&D adopted by global organizations such as Nasa and Big Banks is readily applicable to provide a *25-year head start* to organizations in above ISO risk evolution. **Results:** Over the last two decades, we have developed theoretical and applied frameworks for the *dynamic* world characterized by *uncertainty* and *complexity*, with *business outcomes* as drivers of *real-time* performance rather than *data inputs*. Our forward-looking *anticipation of surprise* focus of KM drives *future organizational adaptation, survival and competence in face of discontinuous environmental change* at organizations such as Goldman Sachs. Our KM focus manages *change*, *uncertainty* and *complexity* as primary (outcome) targets in contrast to *data-driven* (input) approaches. Its focus on *dynamic uncertainty* is complemented by *adversarial uncertainty* from *cyber-adversarial environments*. **Originality | Value:** Quantum uncertainty – encapsulating the two uncertainty types – and time-space complexity from increasingly non-deterministic and statistically non-normal and non-linear environments are the focus of our KM R&D underpinning development of *quantum minds*. Our latest AI-Cybersecurity KM practices are advancing the future of Pentagon's C4I-Cyber-Command-Control-Advanced Battle Management Systems and AWS Network-Centric Agile-Resilient Cloud Computing.

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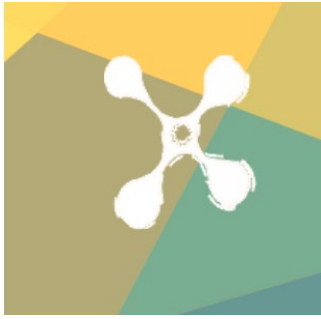

Keywords: Agility and cyber-resilience engineering, Quantum minds and self-adaptive complex systems, Quantum uncertainty and time space complexity, Risk management practices Leading, ISO 31000, Risk management standards

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1. Introduction

As gathered from the latest circulated draft on social media, the ISO 31000 Standard on Risk Management (RM) would aim to be an international standard that provides principles and guidance for effective risk management. It would attempt to prescribe a generic approach not specific to any industry or sector, with potential applicability to any type of risk (financial, technological, natural, project), applicable to any type of organization. It provides a foundation for discussing risk management and undertaking a critical review of an organization's risk management process.

The ISO 31000 aims to propose definitions and terms relevant to risk management, set of principles to inform risk management and recommendations for establishing a risk management framework and risk management process. Based on our review of the ISO 31000 draft document, we find that such definitions advance its legacy focus on physical safety in line with notions of risk followed across Finance and IT industry practices for years. Additionally, ISO 31000 doesn't include any focus on detailed instructions/guidance on how to manage specific risks, advice relevant to any specific domain, and any elements related to certification. In absence of relevant industry specific and/or domain specific examples that have been applied or validated in real practices, there is a critical applied-practical need to address the above gaps to connect the abstract guidance with concrete applied and industry-validated practices. This paper specifically focuses on R&D ranked for impact among Nobel laureates that is leading global industry practices bridging the above gaps. (ISO, 2018)

Silicon Valley venture capitalist, Roger McNamee, mentor to Silicon Valley Big Tech CEO, has implored Silicon Valley to embrace human-driven social networks that *empower* rather than *exploit* users as the *next big thing*. As pioneer of such global digital networks, we were invited to guide Silicon Valley Venture Capitalists and CEO on

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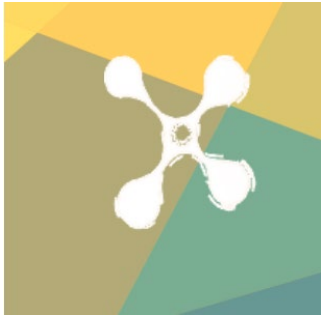

building Global Digital Enterprises for the Wild Web over two decades ago. Not many had foreseen how Wild that Wild Web was going to be 25 years later. Our ventures advance our Silicon Valley-Wall Street-Pentagon-Global CEO-CxO Networks as the *next big thing*, the lighthouse guiding the world across the world overflowing with unprecedented uncertainty.

Our global digital social enterprise, Global Risk Management Network (GRMN), has been leading scientific R&D driven uncertainty management practices applied and validated worldwide for last three decades. GRMN built the world's first top-ranked digital site (Computerworld), search engine, and social network and the world's first, foremost, and largest global digital transformation network adopted and recommended by world-leading global business, technology and government industry leaders, CEO, CIO and CxO. Our digital networks, practices, technologies, and ventures continue to lead industry practices. Our latest digital ventures are Silicon Valley's *next big thing* with a track record of industry-leading R&D building global industry-leading digital practices for three decades, built in collaboration with the United States Air Force Research Lab Commercialization Academy.

Recognized as *your survival network for the brave new world of business*, their raison *d'être* lay in post-WWW "*radical discontinuous change*", *uncertainty* and *complexity* from unprecedented *hyperconnectivity* and *hypervelocity* of global information flows starting with the beta version of the first WWW browser. Our original mission to educate, enlighten and empower worldwide knowledge workers underpinned our latest e-*knowing*, e-*building*, and e-*monetizing* ventures. With the three key focal aspects of digital life as being digital search, digital learning, and digital work, these ventures lead digital transformation of search, learning, and work advancing to the next decentralized

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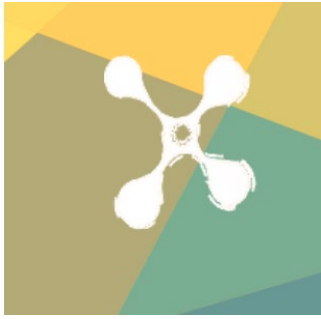

phase of Web 3.0 and DeFi (Decentralized Finance) and the current global social creator and influencer economy.

A recent example of such contributions is our 2022 invited presentation at the State of New York Governor sponsored New York State Cybersecurity Conference where we launched the global CEO and boards guidance on post AI-Quantum Cloud Computing with related industry report as well as conference presentation. Our 4th annual invited presentation on the above New York State Capitol forum advances our mission as Amazon Web Services (AWS) partner building the future of the cloud for addressing the challenges of quantum uncertainty and time-space complexity. Building on the synergy of shared educate, enlighten and empower missions of GRMN and AWS, our related digital venture capital practices are leading and guiding global and national venture capital and private equity firms CEO-CxO teams for building ventures aligned with our *knowing-building-monetizing* focus.

2. Results

2. 1. Uncertainty: the only certainty since the beginning of the WWW

ISO 31000 Standard on Risk Management (RM) recently re-defined risk as the *effect* of *uncertainty* on an organization's ability to meet the *objectives*. Earlier, it had defined risk as a combination of the *probability* and scope of the (predicted) *consequences*. In our view, the revised ISO Risk aligns world's future risk standards with our industry-leading risk and uncertainty management as well as risk and uncertainty modeling practices adopted by worldwide organizations as diverse as the global Big Banks to the National Aeronautics and Space Administration (Nasa). Our global industry practices spanning Silicon Valley-Wall Street-Pentagon-Global organizations are adopted and recommended by leading business and technology accreditation associations.

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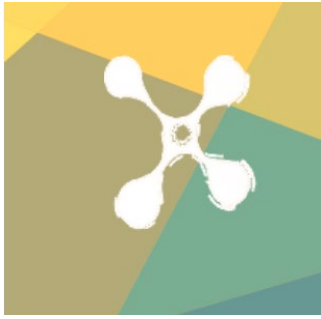

We have developed rich frameworks and models on how to manage specific risks, and related advisory practices relevant to both general and specific domains, with industry leaderships spanning United States and world governments; global science, computing, and cybersecurity leadership organizations such as National Science Foundation; management and leadership programs such as MIT and Princeton, and world development organizations such as the United Nations world HQ. From our origin as the Silicon Valley-Wall Street-Pentagon-Global Digital pioneer built on world's first top digital site-search engine-social network our digital transformation practices are adopted and recommended by worldwide leaders and global organizations. Our related industry keynotes and expert papers continue to advance upon our scientific, scholarly-academic research ranked for global impact among Nobel laureates such as by world's largest business and information technology accreditation organizations and associations such as AACSB and ASIS&T.

The ISO 31000 proposes risk management standards to advance beyond a *static* world view guided by *prediction* and *pre-determination* based primarily upon *historical data*. Adopters of ISO 31000 in real practices can immensely benefit from our three-decade long practices leading a *dynamic* world characterized by *uncertainty* and *complexity* with focus on *business outcomes*. Instead of remaining stuck in the obsolescent paradigm of *IT for managing data and information*, our *human-driven social networks* represented a significant departure in the 1990s from the *textbook focus* of most information and systems related academic *textbook* views by their pragmatic choice to focus on managing what we believe really matters – *change*, *uncertainty*, and *complexity*, and now the world believes so.

After the turn of last century, our digital social enterprise has been most recognized for developing and disseminating worldwide its basic and applied view of *non-*

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deterministic uncertainty and risk management for detecting and pre-empting risk management failures for increasingly unpredictable and complex business environments. On the dawn of the global financial crisis, our long-term perspective on *change*, *uncertainty*, and *complexity* was brought into mainstream focus in terms of extreme events and *black swans* a decade after we published research with related interviews in premiere industry press.

2.2. Why knowledge management systems fail? How to mitigate risk of such failures

Our Knowledge Management (KM) R&D adopted by global organizations such as Nasa and Big Banks can provide a 25-year head start to organizations at different stages of adoption of ISO 31000. Over the last two decades, we have developed theoretical and applied frameworks for the dynamic world characterized by uncertainty and complexity, with business outcomes as key drivers of real-time performance rather than data inputs. Early adopters of our Silicon Valley-Wall Street-Pentagon-Global CEO-CxO networks practices such as at the global investment banking, securities and investment management firm Goldman Sachs are examples of global organizations that have applied our practices. Examples include *forward-looking anticipation of surprise* signature focus of KM-driven *futures* built on *organizational adaptation, survival and competence in face of discontinuous environmental change*. That specific signature-focus of KM is evident across our published KMS research leading global practices such as for clients including Accenture Founding Partners, the Intel Corporation, McKinsey Silicon Valley partners and shared in invited global interviews such as with The Wall Street Journal, and editorial reviews of world-leading practices on self-adaptive complex systems such as in The New York Times and The Wall Street Journal. Related *working definition* of KM that we had originally proposed 25-years ago and discussed in above

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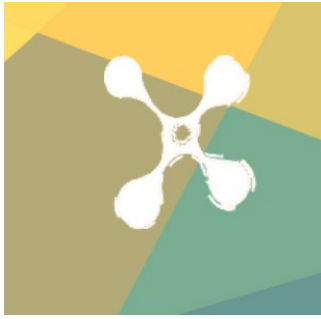

forums has withstood the test of times: *Knowledge Management refers to the critical issues of organizational adaptation, survival and competence against discontinuous environmental change. Essentially, it embodies organizational processes that seek synergistic combination of data and information-processing capacity of information technologies, and the creative and innovative capacity of human beings*. It is the foundation of several key core constructs underlying advanced technologies including AI and Quantum Computing such as Augmented AI, Human-Driven AI (HAI), Meaning-Aware AI, and, Meaning-Aware Quantum Computing, among others.

Our focus is on managing *change*, *uncertainty* and *complexity* as the primary *drivers* of business performance in contrast to *data-driven* approaches. In our view, published across industry-leading, top-ranked and award-winning R&D, a world without any *unpredictable* change, uncertainty and complexity would be the ideal domain for a *data-driven* approach where the historical data from the past would be adequate-sufficient to guide future destiny.

In contrast to above theoretical-controlled focus, the real world, in contrast, is characterized by what Wharton School professor Russell L. Ackoff, my PhD advisor, had called *messes*. He had most notably underscored that *managers don't solve problems, they manage messes*. Recognized for his key role in advancing Operations Research discipline and practices for the *pre-WWW* era *dynamic realities*, he wished me luck when I invited his collaboration in similarly advancing the *post-WWW dynamic future* of Information Systems (IS) discipline in 1990s as a new post-PhD faculty. Incidentally, it was in course of PhD that I happened to build foundations of the Knowledge Management discipline building upon R&D of Ackoff's PhD advisor Charles West Churchman among that of other major Information-Systems scholars for the post-WWW era. Within two years of PhD graduation, my above R&D – adopted and referenced in

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the top journals of the IS discipline – would be ranked among top-three *scholars-practitioners* in Drexel University's global ISWorld survey.

My related focus originating in the cybernetics and control systems for self-adaptive regulation as in the Self-Adaptive Complex Systems (SACS) with which I was familiar prior to PhD would motivate my PhD R&D focus on SACS and Chaos Theory. That would lead to focus on the latest research coming out of the Santa Fe Institute, the related world-leading disciplinary R&D organization based at Santa Fe, New Mexico. There I found then the University of Michigan computer scientist-psychologist Dr. John Holland, the pioneer of Genetic Algorithms (GA). GA would become a popular industry-leading Artificial Intelligence (AI) technology gaining traction in industry at firms such as at John Deere. On receiving my request for his thoughts on building automated AI-driven SACS, Holland would respond:

> There has been an over-concentration on Shannon's definition of information in terms of uncertainty (a very good definition for the original purposes) with little attempt to understand how MEANING directs a message in a network. This, combined with a concentration on end-points (equilibria) rather than properties of the trajectory (move sequence) in games has lead to a very unsatisfactory treatment of the dynamics of organizations. (e-mail communication, june 21, 1995).

My own study of Shannon's Information Theory had left me acutely aware of the evident chasm between the two parallel but related worlds of Computer Sciences and Social Sciences. Specifically, that chasm existed – and continues to exist even today – between the bits-and-bytes world of Computer Science and related technologies such as AI and Quantum Computing and the human socio-technical worlds of *social construction* and *personal construction* of *human meaning*. Human meaning and

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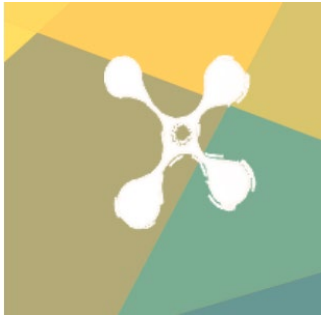

meaningfulness originate in the dynamic complex interplay of human and inter-human *affect, cognition, and action* underlying all learning, unlearning, and related unconscious, sub-conscious, and / or conscious purposive behavior. Given their dynamically complex nature, human meanings are subject to *interpretive flexibility* of diverse human minds interacting with the specific data as well as by the *requisite variety* imposed by diverse interpretation contexts.

In contrast, the world of information technology and computer science-based machines is founded on the most exacting homogenous and exacting same interpretations by all *agents* of specific data. That is the perfect world of routine, structured, and statistically *normal* information wherein exact same symbols generated by all agents will be processed with exactly same similarity and yield exact same outcomes. That is the perfect paradigm for the world of electrical and computing machinery at focus of Shannon's Information Theory. In other words, Shannon's Information Theory, that underlies many related fields of Computer Science including Cryptography, had not much to do with the subjective interpretive notion of *meanings* as generated, applied in human socio-technical contexts. Hence, the related fields of Computer Science, and by extension AI, were *unaware* of *human meaning*.

Those observations would lead to my R&D on what is now known as Human-Centered AI (HAI) and Meaning-Aware AI and by extension Meaning-Aware Quantum Computing. Above R&D with very specific focus on how specific data acquires *specific meaning* as well as *diverse meanings* (such as across time and space, as well as *multi-dimensional* time-space as we discuss later) would lead to broad survey of formal disciplines and published research.

The motivating theme from the IS discipline was its then relatively homogenous focus on *social construction* (of information technology as well as data and information) without

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acknowledging related *personal construction*. That insight led me to the fields of multi-dimensional psychology, including Social Psychology and Cognitive Psychology, which would help bridge the above gaps. Above survey of published research zeroed in on the Psychology of Personal Constructs and the Theory of Personal Constructs developed by George Kelly. Kelly is considered the father of cognitive clinical psychology and is best known for his theory of personality, personal construct psychology (PCP). Kelly and his disciples always emphasized the multi-dimensional focus of PCP beyond simply cognition:

> **Emotion** is not usefully isolated from the knowledge of the situation that arouses it. **Cognition** is not a form of pure knowing to which emotion is added… [and] **Action** is a final common path based on what one knows and feels. The three constitute a unified whole… **To isolate each is like studying the planes of a crystal separately, losing sight of the crystal that gives them being.** (emphasis added).

They also underscored importance of linkages *between emotion, arousal, drive on the one side and learning, problem solving, thinking on the other* for human, group and organizational, learning-unlearning underpinning knowledge creation and application. Our Cybernetics-Control Systems Self-Adaptive Regulation focus would further develop empirical understanding of how emotion, cognition, and action drive volitional behavior. Volition and self-determination are critical differentiating characteristics of all Human Driven *Organic* behaviors in contrast to Machine Driven *Mechanical* behaviors. Related focus of R&D advancing upon the Harvard psychologist Herbert Kelman's focus on the Psychology of Social Influences would help me advance the *carrot and stick* models suitable for *mechanical predictable world to the internalization, identification, and compliance for the organic unpredictable world of human commitments.*

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Associated with the commitment as driver of human behaviors and associated meaning *construction*, University of Rochester's R&D by Ryan and Deci would help me build refined understanding about self-determination as the foundation of volitional vs. non-volitional behaviors over a *continuum* demarcated by *perceived locus of causality*. In other words, where the *locus of causality* of one's behavior is as perceived by the specific human determines the *gradient* between extrinsic and intrinsic motivation *regardless of* associated reward. Alfie Kohn's R&D on *punished by rewards* was another interesting foundation for above research with significant implications for Human Reinforcement Learning (RL) in humans that has yet to inform the critical gaps in the AI related RL.

Above contrasts are critical for socio-psychological and socio-technical design of human-machine self-adaptive complex systems and associated IT and KM strategy and strategic, tactical, and operational focus as in command and control driven *loose-tight systems.* The loose systems are distinguished in terms of organic *interpretive flexibility* needed for handling the *requisite variety* for the non-routine, unstructured, and statistically non-normal and non-linear world to compensate for the environmental hyper-turbulence accentuated at extremes by what are now commonly known as *black swans* and *extreme events*. The tight systems are characterized by their extreme mechanical homogeneity of mechanical meanings and executions of automation systems more compatible with the routine, structured, and statistically normal and linear world.

The above frameworks of loose-tight systems would be critical and foundational to mitigating the risk of failures of data, information, and knowledge management systems for the *two worlds of business*. The focus on the post-WWW *two worlds of business* also emerged from R&D at the Santa Fe Institute such as by Brian Arthur. The *two worlds* – one routine, structured, and statistically normal and linear world, and the other non-

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routine, unstructured, and statistically non-normal and non-linear world exist in any given post-digital organization across any given stage of digitalization. Associated notion of *creative destruction* that would result in elimination of the organizations based on the *obsolete logic* of *more of the same* and *status quo* was the focus of Paul Romer's R&D advancing upon the research of Schumpeter, with whom I was ranked among other most cited authors in Knowledge Management in a University of Minnesota study report.

Complementing the prior discussion focus on dynamic change, complexity, and uncertainty, the foundations of my above related R&D focused (at that time, implicitly, relatively) on adversarial change, complexity, and uncertainty. I had mentioned earlier in the context of invited keynote to Silicon Valley VC and CEO, that not many had foreseen how Wild the Wild Web was going to be 25-years later. We have seen an exponential increase in zero-day cybersecurity and cryptography attacks, vulnerabilities, and threats resulting from exponential increase in inter-connectivity and auto-executions as well as hyper-connectivity and hyper-velocity of global data and information flows.

The notions of misuse, abuse, and disuse of IT and information which were formally examined in R&D widely published and applied would assume adversarial focus in the *classic* contexts of Business Intelligence (BI) and Competitive Intelligence (CI). The misinformation and disinformation pervasive today given associated headlines such as in cyber-warfare, information warfare, and, C4I-Cyber Information, Surveillance and Reconnaissance (ISR) were evident even then in the above BI and CI related domains as I published in some working papers on those topics. Now, the notions of purposive and intentional misinformation through management of meaning and nudge psychology even extending into color revolutions have become exponentially more pervasive. We see them in headlines on role of social media in framing diverse *meanings* to massively influence behaviors across financial markets and national elections. Perhaps, that likely

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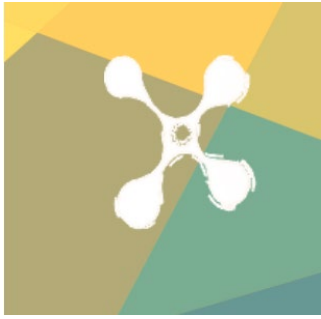

explains why some of my above papers, sometimes even before publication by journal, were circulated by the world's largest intel agencies, as I was informed by someone.

Given the above factors of unprecedented inter-connectivity of systems and networks in the current era of networks of networks, I have characterized it as network-centric computing. From the network perspective, it is the weakest link in the network that can bring the whole network down, particularly from remedial and adversarial perspectives, such as from ethical hacking and penetration testing. Also, it is the collective strength of the network that is being tested again and again as IT and cyber networks now not only underlie rapid dissemination of data and information but rapid *change in state* of Critical National and Global Information Infrastructures underpinning daily work and life.

Hence, latest R&D with focus on networks engineering that spans the diverse IT-computer science, socio-technical, and socio-psychological domains is critically relevant to both AI-Agility and Cyber-Resilience of networks and networked systems at all levels. Key theoretical and research foundations for the design and development of AI-Agile and Cyber-Resilient Systems have been shared in the above discussion. Additionally, other related fields on which my research drew upon included cybernetics such by Norbert Wiener at MIT, systems dynamics by Jay Forrester at MIT, and general systems theory by others such as Karl Ludwig von Bertalanffy and W. Ross Ashby.

Above discussion summarized our KMS focus as well as design for AI-Agility and Cyber-Resilience given the challenges posed by the *dynamic uncertainty* and *adversarial uncertainty* pervasive in increasingly adversarial *cyber-adversarial environments*.

2. 3. Evolution of uncertainty and risk management over three decades since the WWW

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Our evolution of applied risk and uncertainty management frameworks has progressively advanced across diverse inter-related domains of industrial practices spanning some of the largest Silicon Valley, Wall Street, Pentagon and global organizations. Three broad transitions span: (i) post-WWW enterprise computing such as for e-business enterprise architectures as we applied for the Intel Corporation advancing to Real Time Enterprise (RTE) *business models* as we published to advance Gartner proposal on RTE *Technology*, to (ii) post-financial crisis computational quantitative finance and trading risk management for Wall Street hedge funds with $Trillion AUM such as for JP Morgan world HQ Global Head of Quantitative Research and Analytics and US Head of Portfolio Management Teams, to (iii) post-Covid Pentagon Joint Chiefs advisory focus via New York State conference advancing ABMS-JADC2 to next-gen ABMS2-JADAC2-JADCAC2 (Joint All Domain Adversarial Command and Control and Counter-Adversarial Command and Control) with invited interviews for the US Air Force Top Science role of USAF Chief Scientist Pentagon advisory role to USAF Secretary and Chiefs of both US Air Force and Space Force. These above broad transitions have characterized the evolution of our practices on multi-domain as well as inter-domain risk and uncertainty as tested in global practices.

Distinguishing its focus from COSO Enterprise Risk Management interpreted in terms of internal control / auditing with risk primarily as *compliance* activity, ISO 31000 *sees risk management as a strategic process for making risk-adjusted decisions*. Our cybernetics self-regulation frameworks-based SACS KMS design for AI-Agile and Cyber-Resilient Networks encompasses both of them among aspects of risk and uncertainty management material to both survival and sustenance of systems and networks at all levels.

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In reviewing *what's new?* the ISO 31000 shares about its risk management framework as a *management philosophy where risk management is an inseparable aspect of managing change and other forms of decision-making*. ISO 31000 latest focus seems in line with our foundational SACS KMS focus. However, their latest definition of risk as *the effect of uncertainty on an organization's ability to meet its objectives* leaves one wondering *what does it mean*, *what to do about it* and *how to go about making its sense and applying it*! These specific applied and pragmatic concerns are the explicit focus of our SACS KMS focus advancing beyond decision-making to focus on business performance *outcomes* as the key driver of the overall processing logic and machinery of the systems as well, we of the most pertinent, relevant and current inputs including data, algorithms, models, etc. Some sense of the contrast between the latest ISO 31000 and SACS KMS is evident from our technology-push model and the strategy-pull model schematics reproduced below from 2019 Journal of Financial Transformation special issue on alternative capital markets.

Our published article titled *AI augmentation for large-scale global systemic and cyber risk management projects: model risk management for minimizing the downside risks of AI and machine learning* presents our KM framework for model risk management to advance beyond *AI automation* to *AI augmentation* to mitigate KMS failure risks. Our above models published in the Journal of Knowledge Management in 2005 pioneered the foundation of KMS in building real-time systems and saw industry adoption such as in AFCEA keynote by then Air Force Research Lab CIO. Those models also underpin our latest advances of the RTE models as discussed in the context of US Air Force, US Space Force, and Pentagon Joint Chiefs focus on next-generation Advanced Battle Management System (ABMS) Joint All Domain Command and Control (JADC2). Our related presentations include the invited AI-Quantum in Space keynote at global

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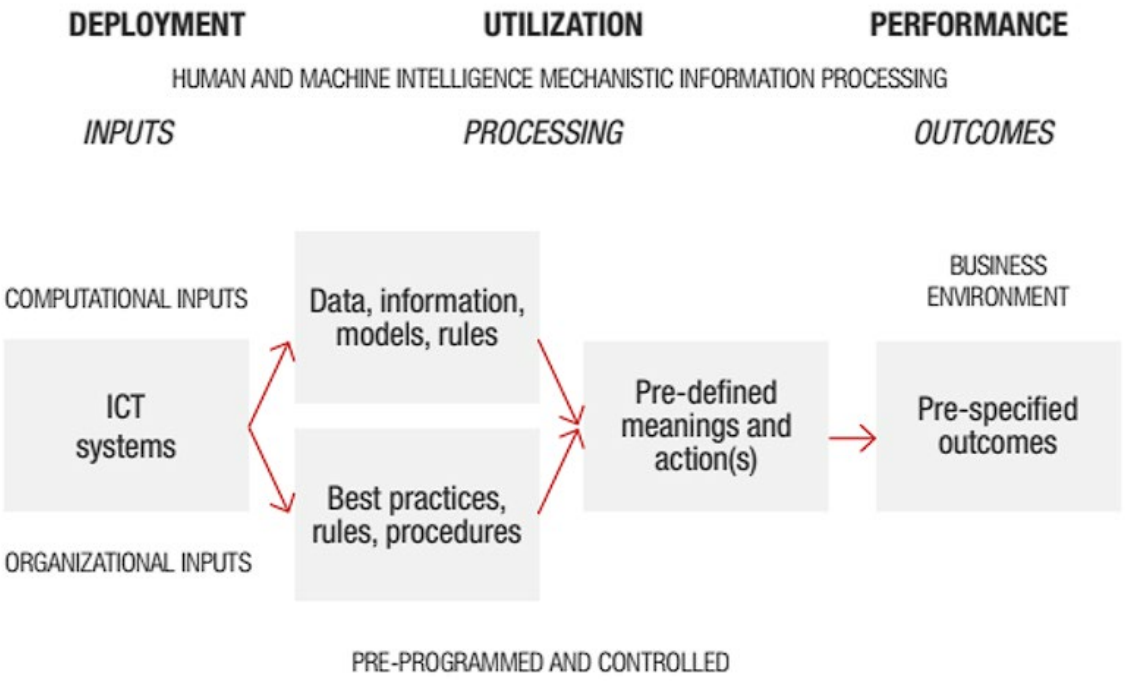
Space4Women Conference of Women Quantum-PhD-Engineers moderated by a US Air Force Chief Technology Officer (CTO).

Our technology-push model of *tight* KM is more applicable to the *mechanical predictable world-of-business* where past data is a reliable *predictor* of future performance. This is typically applicable to structured, routine, procedural and statistically normal and linear operating environments as discussed. In contrast, our strategy-pull model of *loose* KM is more applicable to the *organic unpredictable world-of-business* characterized by *radical discontinuous change*. That is typically applicable in case of unstructured, non-routine, non-procedural and statistically non-normal and non-linear operating environments. Most of the real-world environments spanning enterprise computing to global financial systems to global defense systems often typically represent a mix for mitigating risk of (KMS) failures by applying a mixture of the above two archetypes.

Figure 1 - Technology-push model of KM.



Source: Malhotra (2000).

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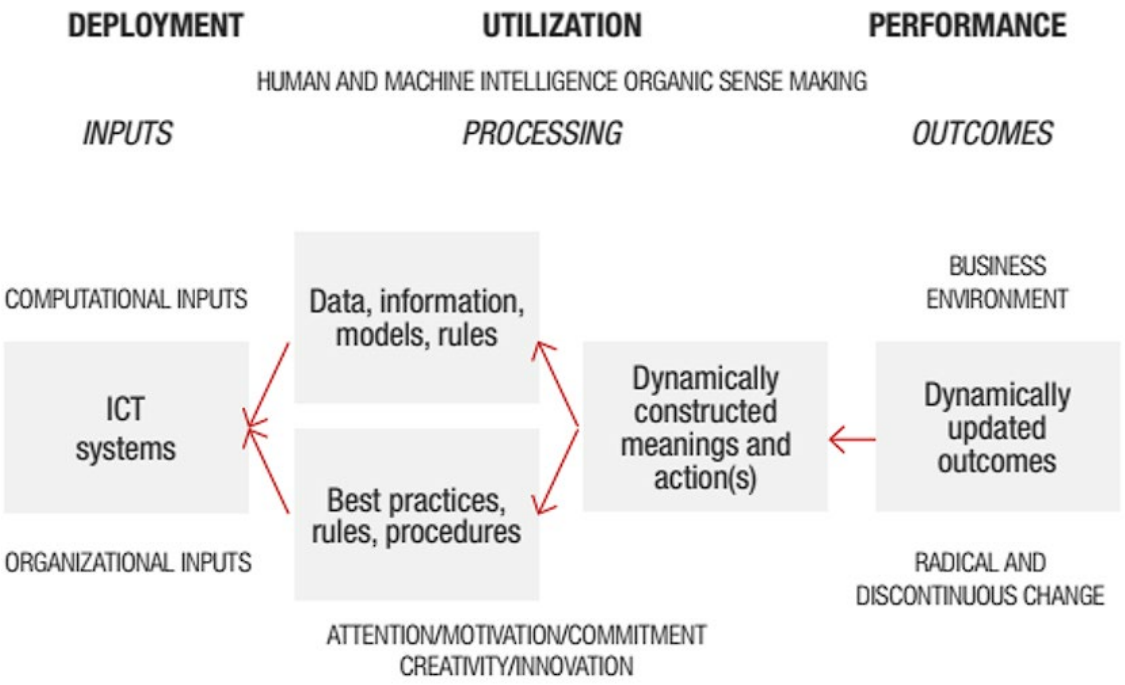
Figure 2 - Strategy-pull model of KM.



Source: Malhotra (2001).

We discuss one such example in the Institute for Supply Management (ISM) interview published in the ISM global membership publication inside supply management in context of building AI-Agile and cyber-resilient global and national industrial supply chains. How both Loose and tight models can be integrated together as loose-tight systems is also discussed in our multiple publications-presentations including the information strategy: The Executive's Journal, Unesco Encyclopedia of Life Support Systems (EOLSS) and invited R&D and industry presentations such as the annual Princeton Quant Trading Conference sessions and the annual New York State Cybersecurity Conference sessions. The above framework of the KMS for the two worlds of business and loose-tight KMS also served as the primary foundation for our invited faculty-subject matter expert role for the MIT Computer Science and AI Lab and MIT Sloan School of Management and Leadership Executive Programs on AI and Business

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Strategy Roadmaps and execution. Despite the significantly evolved uncertainty, complexity and change characterizing dynamic and adversarial aspects of operating environments, above diverse examples spanning the last 25-years or so validate the generalizability of our SACS models.

2. 4. ISO 31000: beyond classical to financial to a new (our old) definition of risk

ISO started with a generally accepted notion of risk in 2002 interpreted as risk: a combination of the probability and scope of the consequences. This is a common interpretation of risk going back decades advanced by many including quantitative finance practitioners when physicists started applying sophisticated statistical physics models to finance and trading practices. ISO 31000 expression of financial risks in terms of *expected loss* is the elementary expression of the product (or sum-product, depending on context) of the probability or mathematical likelihood of loss and the impact of loss. We have built sophisticated models as discussed in industry interviews such as in CIO Magazine adopted by early network clients such as Goldman Sachs advances on Value-at-Risk (VaR) and post-VaR models for $Trillion Wall Street Hedge Funds such as for JP Morgan, and more recent industry presentations such as the Chartered Financial Analyst (CFA) Society invited Keynote, annual Princeton Quant Finance and Trading and FinTech-Crypto conferences sponsored by Princeton University and firms such as Goldman Sachs and Citadel, and, annual New York State Cybersecurity Conferences. In addition, our applied R&D has corrected mathematical and statistical probabilistic actuarial insurance models application by worldwide-global organizations for cyber risk and cyber insurance assessments. An example is our invited expert paper for the National Association of Insurance Commissioners (NAIC), the US national insurance standard-setting and regulatory support organization for which I also served on their

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related national expert panel. That expert paper was based on my world's first post-doctoral research thesis to build robust computational-mathematical-probabilistic modeling foundations for cyber risk modeling practices. Following discussion further advances above discussed pragmatic and applied understanding of latest ISO 31000 risk in terms of *the effect of uncertainty on an organization's ability to meet its objectives*.

2. 5. Latest state-of-art on uncertainty and risk management KMS R&D leading practices

AI-Agility and Cyber-Resilience Engineering in Cloud Computing contexts continue to be focus of our latest *live research* with direct application in practices and formal presentations such as at the New York State Cybersecurity Conference Presentations. The 387-slide 2022 presentation titled *How you can implement well-architected zero trust hybrid-cloud computing beyond lift and shift: cloud-enabled digital innovation at scale with infrastructure as Code, DevSecOps and MLops* and its conference presentation video are accessible from author's live research web sites listed under references. They share our latest focus on above agility-resilience issues. Two other themes that you will find in the latest presentations include our R&D building practices focus on quantum minds and self-adaptive complex systems, and, quantum uncertainty and time space complexity. Related 2021 New York State Cybersecurity Conference Presentation titled *C4I-cyber command and control supremacy: why it's more critical than AI and quantum supremacy and what you can do about it? Security in post-covid virtual era beyond data, models, algorithms* and its conference presentation video are also accessible in the same live research web sites for download. For latest R&D on the above issues, we recommend the reader to visit the author's LinkedIn live research page listed in the references and search for our LinkedIn posts containing hashtags #QuantumMinds and #QuantumUncertainty.

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Respecting 15 pages limit for the article, we share below a synopsis of the above concepts from the online live research reviewed above along with the proposed frameworks for the reader-researcher to study-build to further advance upon our related R&D and practices.

- Consciousness is not a Computation (Roger Penrose)[1]: since early days of WWW, aligned with our SACS Human-Machine Systems focus, we have underscored our KM, AI, and quantum computing focus in terms of smart minds using smart tools smartly, with greater emphasis on smart minds as the lasting non-commodity. This relates to our quantum mechanics focus on developing and building quantum minds that we have defined as *human-machine complex adaptive systems that can help us navigate, manage, and, control quantum uncertainty*. The core central construct of uncertainty, the construct of quantum uncertainty, is a composite construct of dynamic uncertainty and adversarial uncertainty discussed earlier. Inspired by Nobel laureate Roger Penrose's related mathematical research, I have defined *quantum uncertainty* as uncertainty that *characterizes multiple parallel (past and future) trajectories of evolution of systems across diverse time-space continua.* The multi-dimensional time-space is characterized in multiple ways based on quantum mechanics view of quantum uncertainty.

- Data is profoundly dumb (Judea Pearl)[2]: we examine diverse interpretations of data as related to diverse *real time* outcomes resulting from diverse decisions based upon such *interpretations* such as resulting from creative imagination, intuition and insight – Einstein himself had stated *imagination is the mother of all knowledge*. One way is to focus on the discussed key notions of *interpretive flexibility* and *requisite*

[1]Retrieved October 22, 2022, from https://lnkd.in/gx2Ugvdi
[2]Retrieved October 22, 2022, from https://lnkd.in/gn3QMDWQ

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variety based on the respective foundational KM Systems theories and research in how same specific data may acquire different diverse meanings – not only at a given point across the time-space continua (as a function of diverse interpretations of the same user or diverse users differing interpretations) but also at diverse points across time (geographical time, network time, financial time, mathematical time – diverse notions) as well as diverse points across space (geographical space, network space, financial space, mathematical space – diverse notions). The classic notions of computational time complexity and space complexity as in the context of computer algorithms are representative examples of mathematical notions of time and space. Even across the same space point (such as geographical space), variation of time – such as across day and night, across seasons, and across other temporal dimensions, the same space can assume different forms, shapes, colors, etc. resulting in vastly different mathematical maxima and minima scoping a specific diverse risk management *landscape*. From the financial perspective, actual securities and their underlying options, futures and derivatives – such as physical metal stored in warehouses or *rights* to buy or sell such metal – represent the diverse representations of money across diverse time and space points. The disconnect between the physical commodities and respective financial markets and exchanges, often results in such anomalies as in *broken* energy markets as in the case of oil markets wherein oil gets priced for *negative* money given excess of oil and shortage of storage facilities.

- In the above quantum mechanics focus on quantum uncertainty, we view quantum minds as a function of quantum thinking, quantum computing and quantum

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uncertainty[3]. Building upon our prior foundational research focus on meaning such as personal constructivism, subjective meanings based on PCP. Making quantum real:

Meanings = f (cognition, affect, action)

Reality = f (constructs, associations, meanings)

Quantum uncertainty = f (dynamic uncertainty, adversarial uncertainty)

Quantum minds = f (quantum thinking, quantum computing, quantum uncertainty).

Q-Realities = f (Q-Constructs, Q-Associations, Q-Meanings), where Q denotes Quantum.

3. Conclusions

To advance the applied and pragmatic adoption of the latest ISO 31000 standard on risk management, we offer theoretical and applied frameworks and models in addition to domain-specific and general practices applied and validated over three decades. Drawing upon our industry practices and applied research spanning enterprise computing, finance and investments, and defense and space, we advance a quantum mechanics framework for building and applying quantum minds for managing quantum uncertainty. Given imperative needs of R&D and practices recognizing AI having neither common sense nor sense making, smart minds using smart tools smartly offer a feasible solution for advancing both.

[3] *What does it feel like to be both alive and dead?* Scientific American. Retrieved October 22, 2022, from https://lnkd.in/g3dNxpHK

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[4] All of our listed published research papers, expert papers, industry keynotes, conference presentations mentioned in this paper and many more underlying our R&D program are accessible and downloadable in full-video and full-text without any need for sharing any kind of information or any kind of registration from the following online web sites: Amazon Author Page, Biographical Page with All Links, Global CEO-CxO Networks 1, Global CEO-CxO Networks 2, Global CEO-CxO Networks 3, Global CEO-CxO Networks 4, LinkedIn Page, Publication List Page, SSRN Publications Page, YouTube Page.

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