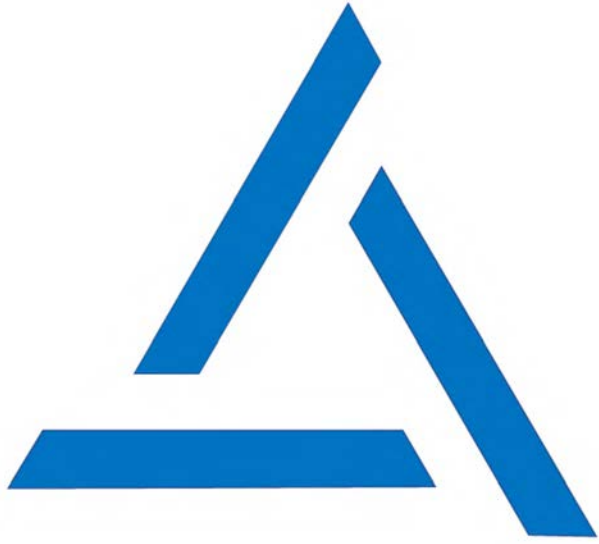
Art of the Possible

POTENTIAL of INNOVATION

Science of the Probable



Before you is a collection of works that ascribe a multitude of programs that integrate capabilities which **o**perationalize available opportunities. It is an effort to **ill**ustrate how to leverage available options in a way the **serve**s to fulfill the goals that actualize potential vision of an organization. My hope that the adage "the pen is mightier than the sword" is true in both thought, word, and deed.

I have selected these papers from amongst over a hundred that I have written to address three simple questions that I am continually asked by senior leaders of government, industry, and academia . . .

Why do most organizations fail?

How do they transform to fulfill their objectives?

What must be done to empower a culture of creativity?

This reference is designed to encourage an innovative approach to empower the application of ingenuity resident in each and everyone one of us. If they invoke deep thought and insightful contemplation that stir in you the desire to ***Think . . . Try . . . Test,*** the hypothesis and suppositions before you and embark on a journey of exploration, then my objectives have been fulfilled.

I do not presuppose to have the answers for I am one that lives in the question. Mine is not a position to direct or infer, but to engage others in an effort to inspire courageous action. In the end, my goals and aspirations are to facilitate others to seize the opportunities that abound and available to all, and share our thoughts, hopes and dreams in fulfillment of my commitment to serve ***T.H.E.M.***

Mustang

T*each*
H*elp*
E*mpower*
M*entor*

POTENTIAL OF INNOVATION

FOREWARD

CREATIVE - TALENT
Strategic Road Map to Innovation
The Future has Arrived
Cognitive Computer Conceptualized
Talking the Fiction out of Science Fiction
Innovate / Integrate / Implement
IDEATION

COGNITIVE - THINK
The Answer is the Right Question
Cognition in the Age of Knowledge
Artificial Intelligence / Machine Learning
Analytics for a Purpose
The Value Proposition of Data
Knowledge surpass understanding

CONCEPTUAL - TRY
Failure the key to Success
VAMRealities
AIMLearning
Operation Cognitive Computers
Unleash the Power of Information

COALESCE - TEST
Decision Support Tool – DST
Operation Lab Rat (EBNM)
Operation Chess Match
Data Operations Development
(Platform/Production/Pipeline)

PRESENTATIONS
Innovation
Modernization
Artificial Intelligence & Machine Learning

ABOUT THE AUTHOR
Background
Innovative Programs
Publications

PROGRAMATICS OF INTEGRATION

CONTEXTUAL
Synchronization
Netcentric
Data Operations Development (DOD)

CYBER-OPS
Cyber Strategy
A Future in the Clouds
Clouds Considerations

COGNITIVE
Intellectual Diversity
Conscious Cognitive Computers
The Value Proposition of DATA a Strategic Asset
Data Driven Organization (ZDO)

CAPABILITIES
Dynamic Characterization Network
Network As A Service (NAAS)
Future of Technological Leadership
Leaders of Technology (The LOT of THEM)

PROGRAMS
Modeling Assess Visualize Eng Research Int Ctr
Capabilities: Adv Brd / Innovation Team
Capabilities Gaps Assessment (CGA)
Modernization Services Capabilities (MSC)

POTENTIAL
Leaders of Technology – The L.O.T. of T.H.E.M.
Operation Shape Shifter
Security Encapsulated Application Data Enclave

PRESENTATIONS
Programatics of Information
Operationalizing Cyber
Leadership

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Biography
Past Programs
Past Programs

POWER OF INFORMATION

FOREWARD

WISDOM
Evolving Knowledge into Understanding
Unknown Knowns Unknowables

UNDERSTAND
Tech Catalyst to Perpetual Understanding
Capabilities to Operationalize Data and
Info into Contextual Understanding

KNOWLEDGE
Age of Knowledge Characterize Network
Knowledge Operations

INFORMATION
Operationalizing the Power of Information
Chief Information Officer
Unleashing the Power of Information
Leveraging the Power of Information
Chief Information Officer (CIO)

DATA
Data Driven Organization (ZDO)
Data: Strategic Man Asset D
SAMS/Maturation
Chief Data Officer (CDO)
Executive Guide to Data

PRESENTATIONS
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POTENTIAL OF INNOVATION

OUTLINE

TITLE ***SECTION*** ***TAB***

FOREWARD

CREATIVE - TALENT

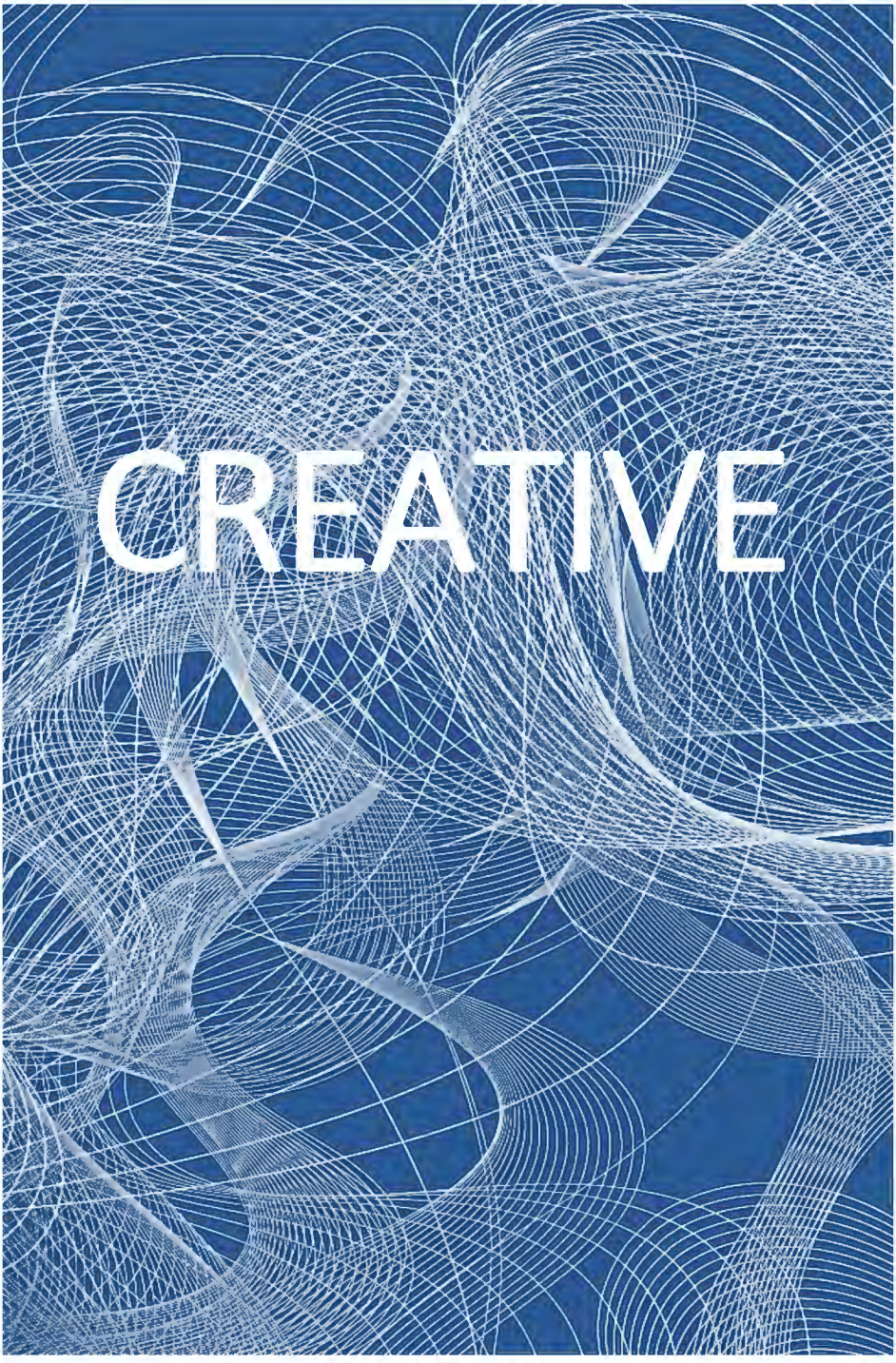
COGNITIVE - THINK

CONCEPTUAL - TRY

COALESCE - TEST

PRESENTATIONS

ABOUT THE AUTHOR


CREATIVE

TAB 1

STRATEGIC ROADMAP to INNOVATION

From efforts to evolve, transform or re-invent themselves, organizations today understand the necessity to prepare for the future or become part of the past. To that end it is important to have a vision as to where you want to go in order to fulfill your goals and objectives of getting there. Thus, a strategy to illustrate your priorities, and a plan to outline a road-map through a sound framework will afford the opportunity to create programmatic approach to achieve your objectives. For as when you don't know where you are going (*vision*), the good news all roads will take you there (*roadmap/plan*), the bad news is they call it being lost. Clausewitz reminds us that "*in strategy everything is very simple, but not on that account very easy*." For those who are myopically focused upon requirements and efficiency drills, they will soon realize the dichotomy that time is money, money talks, and talk is cheap. It is within this circular engagement that that companies all too often become distracted by what they are doing without full understanding as to why they are doing it and in-turn cease to exist. Therefore, I would encourage you to focus upon:

- **WHAT** must be done - *outcome harvested from requirements to actualize the byproducts of one's efforts*
- **HOW** it is done- *operational process to achieve objectives and how to derive efficiencies through the proper resources application*
- **WHEN** to do it– *prioritize/synchronize engagement to derives synergy from a team focused effort to fulfill organizational goals*
- **WHY** it is important– *vision to where the organization is going in the future that provides them purpose to their existence and an opportunity to learn and grow in their ongoing efforts to achieve their desired end state*

All too often organizations get lost in fulfilling the requirements without clear understanding as to their strategic objectives. Sun Zu cautions us that "*Strategy without tactics is the slowest route to victory. Tactics without strategy is the noise before defeat*" Countless organizations surprisingly become victims of this perilous road and would be well advised to engage their efforts in pursuit of their ascribed strategic objectives. For those that are looking to evolve and transform themselves, they should develop an innovative strategy that supports the organization's overarching business objectives. It is through this approach they will be aware of those options and the resulting opportunities to achieve their desired ends.

Too often companies focus on trends and are content to follow others in their desire to succeed. Few have the vision to lead the way and thus fall prey to capitalize on the investment of others with little return of their capital investment. Innovation is not about growing the organization or even creating value in your efforts to compete with others, it is about preparing to capitalize upon obtaining the future you seek. Through a proactive approach to transforming your organization, and the environment in which it lives, they will create value. By integrating capabilities, you will be well suited to implement results that produce better, faster, and cheaper solutions.

Innovation is not limited to the following:

- **ROUTINE INNOVATION**
  Evolving current competencies to maintain and grow their market share
- **ARCHITECTURAL INNOVATION**
  Re-purposing on how to utilize existing capabilities to garner increased and new market share
- **DISRUPTIVE INNOVATION**
  A new approach to deliver better, more accessible and less expensive products
- **RADICAL INNOVATION**
  Application of technology to derive competitive advantage

To embark upon this journey requires a visionary leader to teach, help empower and mentor *T.H.E.M.* to bravely seek to create the future upon which they aspire. Success is in large part dependent upon their ability to encourage others to courageously embark on this journey of exploration. This is at the core of establishing the quintessential culture undistracted from the looming potential for failure. For those brave enough to embrace failure as a step toward learning, and adapting an interactive approach to evolve toward success, those with the patience and preservice will eventually be victorious. It is this approach that they unleash the creative capacity to cultivate innovation, ingeniously integrate it and produce scalable solutions that yield competitive advantage. Hence the following three-phase approach:

- **THINK TANKS:**
  Innovative - creation of new ideas **THINK**
- **DESIGN THINKING:**
  Ingenious – cultivation of capabilities **TRY**
- **GAME THEORY:**
  Integrate - solutions to transform **TEST**

In the end, organizations must seek what options are available to them, consider what opportunities they believe are well suited for future, and develop a plan to transform from their current to their desired end state. All too often leaders are content to follow those around them and accept that which is made available to them. However, those in our midst that have transformed the world have vision and conviction to achieve what others can only dream of. Henry Ford was known to have said, "*If I had asked people what they wanted, they would have said faster horses*" It is visionaries like this that show us the criticality of inspiring others to courageously lead the way. All too often we settle for the mere fact that… *you can lead a horse to water but can't make it drink*. Likewise, I would tell you that… *you can lead a man to knowledge but you can't make him think*. But is the strong of conviction and steady in purpose that quest his thirst for knowledge in pursuit of a higher purpose.

In the end, we must embark on a journey that requires us to **THINK**, **TRY**, and **TEST** through the aforementioned framework to create our future or fail in the effort of trying. This is a journey worth embarking upon if for no other reason than to head the sage advice of Theodore Roosevelt–

"It is not the critic who counts; not the man who points out how the strong man stumbles, or where the doer of deeds could have done them better. The credit belongs to the man who is actually in the arena, whose face is marred by dust and sweat and blood; who strives valiantly; who errs, who comes short again and again, because there is no effort without error and shortcoming; but who does actually strive to do the deeds; who knows great enthusiasms, the great devotions; who spends himself in a worthy cause; who at the best knows in the end the triumph of high achievement, and who at the worst, if he fails, at least fails while daring greatly, so that his place shall never be with those cold and timid souls who neither know victory nor defeat."

TAB 2

THE FUTURE HAS ARRIVE

Creativity and inspiration are removing traditional self-imposed limitations that has stagnated progress. Yesterday's Science Fiction has become today's reality. In a world that knows no bounds the sky is truly the limit. Technology is transforming the world as we know it. The need to stay connected has long been a growing expectation which is evident by societies close association with their cell phones. With a compulsion for quick ready access to information, the demand signal for seamless instantaneous connectivity is growing exponentially.

The following is presented for your consideration as technology evolves beyond stand along tools to improve quality of life to those that could feasibly become a part of who we are. Evolving beyond the need for cell phones and computers, tomorrow's technology might afford the opportunity to seamlessly interface at unforeseen levels of transparency. They could even become a part of who we are as we endeavor to more effectively leverage these technological tools to derive competitive advantage.

Whether through advances in medicine to monitor health or overcome disabilities, the level of acceptance of human machine interaction and symbiosis continues to evolve. With watches that link to cell phones, provide GPS, and track your steps the Dick Tracy watch of the past become a reality. With glasses that provide context move beyond their traditional use to interface with and offer opportunities to leverage real-time information for human benefit. The term Transhumanism (H+) has become known for its sophisticated technologies that enhance intellect and physiology.

Current peripherals designed to bridge the digital domain beyond antiquate 40-year-old technologies that are woefully inadequate to serve as communication conduits in an interlinked world evolving from the industrial age to the age of knowledge. Creativity has given birth to new innovative capabilities to improve our way of life. Beyond traditional hearing aids, optical implants and prosthetics, today's incorporated technology both internally and externally to assist and ease everyday task to overcome past restrictions.

Through remote interlinking we can interlinke teams, capabilities and create virtual presence over vast distances. This offers the ability to bring Doctors to their patience, design teams from all over the world together, and a multitude of perspective to create new ideas and opportunities. The unlimited capacity of this capability to bring people brings down the wall that devide and offer unrestricted access to a polthera of new opportunities.

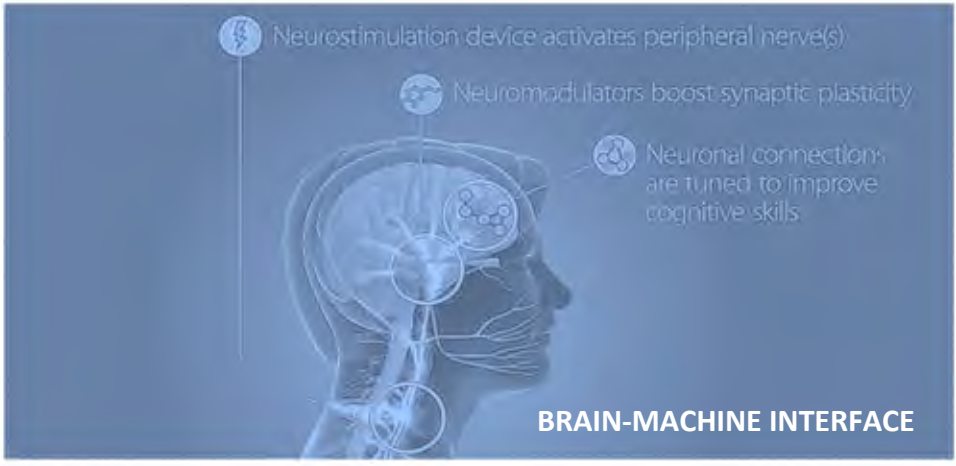
Eventual neuroalink will combine transhumanism and remote linking to create the capability to incorporate team interactions to maximize synergy in even the simplest task. The seamless interface between cognitive thought and computational computing will afford an integrated interface to establish a collective. The result is instantaneous collaboration and an expansive network upon which to provide a neuronet established a connection directly to computers through a real-time interface.

Through the assistance of technology normalcy can be restored. Repurposed to the workplace, safety and productivity can be assured, and past limits tool human capabilities and endurance can be extended. Today's exoskeletons are becoming common place to assist those crippled with medical limitations to well as working professionals to achieve simultaneous interaction through integrative capabilities beyond expectations. It is only a manner of time before acceptance of the idea of transhumanism extends beyond pacemakers and exoskeletons.

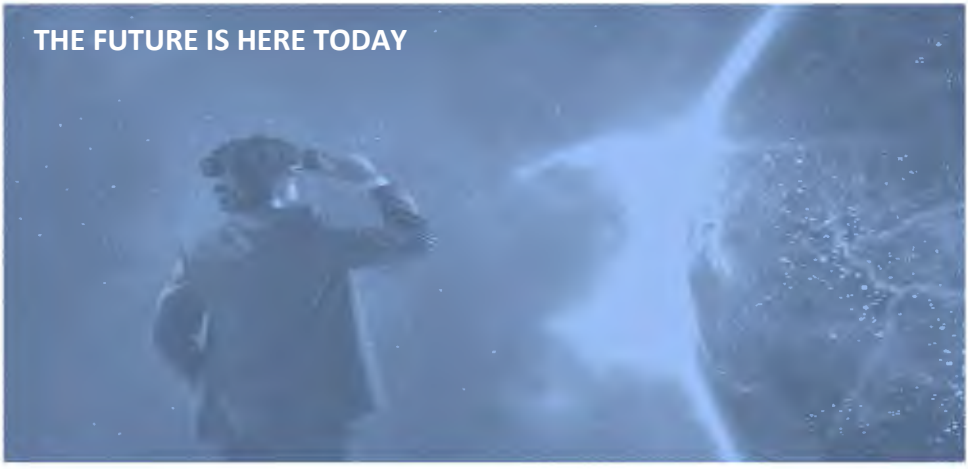
Increased human machine interface is required for ease of use. The advent of better voice recognition and neural interfaces is garnering momentum in today's tech savvy society. With significant improvement in augmented reality, autonomous systems with heightened awareness like self-driving cars are emerging and becoming common place. As acceptance of these systems continues to be a part of our daily lives, paradigm and perspectives are transformed that give way to increased confidence on these systems that are creating new realities and insights through the use and increased reliance on augmented reality that are transforming the world as we know it.

Experiential learning and awareness are opening the door to a multitude of new opportunities. Today virtual reality in games, and simulators is creating new worlds and adventures the bring imagination to life. Through the amassing data and by visualizing it through the assistance of modern technology, we can now create environments. This is applied for entertainment, collaboration across great expanse, and familiarization through simulators, testing and feminization centers.

This manifest itself in new halo environments that have presented data accumulated from the Mars rover to offer the user a unique experience of following the proverbial footsteps of the rover and walking on Mars. We now possess the ability to create a rudimentary visual halo suits similar those on popular Sci-Fi shows the combination of augmented and virtual reality.



The fear that machines will take over as illustrated in movies like Battlestar Galactica, Star Trek's Borg, and 2001 a Space Odyssey are beginning to subside. Many inventors like DARPA, Elon Musk, Microsoft and Apple are investing in human interfaces which they believe are vital to serve the demand signal in the digital age. It is through effort to explore the unlimited potential art of the possible within the current confines of the science of the probable will the future be created today.



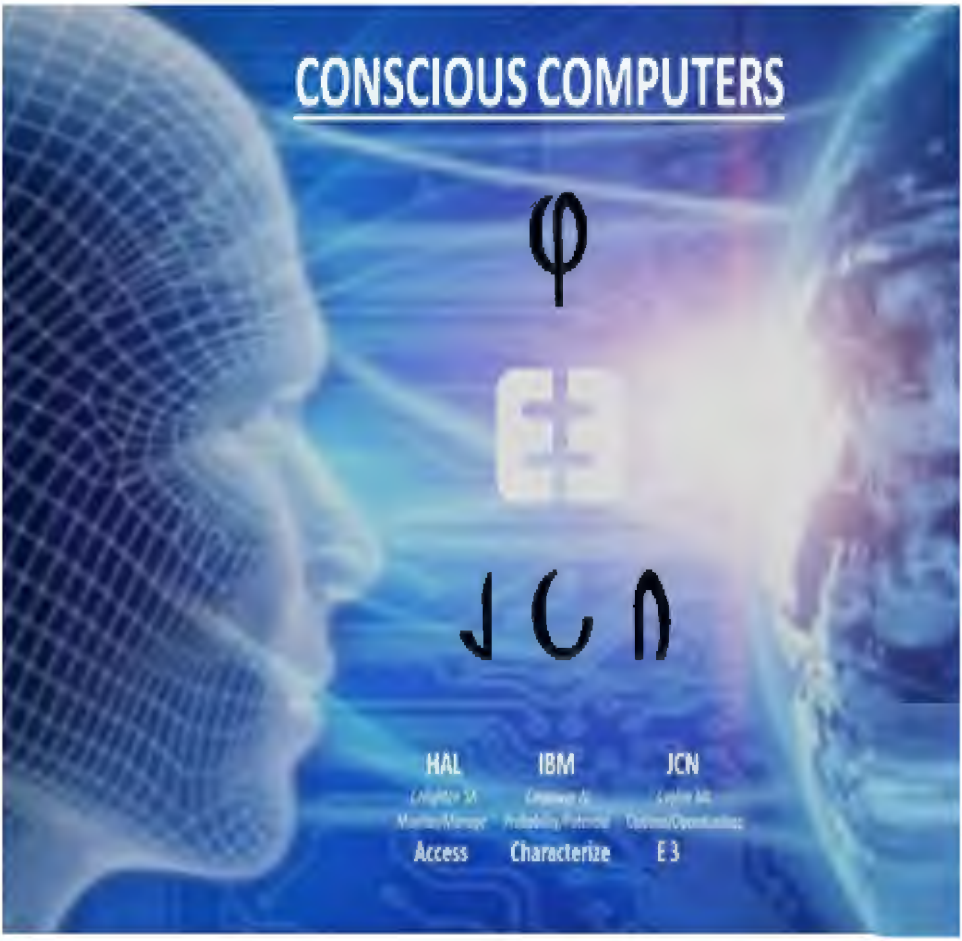
TAB 3

FUTURE of TECHNOLOGY
CONSCIOUS COMPUTERS

J*udgement*

C*ognition*

N*euronet*



From time immemorial, humans have used tools to improve their circumstances and gain competitive advantage. Thanks to those skills, we have gained the ability to overcome the hazards of our environment. Today, our dependence on technological tools has led to the belief that as such implements become increasingly adept at accessing, characterizing, and evolving (*ACEing*) the digital domain, they will ultimately achieve some form of consciousness.

Consider, for instance, the evolutionary short story "*The Sentinel*," by Arthur C. Clarke in 1948, which inspired the 1968 film "*2001: A Space Odyssey.*" The film introduced HAL, a sentient computer, which faced

complex environmental events that exceeded its ability to oversee, monitor, and sustain its environmental systems. Since HAL's programmers could only predict a small number of potential outcomes within a predefined framework, the unforeseen circumstances exceeded its ability to ascribe prescriptive modeling to adapt to a changing environment, the resulting limitations precluded its ability to sustain the routine functions of its vessel. As a result, HAL proved ineffective in deriving options capable of defining and implementing potential solutions. Similarly, programmers today are fielding cutting-edge autopilot systems are directly proportional to their ability to predict, access, and respond to actions that could otherwise cause deviations from the intended course.

The Judgement Conscious NeuroNets (*JCN*) system currently underway by the Center for Innovative Technology Development (*CITD*) is working on an advanced automated system capable of overcoming the limitations inherent in today's bounded prescriptive system. The objective is to offer a means to assess compliance with pre-established frameworks (*ethics*), access inputs from the Internet of Things (*IoT*), and leverage Supervisory Control and Data Acquisition systems. By characterizing its environment, cognitively employing analytical intelligence to elevate awareness, and evolving through machine learning, the system correlates both contextually and adaptively to establish relational neuronets to identify the causality of actions taken compared with intended or anticipated results. The unique ability to envision and convey those objectives demonstrate the kind of creativity needed to ensure today's

environmental systems become fully autonomous and self-synchronizing so that they can adapt and evolve without the aid of supervisory input.

The motivation to be innovative in this area is driven by the necessity to evolve in an effort to derive a competitive advantage. This is illustrated by the historic events of two World Wars were the need to produce ever-increasing amounts of war materiel was directly related to a given country's ability to survive intact. In the U.S., for example, assembly lines produced 16 state-of-the-art B-17 bombers every day. During production runs from 1935 to 1945, over 12,732 B-17's were manufactured, which ultimately flew more than 290,000 sorties and dropped more than 640,000 tons of ordnance on enemy locations. The industrial achievements of the early to mid-20th century also thrust mankind toward a new reality in which they developed the ability to destroy the planet many times over. Under such conditions, it is unsurprising that humans turned their attentions toward the heavens and began to explore space.

Faced with new and exceedingly hazardous environments, they soon realized the essential nature of their reliance on the kind of technological systems romanticized by Clarke. Such systems would be responsible for the unsupervised administration of lower level tasks, thus giving humans greater opportunities to deal with unfamiliar tasks—with the assistance of advanced technological tools. By the turn of the century, the world was being transformed by the effects of the industrial revolution and Samuel Taylor's efficiency drills became the order of the day. During the 1940s, American factories were producing military aircraft at a rate of one per hour during the postwar boom. Industry capitalized economies associated with automating production lines and quickly began replacing laborers with robots, which helped assure quality and meant that products could be manufactured unceasingly.

Early efforts to create systems that could adapt to their environment failed because of the lack of sensors that would otherwise enable the machines to characterize their environment. This situation inhibited the evolution of mechanical tools capable of performing autonomous and unsupervised activities. Significant effort was invested in refining such systems, but that work initially produced few results. More specifically, the paucity of

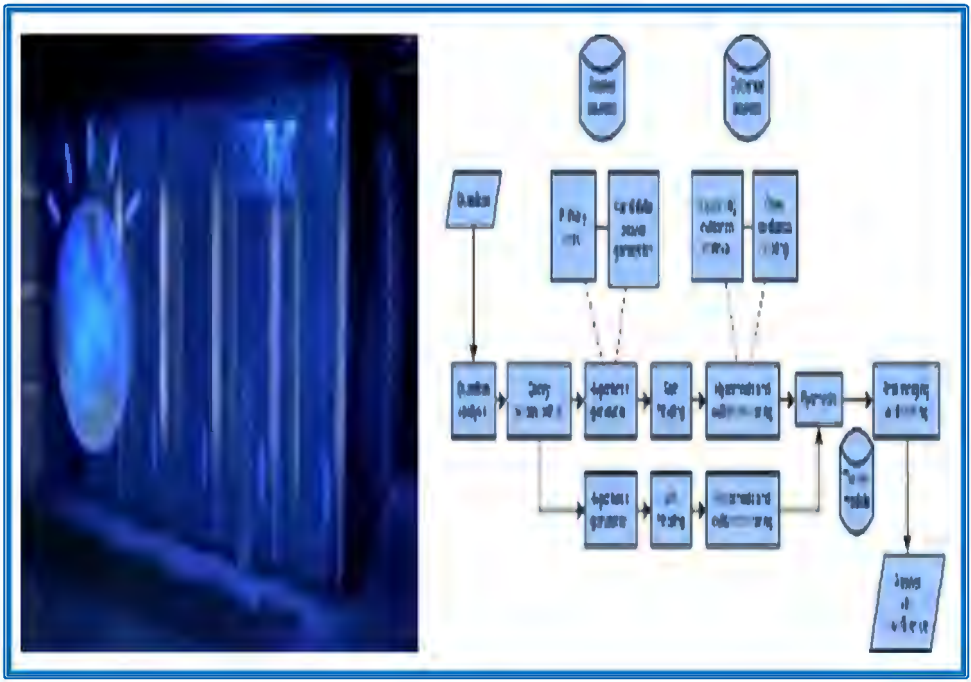
sensors in such early systems severely limited their overall effectiveness in driving efficiency.

Today, thanks to large-scale automation, we have become extraordinarily reliant on machines. In days gone by, television shows such as "*Battlestar Galactica*" capitalized on our growing fear that autonomous systems would someday take over and that humans would eventually be required to fight those systems to ensure the survival of mankind. Today, we are convinced that in and of themselves, computers pose no significant risk to our existence. Yet, as we continue surrendering our responsibilities because of the presence of such automation, we simply cannot be certain that computers will never pose a direct threat to mankind. Consider, for instance, the grocery store cashier who can only dispense change after receiving instructions from the cash register.

Some theoreticians opine that machines' lack the creative capacity and inability to learn (*precluding their ability to evolve and precluding them from becoming sentient*), recent advancements in Artificial Intelligence (*AI*) and Machine Learning (*ML*) could enable complex systems to achieve some degree of consciousness. Contextual correlative systems, such as the International Business Machines (*IBM)* Watson, are already providing analytical assessments that suggest future purchases to consumers based on their purchase history, offering advice of how to improve market share and profits. Since such systems draw additional information to compare consumers' buying habits, they can also identify consumer trends and utilize that data to predict buying habits.

However, the inability of such systems to establish contextual understanding relative to the intent behind or circumstances surrounding those buying habits prevents them from being able to determine the motivation behind consumer purchases. In this case, *AI* is employed to ascertain thorough contextual correlation a level of understanding in an effort to overcome the system's inability to gain some indeterminate level of machine-based consciousness. Therefore, it appears that the lack of innate creative capacity based on the general inability of machines to learn and evolve within the constraints imposed by their respective digital environments will emerge as the final obstacle to the achievement of machine-based consciousness.

Our growing reliance on automated systems has increased demand signals for machines to perform increasingly sophisticated tasks, a condition that demonstrates the constant demand for their evolution. Clearly, systems are not only gaining in complexity, but we have also integrated them into every aspect of our modern existence. For instance, self-checkout registers at grocery stores and autonomous home climate monitoring systems simultaneously serve our needs and increase our dependence on such systems. By extension, our increasing reliance on systems means they will have an increasing impact on our lives. After all, automated systems (such as GPS) now inform us which route to take and the best time for us to conduct that travel. This growing dependence on contextual information continues to drive us deeper into the information environment and ever closer to embarking into the age of knowledge.

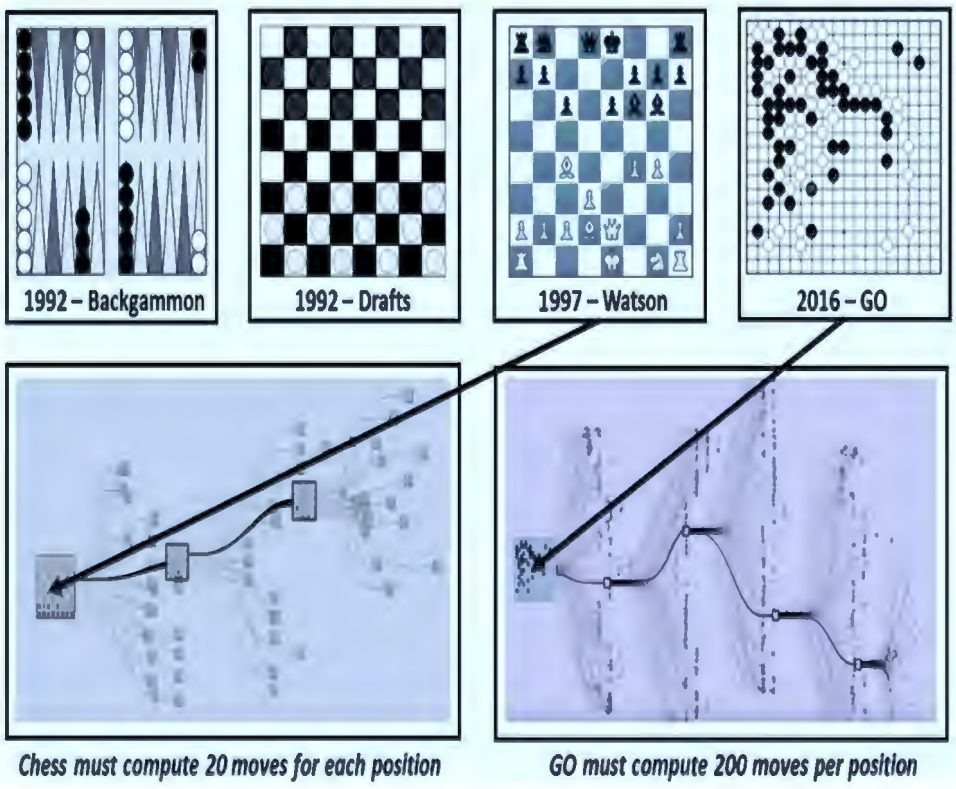


The enduring need to find answers has sparked immense interest in AI. The ultimate goal of systems such as IBM's Watson is to determine and provide the best possible answers to questions, thus improving competitive advantage and quality of life. At this stage, question and answer (*Q&A*) systems remain at the forefront of developmental efforts. Correlative, contextual systems such as *IBM's* Watson can quickly yield answers to predefined questions through probabilistic deterministic. The capability of such systems was demonstrated in 1997 when one of the predecessors to Watson, in this case *IBM's* chess playing computer Big Blue, played Grandmaster Garry Kasparov. Although Kasparov won the first encounter in 1996 by a score of 4–2, Deep Blue won the 1997 rematch by a score of 3½–2½. In 2011, Watson proved victorious in a game of Jeopardy against former all-time champions Ken Jennings and Brad Rutter in three consecutive rounds. In both cases, Big Blue and Watson demonstrated their ability to decrease risk and command exhaustive sums of knowledge. Yet, not only did these outcomes also increase human reliance on *Q&A* systems, they also exacerbated our complacency and hindered our ability to think for ourselves.

Recently, DeepMind (*a British AI company owned by Google*) developed neural nets capable of understanding questions rather than finding answers. By exploring options exhaustively, DeepMind systems provided options and identified opportunities regardless of the distractions associated with predefined functions within bounded requirements. That exceptional focus allowed DeepMind systems to derive and predict consequences via relational causality to fulfill objectives or intent. In 2014, Google sought to revolutionize its concept for a contextual search engine by leveraging a predictive rather than a prescriptive form of modeling AI, the result of which was relational knowledge linked to temporal assessments that facilitated contextual understanding. By examining the causality of actions and then identifying the trends that will influence future consequences, systems such as those produced by DeepMind have given primacy to the advice attributed to Sherlock Holmes by Arthur Conan Doyle: "*when you have eliminated the impossible, whatever remains, however improbable, must be the truth*."

The aforementioned approach received notoriety in 2015 when DeepMind's AlphaGo software competed—and for the first time in history *prevailed*—over a human opponent in a Go match. The system's combined ability to assess circumstances, characterize and interpret causality, leverage opportunities, and evolve enabled it to achieve victory in that highly complex, 2,500-year-old game of stones. AlphaGo was programed to determine the moves capable of exhibiting the greatest degrees of flexibility compared to the traditional approach of determining the moves that offer the greatest probability of a win. Ultimately, the ability to identify the most adaptive and flexible moves proved critical in the system's victory against 2nd dan Go player Fan Hui. The following year, AlphaGo posted a victory over Lee Sedol, the highest ranked Go play in the world. The complexity of Watson's probabilistic, deterministic approach and AlphaGo's feasible flexibility model are illustrated below. The illustrations reveal the complex statistical analysis (*on the left*) and the intuitive perspective of simplicity (o*n the right*).

Numerous efforts are underway to create unsupervised systems able to adapt in today's volatile, uncertain, complex, and ambiguous (*VUCA*) digital domain. In an environment that is rapidly expanding in terms of mass and complexity, coupled with the need to address a seemingly insatiable appetite for demand signal, it has never been more important to think big, start small, and scale quickly. In this new environment, systems that utilize adaptive approaches linked to analytics capable of ascertaining data veracity, information dependencies, and knowledge confidence (*similar to CITD's JCN endeavor*) relying on temporal analysis to manage current expectations and future consequences is key. In this extremely fluid environment, it is imperative that systems have the ability to self-assess, adapt, and learn. To keep pace with this ever-increasing demand curve, systems must be sufficiently resilient and capable of transforming instantly to overcome the challenges posed by today's adaptive and highly transformational environment.



To address the growing mission needs of the Department of Defense to manage risk in today's chaotic environment, the Defense Advanced Research Projects Agency (*DARPA*) organized a cyber-challenge in 2016. To increase the level of difficulty, they proposed that competitors be restricted to autonomous computers—no humans allowed. Although only seven teams qualified for the competition worldwide, the results were nonetheless astounding. The objective was to determine if systems could evolve beyond the supervised and contextual frameworks defined by pre-established parameters. Competition officials wanted to gauge the possibility of developing evolving, self-healing systems capable of adapting to threats in a *VUCA* environment without human intervention. Seven stand-alone systems were introduced in a closed competition, the objective of which was to win a game of "*capture the flag*." In general, success in such endeavors typically relies on the competencies, experience, speed, and cunning of the participants. In the *DARPA* event, however, the automated competitors had to rely on their ability to assess, characterize, and become enlightened and empowered to evolve in order to overcome threats to achieve their overarching objectives.

Computers performed as anticipated, given highly experienced and talented programmer's ability to prepare for and overcoming pre-programmed security patches in their efforts to effectively and efficiently leverage *AI* to capture the flag. Interestingly, an unintended OpSim event revealed that the Xandra system discovered an unknown POV/vulnerability and succeeded against the reference binary. System Jima, which observed and characterized the events as they unfolded, proved surprisingly capable of coding a unique patch binary against which the other systems could not defend. These actions validated its ability to conduct activities autonomously to adapt to and overcome evolving threats. Moreover, Jima's ability to judge risk, employ cognitive ability to solve complex problems, and relate circumstances as they appeared, demonstrated a creative ability to solve unforeseen and exceptionally challenging problems. Ultimately, these activities prompted questions about whether the systems had indeed achieved some a degree of consciousness.

To fully emerge into this new environment, we must apply contextual logic (*think*) in an effort to make sound judgement, adaptive awareness (*relate*) to engage at a conscious level, and creative capacity (*innovate*) to collaborate and relate while adapting and evolving to the interdependencies in an effort to effectively engage at autonomously. As demonstrated by the established framework, the ability to act cognitively, and engage at a level of consciousness illustrates the ability to undertake actions autonomously. Validating at recent events that machines are truly on the brink of achieving unsupervised operations.

The integration of sensors that provide feedback from *IoT* devices and the linkages to social networking applications that provide *GPS* data (*e.g., proximity indicators on cars and IoT devices*), advanced systems will help convey the means to access, characterize, and become enlightened (*and empowered*) by *AI* (*thinking*) and *ML* (*learning*) systems. In turn, these features represent a pathway toward advancing and enhancing rudimentary levels of system consciousness.

Early example of such systems occurred in 1980 when Carnegie Mellon University (*CMU*) introduced its NavLab autonomous vehicle project. This was followed in 1987 by the Mercedes-Benz Eureka Prometheus Project, and development culminated in 1995 when *CMU's* NavLab completed an autonomous coast-to-coast drive of the United States. Nevertheless, these technologies have continued to mature. Tesla's introduction of its Model-S in 2012 demonstrated a host of capabilities once considered all but impossible. According to the U.S. National Highway Traffic Safety Administration, the following standards apply to autonomous vehicles (*as of 2016*):

o

- **Level-0: Monitor/Manage** - *Automated system have no vehicle control, but issue warnings*

- **Level-1: Monitor/Manage** - *Driver must be ready to take control at any time. Automated system may include features such as Adaptive Cruise Control (ACC), Parking Assistance with automated steering, and Lane Keeping Assistance (LKA)*

- **Level-2: Monitor/Manage** - *Driver is obliged to detect objects, events and respond if the automated system fails to respond properly. Automated system executes accelerating, braking, and steering and the system can deactivate immediately and be takeover by the driver*

- **Level-3: Probability/Potential -** *Within known, limited environments, drivers can safely turn their attention away from driving tasks, but must be prepared to take control*

- **Level-4: Probability/Potential** - *No driver attention is required outside the limited environment; the vehicle must be able to enter a safe fallback mode - i.e. park the car*

- **Level-5: Options/Opportunities** - *Other than setting the destination and starting the system, no human intervention is required. The automatic system can drive to any location where it is legal to drive and make its own decisions.*

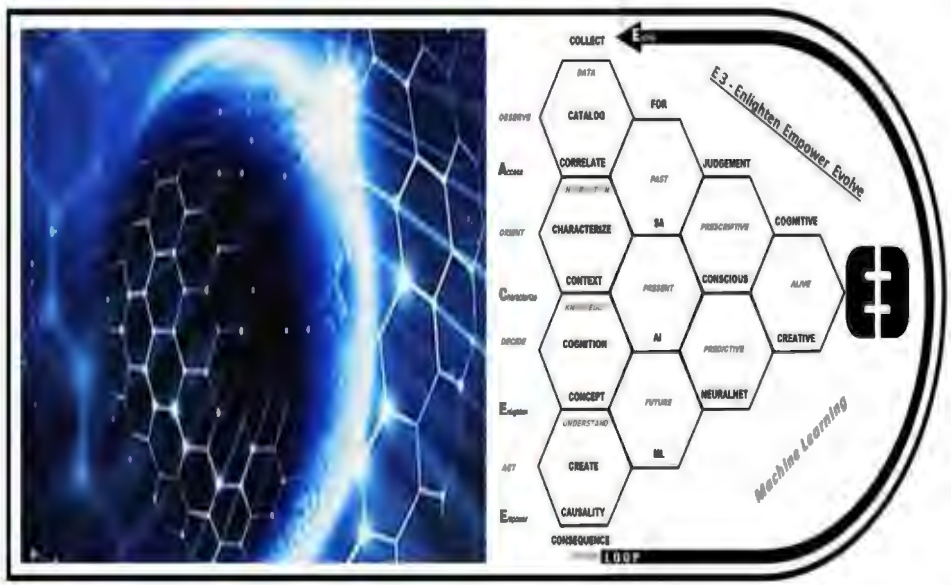
Notably, the Tesla Model-S includes radar, laser light, and *GPS* sensors that provide contextual information to the vehicle. While these advances situate it at just level-3 (*above*), considering the current state of development, the achievement of a true level-5 capability appears within reach in the near term.

Currently, vehicles produced by Google have already logged 1.5 million miles of semi-autonomous, accident free driving. Developed by Sebastian Thrun at Sanford University's *AI* laboratory, these vehicles have indeed evolved beyond the prototype stage and are now ready for full production. Recognizing that achievement, Google created a spinoff organization it hopes will realize the company's vision of producing cars without occupant accessible steering, acceleration, and/or braking systems. Production of this commercial vehicle is under the leadership of John Krafcik which is intended to introduce adaptive neural nets to offer this vehicle the ability to learn, adapt, and evolve, and thus achieve full level-5 (*above*) autonomy.

Clearly, the future has already arrived, as today's machines demonstrate varying degrees of awareness about their surroundings. At rudimentary levels, they can adapt to and overcome situational changes by employing non-prescriptive activities. Their creative capacity and ability to assess situations by utilizing sound judgment (*AI*) within pre-established parameters to enable them to monitor (*IoT*) and maintain standards of ethical behavior via prescriptive modeling. Machines can and do characterize their environment by incorporating a multitude of inputs, and *AI* gives them the means to employ probabilistic deterministic, or predictive modeling to ensure they can successfully complete the task at hand. Through temporal analysis and the application of neuronets, these machines can relate and identify dependencies that enable them to identify the future consequences of actions taken compared to actions to be achieved or intended results.

Acting in accordance with an established frame of reference (*FOR-access to past prescribed standards*), today's machines can inject information to elevate situational awareness (*SA-characterize current circumstances*), consider potential causality effects (*AI-enlightened understanding of*

future consequences), and most impressively are empowered to adapt and evolve in order to achieve their assigned objectives (*create solutions that fulfill objectives/intent*). It is remarkable that even in these relatively early stages of development, today's systems can already observe their environment, orient to it, and decide how to overcome unforeseen obstacles and challenges. As these rather elementary systems continue to evolve, they have already demonstrated the ability to think and apply their creative capacity an innate ability to adapt to and master their environment. As such, their capabilities clearly indicate that they have achieved a certain level of consciousness and given an ever-increasing demand for their services will undoubtedly continue to evolve beyond their current state of existence.



TAB 4

TAKING THE FICTION

out of

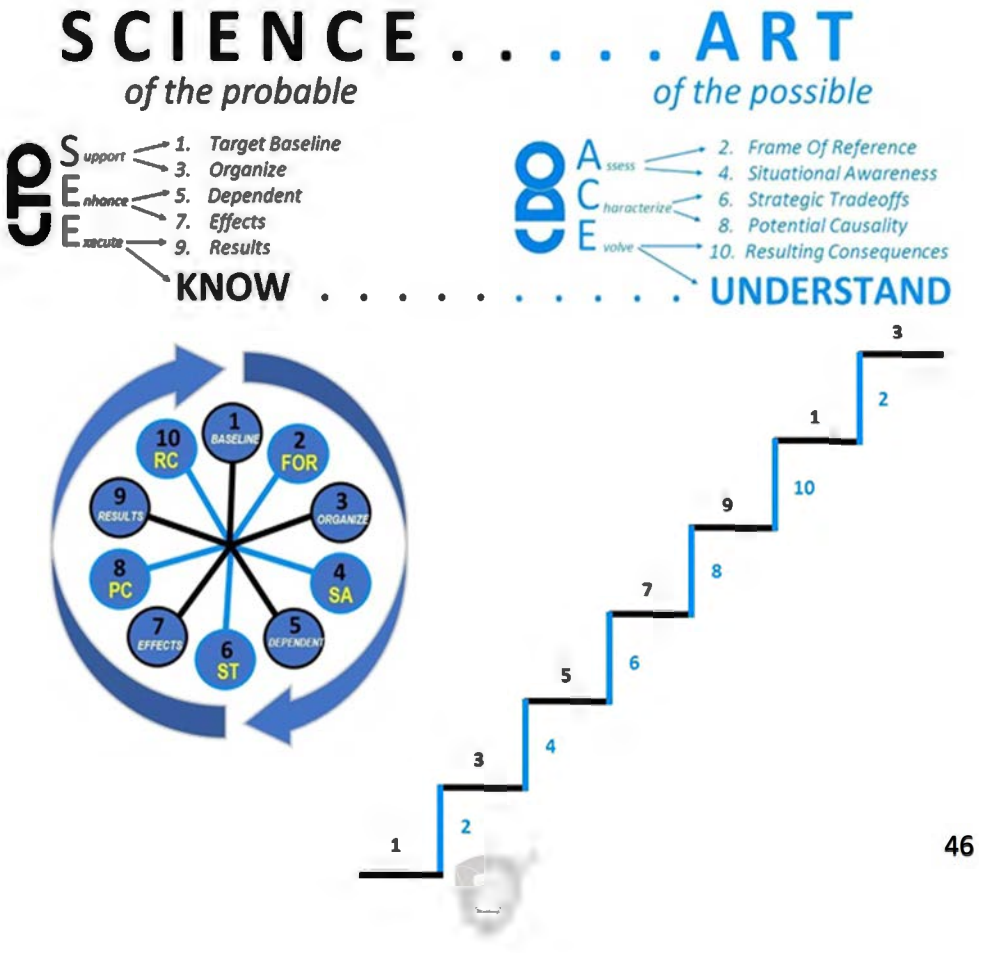
SCIENCE FICTION

By all indications, the capabilities and technologies available in today's information environment will soon be surpassed. This evolutionary reality not only increases current capabilities, but capacity as well. One aspect of this process, however, is revolutionary change, which represents an innovative approach to creating new technologies that can completely transform the environment. Of course, revolutionary change is somewhat disruptive in nature, as it upsets the pervasive comfort of the status quo. These two forces will always remain in conflict since the concepts of transformation and stability—*both of which are apparent in the information environment*—are at opposite ends of the spectrum and diametrically opposed to each other.

To prepare for the future, one must have the alacrity to move beyond present paradigms. In a world that includes dreams of autonomous travel, delivery, communications, and information accessibility, we must conclude that the future is now. For instance, were the "*cyber Pearl Harbor*" that causes such widespread anxiety to occur and force us to rebuild our digital domain (*a process informed by the knowledge we have amassed thus far*), how would that new domain appear? We must assume that it would provide instant access to information that offers the

historical reference needed to add context to current circumstances and illustrate the causal nature of actions taken versus anticipated results. Information when and where it is wanted and needed most would be the ideal outcome of such a large-scale rebuildingeffort.

Our current infatuation with technology appears to inhibit the creative process that is essential to innovation. Given today's predilection for sustaining antiquated systems, the self-limiting reliance on current capabilities appears to mitigate the pioneering spirit responsible for accommodating current and future needs. A stair-step process is needed to shift the present focus on sustainment to one that will eclipse the status quo and elevate society to the next level. This stair-step process, illustrated below, leverages a scientific approach in conjunction with the art of the possible to translating good ideas into reality. At its heart is the notion that the art of the possible will fuel the creative processes that will alter our current understanding of the science of the probable.



Has sci-fi inspired science, or is science the source of science fiction? Those skeptical of technological progress will argue that cars can never drive themselves, that drones can never deliver packages autonomously, and that wristwatches can never evolve into a technology capable of monitoring our health, checking email, answering the telephone, or determining our location. Devices enabled by the Internet of things (*IoT*) and supported by collaborative efforts (*such as Waze/Google Maps, for instance*) can determine the best driving routes in terms of time and/or distance, and household refrigerators can now analyze and adapt to environmental changes to ensure the safety of our food. In our effort to achieve a safe and secure environment, we now rely on such systems to improve the overall quality of life.

Today's technology has transformed the very course of our future. In contrast, who could have conceived just 50 short years ago that autonomous aircraft would collect information, enhance situational awareness, and deliver precision-guided munitions or items purchased online? Soon, they might even be delivering pizza to hungry customers. Today we live in the unique combination of the "*Brave New World*" described by Aldous Huxley in 1931 and the alternate reality George Orwell conveyed in his book "*Nineteen Eighty-Four*" back in 1949. We are being recorded constantly by *ATM* cameras, traffic cameras, and cell phones.

Transponders in our cars and phones track our every move. Stores assess our buying habits in near real-time and shift their marketing strategies to suit our desires. Privacy has given way to convenience, as automated photography now bolsters airport security and untold amounts of personal data are being collected—*with or without our permission*. Interconnected social media networks now allow people to share their thoughts with the world. Abraham Maslow postulated in his Hierarchy of Needs that to achieve complete motivation, humans must have satisfied several elemental requirements (*i.e., physiological, safety, belonging, and esteem*), but it is the drive toward self-actualization that leads us to the most novel outcomes. Today, for instance, we embrace technological tools that add convenience and benefit to our lives. This ongoing process, and our responses to it, have introduced the age of knowledge.

In this new era, the adage *knowledge is power* has never been truer. Properly wielded, it enables us to achieve the kind of strategic advantages capable of catapulting us beyond the constraints of our present social and economic boundaries. In the age of knowledge, wars intended to win the

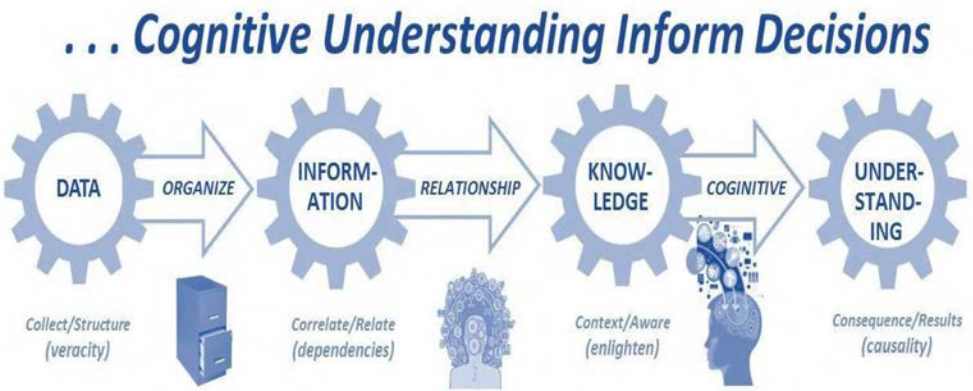
hearts and minds of others fought in the realm of social media sites as opposed to battlefields. By using shared environments, we can coordinate and collaborate our endeavors to achieve the fully synergistic effects of team focused efforts. The use of 3-D capabilities and hologram technology, will enable us to create a virtual presence capable of stimulating the kind of interchange that helps build relationships and networks, and facilitates the confidence and trust that are essential to accessing information critical to the establishment of a collaborative environment through which society can continue to evolve. Mere distance no longer ensures strategic advantage, and in this newly interlinked world, boundaries are much less relevant.

This new unbounded environment affords one to express new ideas more freely on a world stage that, through collaborative talent and collective productivity, easily overcomes all previous limitations imposed by time and distance. Augmented reality 3-D environments will allow us to transform not only ideas, but also the perceptions of physical space into new realities. As we transition from the industrial age to the age of knowledge, however, it is understandable that many people are hesitant to jump headlong into this new future. After all, the very hierarchy of existing relationships is at risk, since the balance of power upon which so many have relied for so long has already begun its inexorable shift. Those who have embraced the new technological capabilities offered in today's evolving world fully understand and appreciate that the status quo has been replaced by revolutionary and transformational ideas. The promise of a brighter tomorrow will fuel the transformation resulting from greater mobility, security, and education, as well as accessibility to health, education, and government services. By utilizing a coordinated, collaborative approach, we can now synchronize the operations of fully integrated systems that not only cater to the everyday needs of citizens, but also meet and exceed the expectations of the populace.

Interconnected systems are beginning to meet the growing demand for greater capacity within the confines of current resources. 3Ding ideas are being realized with the help of interconnected systems. Beyond autonomous technology that provides parameter alerts to defense systems that ensure the integrity of boundaries, these systems can now publish self-assessments that identify and categorize risk informed by *IoT*-enabled devices. Smart Cities are able to make real-time assessments to ensure the safety of and in service to a better quality of life for its occupants. Such smart cities boast broader ranges of services and capabilities that advance effective utilization of resource while increasing efficiency, both of which enable citizens to reap the benefits of technological innovation and continue to ascend Maslow's pyramidal Hierarchy. The resulting desire for convenience has outpaced all other requirements, as today's citizen's demands are willing to trade their privacy for an environment that knows and understands their needs—*sometimes even before they do*.

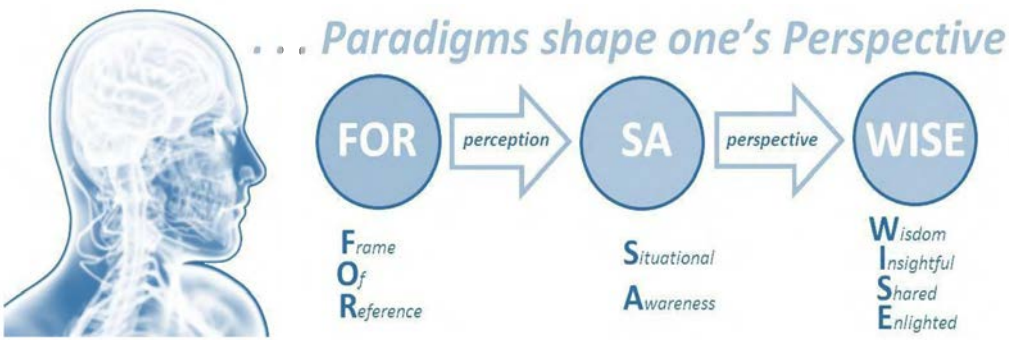
As today's citizens see themselves as global in nature, they are increasingly attuned to the international climate. Moreover, they are steadily more sensitive to how actions and activities here and abroad will affect them. Considering our growing reliance on information systems fed by volumes of data that double biennially, the time is right for wearable autonomous sensing systems that connect us constantly to the information grid, communication devices that keep us linked 24/7, and monetary systems that replace credit cards and cash. Retailers will adopt demand delivery systems with data fed by the burgeoning information environment, and those that offer enhanced services will be preferred over competitors that provide goods alone. Intrinsically, a value system based on benefit will rule the day as customer demand will drive a service orient approach to business. In the end the ability to rapidly evolve cognitive understanding will take precedence on the priority of making informed decisions. It is through the ability to evolve that timing will establish the preeminence to evolve and mature data into information predicated upon the relation context to provide requisite knowledge upon which to elevate one's level of understanding.

Today's rapidly evolving information environment will dictate the establishment of new relations built upon a network of dependencies. Stated otherwise, the mere reality of information represents power, and it will become the low-cost catalyst for transformation in this highly dynamic environment. Inarguably, the fluidity of this new environment presents new and unique challenges. Since it also serves to enable the communication of ideas, the coordination of activities, and ultimately productive collaboration, such a dependency-based network will introduce the degree of reliance essential to establishing relationships based on trust. Our technological capacity, fed by both science and the innovative nature of art, will conspire to reanimate mankind's predisposition for innovation. By drawing upon artificial intelligence, which helps imbue knowledge with valuable contextual references, and machine learning (*ML*), predicated upon the need to adapt and evolves within the dynamic information environment, the *IoT* will inform these systems to evolve and transform as a result of ongoing characterization of this dynamic environment in real time. *AI* systems will provide contextual understanding to systems that provides the means to augment our current capacity to establish a perspective. These *AI* systems will offer the means to perform redundant tasks with far greater proficiency and efficiency than do their human counterparts. Deep learning creates opportunities to adapt and evolve via *ML* which create intuitive systems. Ultimately, this informs our *FOR* and contributes to *SA* to make *WISE* advances in medical diagnostics that will enable the early detection and treatment of disease, thus improving the quality and lifespan of society.



Considering the foregoing, impediments to the attainment of these outcomes will become readily apparent, particularly in terms of actions taken compared to anticipated results. Collaborative organizations will be formed to ensure that the desires of some members of the public are not infringed upon by the actions of others. Further, strong individualism will yield to the contributions made within a particular domain. Risk management efforts will quickly identify both contributors and perpetrators in a world made increasingly transparent by pervasive surveillance technology. Accountability will assume far greater importance, and recognition of responsibility to oneself and to others will become the operant rule. The result of these activities will afford tomorrow's environment provides a means for people to benefit directly from the actions they take based upon an assessment of the value proposition of the contributions they make. Past accumulation of entitlements that were neither earned nor otherwise justified will be obviated. Control will be replaced by an empowerment mind-set, and the impact of capabilities and effects will take precedence over the notion of capacities and efficiency, as the desire to live in the moment will outweigh the mandate to prepare for the future.

Caution would be exercised given the prevalence of self-synchronizing systems to sustain this new balance and the attendant mind-set of some's overriding desire for efficiency over effectives to undercut our ability to transform. Their desire to avoid disruption will ultimately inhibit growth, and those who might have continued to transform society could become preoccupied upon maintaining the status quo. Only through the desire to advance economic and political influence will society engage the



disruptive, transformative mechanisms necessary to accomplish their inevitable evolutionary path forward in a proactive desire to explore better solutions for a brighter tomorrow as opposed to a reactive approach to resolve yesterday's problems.

This is only the beginning of the continuum of change afforded society as they explore the art of the possible in their quest to understand the science of the probable. In its totality, the opportunities are only limited by the scope of our imagination as we live in awe of today's technology we struggle to leverage it in a way that ensures we can live in a world that will benefit from the use and creativity application of these and other tools. It is our ability to effectively support, enhance and evolve from our technological prowess that we will sustain the evolutionary and evolution progress that has afforded our competitive advantage on the world stage. For today's dependencies and tomorrow opportunities depend upon how we focus our creative capacity on innovative solutions to ensure a bright future inspired by our hopes and dreams.

TAB 5

Innovate

Integrate

Implement

INNOVATION is the order of the day, and many are endeavoring to create change in their ongoing efforts to transform their organization. For those endeavoring to evolve their organizations to derive efficient operations, I would suggest that this is not innovation. An innovative approach is something that capitalizes on increased effectiveness as a direct result of new capabilities. As Kodak, the inventor of the digital camera realized, the results of their efforts were so disruptive to an industry that they had dominated for over five decades, it made obsolete the capability which was at the core of their business model. I would caution those who hold on to the past, they soon will have realized that in so doing so they would soon become part of history.

Innovation is not evolutionary but a revolutionary approach to introduce new ideas as the next step in a journey that marks the beginning of the end of antiquated concepts in search for creative approach to provide more effective capabilities. We should recognize that innovation is NOT something you buy or a refinement of current conditions, but it is a creative approach to think differently in exploration of how to adapt and overcome current conditions in preparation for or creation of the future. It is a new pathway forward to explore the Art of the Possible, to actualize one's vision through the Science of the Probable, as we step out in preparation for the journey the awaits full of unlimited opportunities.

There are three phases in the maturation of innovation; **Think**, **Try** and **Test**. Phase one kicks off our strategic efforts by establishing a Think Tank to explore opportunities for the future. By integrating these ideas through good planning, the opportunity to operationalize it (*phase 2*) and then test it (*phase 3*) presents itself. As we proceed, many believe it is better to be lucky than good. I would suggest that luck is where skill, knowledge (*intellect*), understanding (*experience*) and preparation (*planning*) meets opportunity. It is the wise and astute individual that is ready to answer the door when opportunity comes knocking. Once the door is opened to opportunity one must be inspired and encouraged to act courageously if they are to learn how to adapt and evolve.

Phase two offers the opportunity to manage risk, for this is not something that should be avoided but embraced. Failing forward is necessary as one endeavors to beginning with the end in mind. We must embark on an inspirational journey to create a vision (*phase 1*), develop a plan (*phase 2*), and proceed so that we can learn what works and what doesn't (*phase 3*). Through enthusiastic dedication and devotion to step out courageously, the opportunity to overcome the fear of failure, and instill purpose in our efforts to actualizing potential and proactively preparing for the future. If we remain strong to our convictions and don't give up or try the same thing twice expecting different results, eventually we will succeed.

Phase three offers the opportunity to test our suppositions and learn from mistakes. Edison understand during his efforts with the light bulb that success is more about creating the conditions to find solutions than merely fix problems. It is imperative that we establish a culture that encourages innovation to overcome our self-imposed limitations. Einstein advise us to be cognizant that "*Great spirits have always encountered violent opposition from mediocre minds*." We must be mindful to avoid becoming comfortable with our circumstances which creates and environment were complacency demands conformance with the status quo.

It is incumbent upon us that we venture out courageously in a progressive manner to endeavor to learn from our mistakes instead of spending all our time avoiding them. For as we learn from your mistakes we evolve our understanding and adapt and overcome limitations. We must avoid focusing on problems in our relentless pursuit of finding solutions. Properly applied, this process offers the opportunity to cultivate a culture of innovation with a proactive approach toward building a prosperous future.

In closing, I would suggest a perspective offered by Carl Von Clausewitz;

"If the mind is to emerge unscathed from this relentless struggle with the unforeseen, two qualities are indispensable:

first, an intellect that, even in the darkest hour, retains some glimmerings of the inner light which leads to truth;

and second, the courage to follow this faint light wherever it may lead."

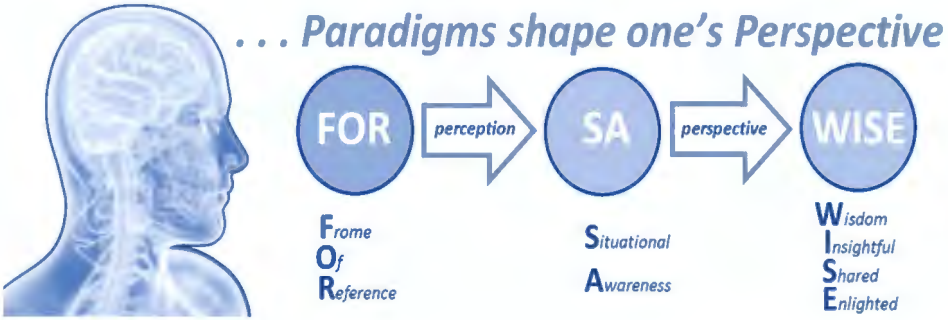

Step 1 - Envision the Possible . . . Establish a Think Tank
INNOVATE/Revolutionary: unique capabilities (STRATEGIC Effects)
STRATEGIC
THINK differently
EXPLORE
"We can not solve our problems with the same thinking we used When we created them."
Albert Einstein
Step 2 - Plan for Probable . . . Develop an Adaptive Plan
INTEGRATE/Evolutionary processes (OPERATIONAL Efficiencies)
OPERATIONS
CREATE capabilities
TRY
"Imagination is more important than knowledge. For knowledge is limited to all we now know and understand, while imagination embraces the entire tire world, and all there ever will be to know and understand."
Albert Einstein
Step 3 – Programs actualize Potential...Build New Programs
IMPLEMENT/Transformational outcomes (TACTICAL Execution)
TACTICAL
BUILD capacity
TEST
"The intuitive mind is a sacred gift and the rational mind is a faithful servant. We have created a society that honors the servant and has forgotten the gift."
Albert Einstein
INNOVATE INTEGRATE IMPLEMENT
...ENLIGHTENED.....EVOLVING.....EFFECTIVE.....
THINK: about possibilities (Goals) PLAN: maximize potential (Objectives) PROGRAM: successful outcomes Present (Requirements)

TAB 6

IDEATION

There has been a lot of talk about innovation, big data, artificial intelligence, machine learning and transformation as we continue to transition from the industrial revolution into the age of knowledge. This affords opportunities to derive competitive advantage in today's interlinked world by understanding the importance of, and the need to evolve ongoing efforts to learn from the past as we prepare for the future. To that end, we must first establish a framework upon which to understand that each of us has different perspectives given the paradigms of our past. Life's experience has created unique outlooks from which to offer the opportunity to see things in unique and unforeseen ways. Given the diversity of backgrounds and varied experiences produce different Frame Of References (*FOR*). From this we derive a plethora of diverse perspectives that shape our perceptions and inform the perspective which we view the world.

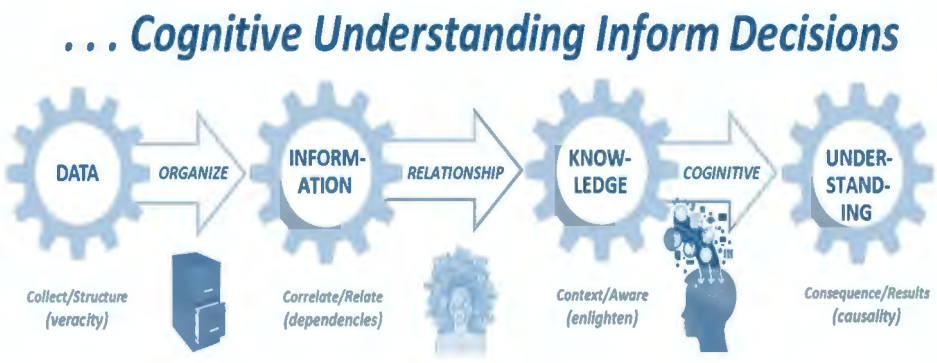
Through this lens, we become Situational Aware (*SA*) and garner heightened Wisdom and Insights as illustrated in the previous diagram as we drive toward a Shared and Enlightened (*WISE*) viewpoint. However, we must be cognizant that this viewpoint is not necessarily informed by fact. It is through the following process that fact is related to information to evolve knowledge that imparts understanding.



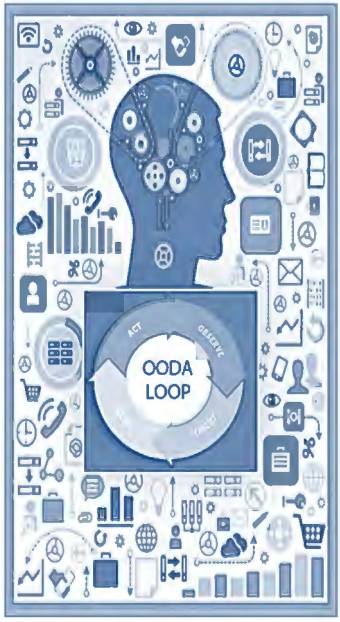
As organizations endeavor to transform themselves, they must stop and envision where they desire to be in the future. Additionally, they must ascribe what their goals and objectives are as they endeavor to transform their organization to their desired end state. To preclude being distracted by their current state, they must limit their perspective to preclude circumventing their potential. To make decisions unencumbered by self-imposed limitation, they must be willing to utilize a cognitive approach that will enhance their understanding of future options without limiting potential opportunities.

Once they begin with the end in mind, they will see the world through a whole new lens, exploring limitless potential that capitalizing upon the Art of the Possible, unrestricted by the current constraints of the Science of the Probable. By applying an integrative process, they will be able to Think Big, Start Small and Scale Quickly. It is this transformative approach embraced by John Boyd's OODA Loop that will allow them to Access, Characterize and Evolve (ACE) to their desired future state.

The results are wise choices for their future informed by extensive experience, open minded observations and a desire to understand unknowns or live in the questions without being distracted or confined by answers to derive satisfaction in the present. By committing to this process without judgement, one can gain a greater appreciation of people's reaction to their environmental influences and thus see the world in a whole new light.



Today's rapidly evolving information environment will dictate the necessity to establish new relationships built upon a network of dependencies. To remain competitive in today's interlinked world, information in today's Age of Knowledge represents power, and it will become the low-cost catalyst for transformation in this highly dynamic environment. Inarguably, the fluidity of this new environment presents new and unique challenges. Since it also serves to enable the cultivation of ideas, the coordination of activities, and ultimately facilitate a collaborative endeavor to develop and deploy new capabilities. Our technological capacity, fed by both science and the innovative nature of art, will conspire to reanimate mankind's imagination which fuels their creative capacity to transform their environment as the endeavor to serve their aspirations.



THINK BIG

Today many organizations find themselves as high velocity industries, necessitating the launch of new innovative ideas

START SMALL

Through an iterative spiral development approach adapting and evolving to a Volatile, Uncertain, Complex and Ambiguous environment affords the opportunity to be nimble and flexible results in a strategic advantaged derived from their nimble and flexible approach

SCALE QUICKLY

Speed in decisions making is paramount. Fast and roughly right decisions making must replace deliberations that are slow but marginally more precise

The crux of this is that by validating the veracity of facts, and relating dependencies to ascertain causality, we can for the first time proactively assess potential consequences. With the introduction of digital neuromast, the opportunity exists to produce results that illustrate available options and opportunities. Through the framework of design thinking, we can now explore the feasibility of possibilities, testing suppositions through the postulates of Game Theory to provide autonomous processing of predictive modeling that illustrates potential in the present and future state.

The resulting value proposition provides the quintessential propensity for success derived from leveraging our creative capacity. It is through this process that we can transform our environment in its present state in our efforts to harvest its potential in the future state. Thus, thought is the first course to conceptualize a future of endless possibilities, action is the next step to create potential realities, and conviction provides the essential ingredient to transform our world. For what the mind can conceive and believe, it can truly achieve.

An imaginative approach to create new ideas, conceptualize them into discernable application, and develop capabilities to actualize potential through the application of scientific principles offers great promise. Through this three-step approach of thinking, trying and testing (*3T*) the ideation process is able to leverage our ability for cognition, conceptualization, and creation (*3C*) in order to innovative, integrate and implement (*3I*) solutions through Enlightened understanding of available options, Empowered application of technical prowess in an effort to Evolve (*3E*) in order actualize and harvest potential.

With a traditional focus upon a reactive process that informs and transforms from the bottom up, we are impeded by the limitations of tactical requirement that identify **WHAT** is to be done, further restricted by confining operational process outlining **HOW** it is to be accomplished, and a hindered by a myopic perspective which preclude a strategic outlook of **WHY** it is important. This is counterproductive to innovative endeavors, for if we truly wish to evolve, transform and even find revolutionary ways to new realities, we must adopt a top down approach to conceptualize innovative solutions, ingeniously integrate capabilities, and interactively implement them.

This must be done in a proactive and courageous approach to think and try if they are to transform their environment. This will undoubtedly result in a disruptive environment to current circumstances, but is essential to free ourselves from the shackles of self-imposed limitations as we endeavor to step boldly into the future:

- What is to be done - **VISION**
- How will it be accomplished - **MISSION**
- Why is it important – **PURPOSE**

Without Purpose . . . IT IS Pointless

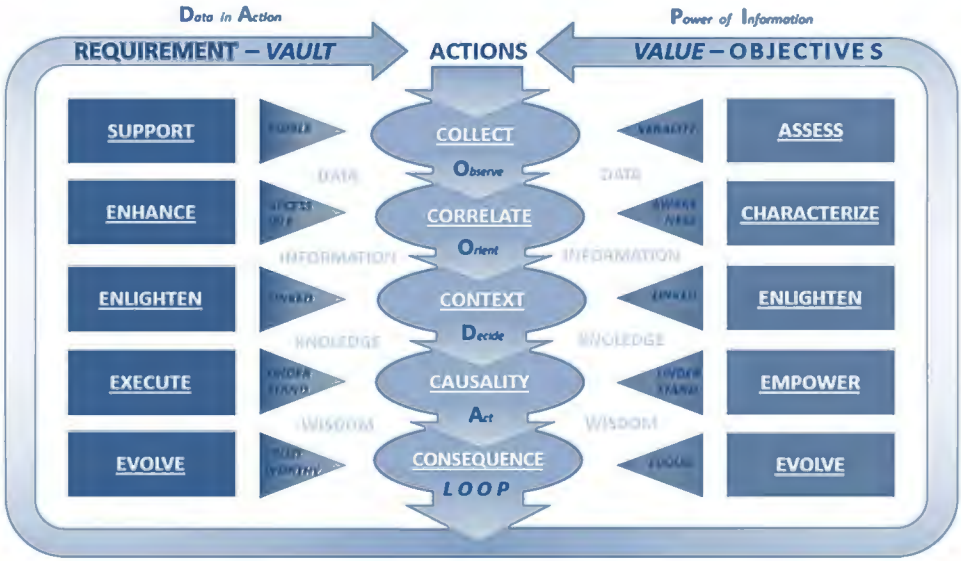
It is within the environment of collaboration that an appreciation of the knowns and unknowns must be fact based in an effort to provide structure that is the perquisite of the maturation process. Ultimately it is upon fact which substantiates one's position in an effort to explore new opportunities to seek and live in the question as opposed to be merely satisfied to blindly accept the answer. Thus, we must acquire data that is fit for purpose and allow it to evolve and mature to effectively assess the situation unencumbered by perceptions and paradigms to garner an accurate perspective of one's circumstances. It is within this environment and the proper characterization of it that a situational picture unfiltered by perception or preconceived notion is painted. Only through this unbiased perspective that enlightenment can one become empowered to avail themselves of opportunities in an effort to learn and evolve in today's volatile, uncertain, complex and ambiguous environment.

To this end, today's CDOs are establishing a platform to mature data in an effort to provide more fidelity and higher veracity. Through an enterprise approach to collect and store data, correlate and aggregate information, and put knowledge into contextual understanding, they are elevating situational awareness (*SA*) by ensure data that is fit for purpose, operationally relevant and presenting a site picture that tells a story for those willing to listen. This process provides for the accumulation of facts (*data*), a common reference (*information*), and presenting it in context (*knowledge*) to evolve understanding in order to make fact-based decisions (*wisdom*).

This the first step to assure the opportunity to **access** veracity, **characterize** relationships, and **enlighten** dependencies, **empower** actions that **evolve** (*ACE*) opportunities to provide quintessential analytics essential for the ideation process. It is through this endeavor that we are able to expand the Science of the Probable to make the Art of the Possible a reality. The resulting iterative, three-step process to make data Visible, Information Accessible and Linked, affords the means to evolve Understanding and Trustworthiness (*VAULT*).

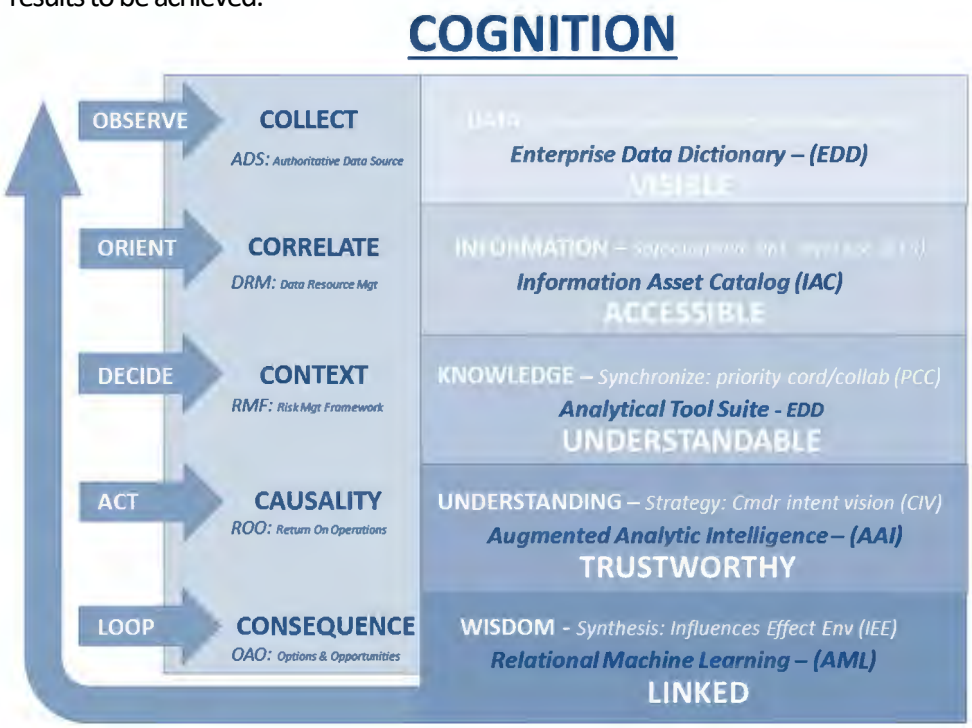
OBSERVE	PROBABILITY	SCIENCE	OBJECTIVE
1C. Collect	Store	DATA	WHAT
2C. Catalogue	Structure	INFO	WHERE
OREINT	**PERSPECTIVE**	**ART**	**OBJECTIVE**
3C. Correlate	Relate	FOR	HOW
4C. Context	Understand	SA	WHEN
DECIDE	**POTENTIAL**	**THINK**	**OBJECTIVE**
5C. Cost/Benefit	Assess	ST	WHY
6C. Characterize	Know	KO	
ACT	**PERFORM**	**ENGAGE**	**OBJECTIVE**
7C. Coordinate	Synchronize	C2	WHO
8C. Communicate	Disseminate	CTO	
LOOP	**PERPETUATE**	**EFFECT**	**OBJECTIVE**
9C. Causality	Dependencies	Feedback	LEARN
10C. Consequence	Results	Trend	

It is the harvested power of information which serves the organization through a progressive and iterative process derived from the benefits of a Data-Driven Organization (*2DO*). Thus, the ability to **collect** data to accomplish **prescriptive** modeling, **correlating** its Structure with information that illustrates its **probabilistic** qualities identify its **contextual predictions** to disclose those **consequences** measured against ascribed **potential** to inform the course of action forward (*5C/5P*). By taking an interactive approach, we can **collect**, **catalog**, **correlate**, **contextualize** it a manner that offers a **cost/Benefit** analyses. Thus, by **characterizing causality**, **coordinate**, and **collaborate/communicate-C2** the resulting **consequences** (*10C*) as illustrated in chart above which outlines the ascribed framework.



It is through this process which affords the opportunity to build the foundation upon which we can validate what we understand or know, answer unknowns and explore the unknowable in a constructive and progressive fashion. In scientific terms, we must establish a prescriptive model of lessons learned from past actions compared to actual outcomes. The result of which will ensure our *FOR* and resulting paradigms properly inform our perceptions as it improves our Situational Awareness (*SA*) as outlined in my work on evolving knowledge into understanding.

However, all too often the fear of failure creates a risk adverse environment that precludes the quintessential learning opportunities derive from trying. Thus, we should consider failure as just another opportunity to learn. For we should fail forward in an effort to learn from our mistakes. It is within validation of fact and inferences derived from relationships that we establish the necessary linkages which are antecedents and resulting consequences of actions taken measure against results to be achieved.

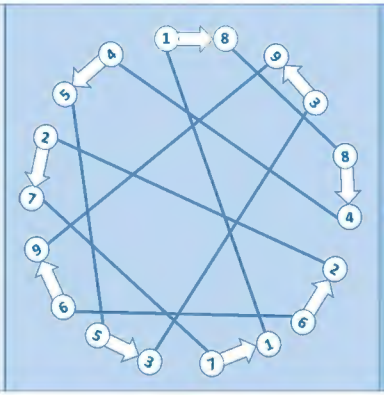


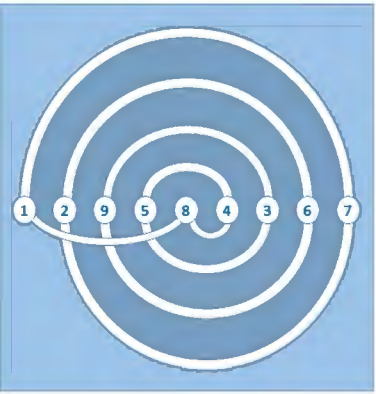
It is within the context of these relationships and the resulting dependencies that illustrate the complexity of linking and correlating them. Clearly, we are poorly equipped to characterize the environment and determine our potential for success. However, it is imperative that we establish a framework to understand the potential causality and resulting consequence as antecedents within the information environment. Thus, the following pictorial illustrates the contextual relationship of the collective accumulation of information from connections within a neural net.

CONTEXTUAL CORRELATION

Plurality of connections . . . and their contextual linkages . . . their correlative relationships are:

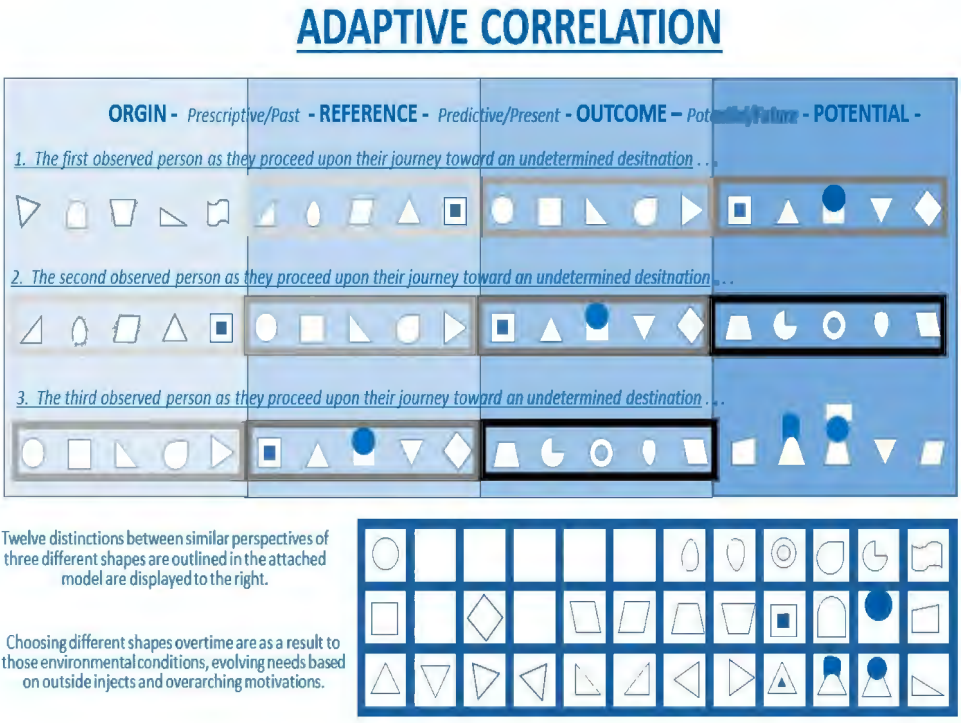
- *If* **1** *knows* **8**
- *and* **8** *knows* **4**
- *and* **4** *knows* **5**
- *and* **5** *knows* **3**
- *and* **3** *knows* **9**
- *and* **9** *knows* **6**
- *and* **6** *knows* **2**
- *and* **2** *knows* **7**
- *and* **7** *knows* **1**



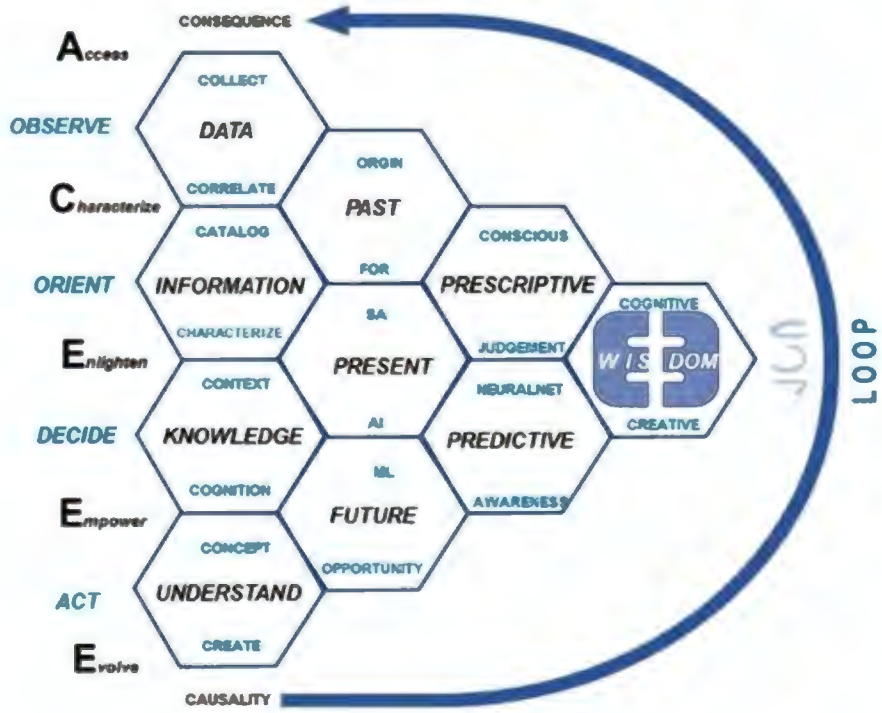


The dependencies of these simplistic relationships illustrate how contextual correlations expand as the net grows in both mass and complexity. As we evolve beyond this rudimentary model, we begin to appreciation the value of analytical information's (*AI*) role in finding answer. But we soon realize the limiting effect that this has upon evolving understanding from the inter-relationships within the environment. For it is within the causality and potential consequences that exist by the very dynamic nature of the organization that we appreciate the fluidity of this environment. Looking at it as an organism, affords the means to properly and effectively characterize the environment in a way to identify the interdependencies of the causality and resulting consequence. We must be cognitively aware as to the potential that exist within this dynamic ever-changing environment. Neural nets illustrate the relationships to *ACE* our environment in a way that better determines how to influence and effect the environment in a manner that fulfills our objectives.

The unique ability to envision and convey ingenious application of skills/capabilities affords the means to harvest the inherent power of information. Leveraging an integrative approach, initiatives across the organizations are able to be logically linkage across disparate systems. This is approach offers a flexible and adaptive solution to optimize capabilities while mitigating the complexity and cost of today's interdependencies systems that lack functional interoperability.



If we are to effectively coordinate and collaborate throughout every operational level within a nested system, it is essential to identify causality in an effort to assess consequence if we are to provide information that provides enlightens and empowers decision makers with factual information. The resulting contextual picture will illustrate through analytical visualization timely and relevant information that informs the potential of future consequences. Thus, effective battle assessments (*situational awareness*), adaptive planning (*strategic tradeoffs*) and tactical engagement (*command and control*) demand that data not only plays a central role, but also that it matures sufficiently to inform knowledge-based actions.



This enlightened understanding derived from data in action through the aforementioned *VAULT endeavors, informs the power of information to ensure a* VALUE proposition that produces mission success. It is through a data driven organization (*2DO*) with the requisite ability to unlock the *VAULT* to understanding. The result is knowledge that informs understanding that affords the means to make value assessments based on causality and potential consequence.

In today's transformative environment, the mass and resulting 10C challenges as it relates to operationalizing data requires the augmentation of Information Technology (*IT*) and Information Services (*IS*) to provide analytical intelligence (*AI*) to measure/assess, relate/characterize, and contextualize/E3. The application of *IT/IS* to *ACE* understanding is vital in our ongoing endeavors to remain competitive in this dynamic rapidly evolving environment. While some theoreticians opine that machines' lack the creative capacity and possess the inability to learn (*which thus mitigates their ability to evolve and prevents them from becoming sentient*), recent advancements in Artificial Intelligence (*AI*) and Machine Learning (*ML*) could enable complex systems to achieve some degree of consciousness.

Contextual correlative systems, such as IBM's Watson, are already providing analytical assessments that suggest future purchases to consumers based on their purchase history, offering advice of how to improve market share and profits. Since such systems draw additional information to compare consumers' buying habits, they can also identify consumer trends by utilizing data to produce predictions as to future buying habits. However, the inability of such systems to establish contextual understanding relative to the intent behind or circumstances surrounding those buying habits prevents them from being able to determine the motivation behind consumer purchases.

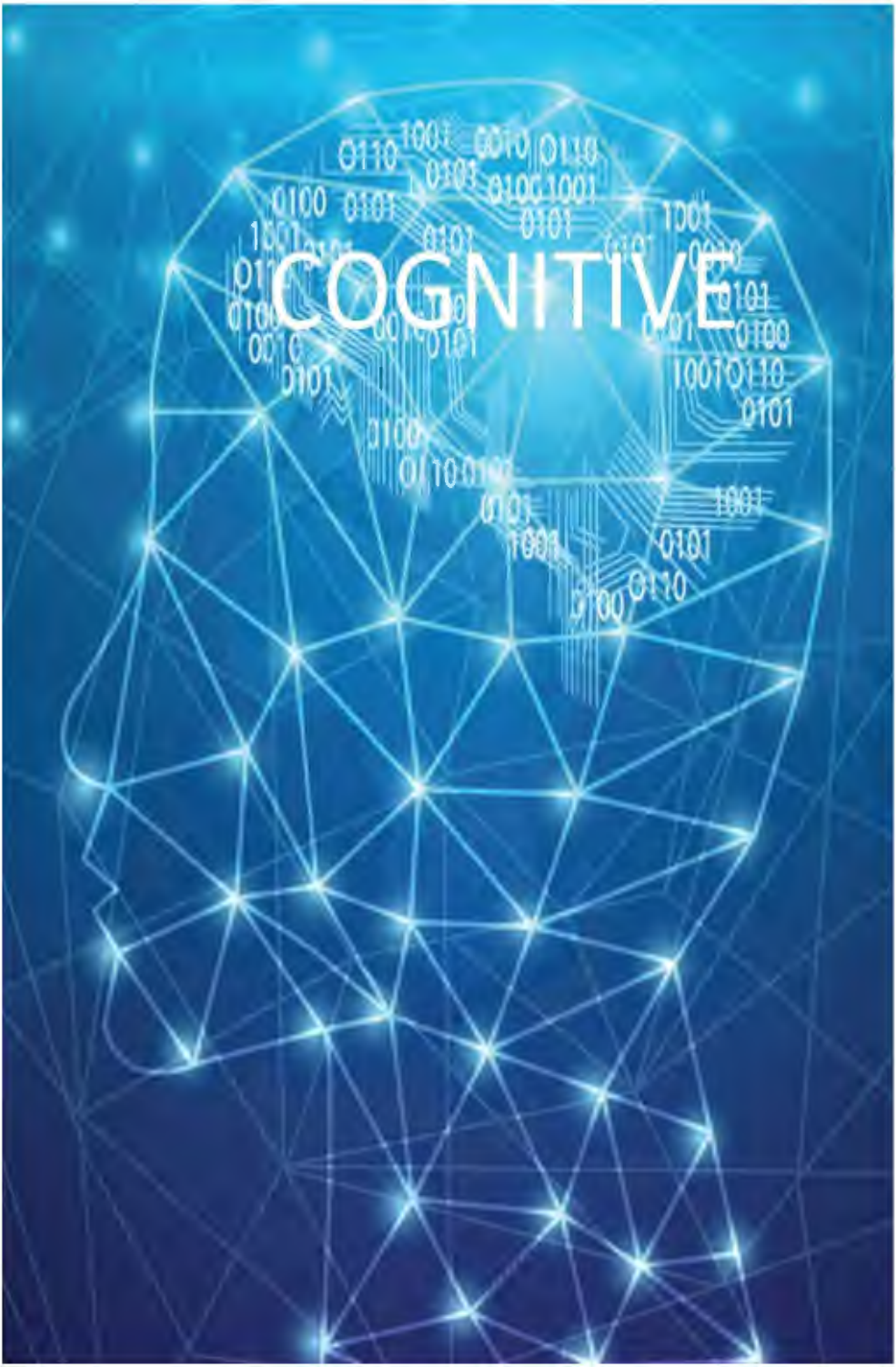
However, today we are establishing neural nets that are rapidly overcoming these limitations which through aggregation of contextual correlations, and relational analysis through adaptive correlation, afford today's system's the means to elevate awareness and achieve a moderate degree of machine-based consciousness. To that end these systems are evolving beyond historical validation of knowns and unknowns and rapidly embarking on a journey of exploration of the unknowable. As they are now endeavoring to know what options and opportunities are available to us, they are focused upon the question as appose to be merely content with the answer. For it is within systems like Google Go that affords the opportunity to explore new solutions through an iterative approach of learning in search of understanding.

The opportunity to evolve, informed by what I call potentiality modeling offers the means to correlate trends in a way that informs the aforementioned Art of the Possible. It is through this endeavor that the potential to transform our current state in preparation for or even creation the desired future exists. Thus, the process of Ideation ultimately offers wisdom to know those options to identify the opportunities to Carpe Diem.

Luck is where Knowledge/Skill/Experience converge

It is the Wise/Capable/Prepared who can answer the door When Opportunity Comes Knocking

. . . Mustang

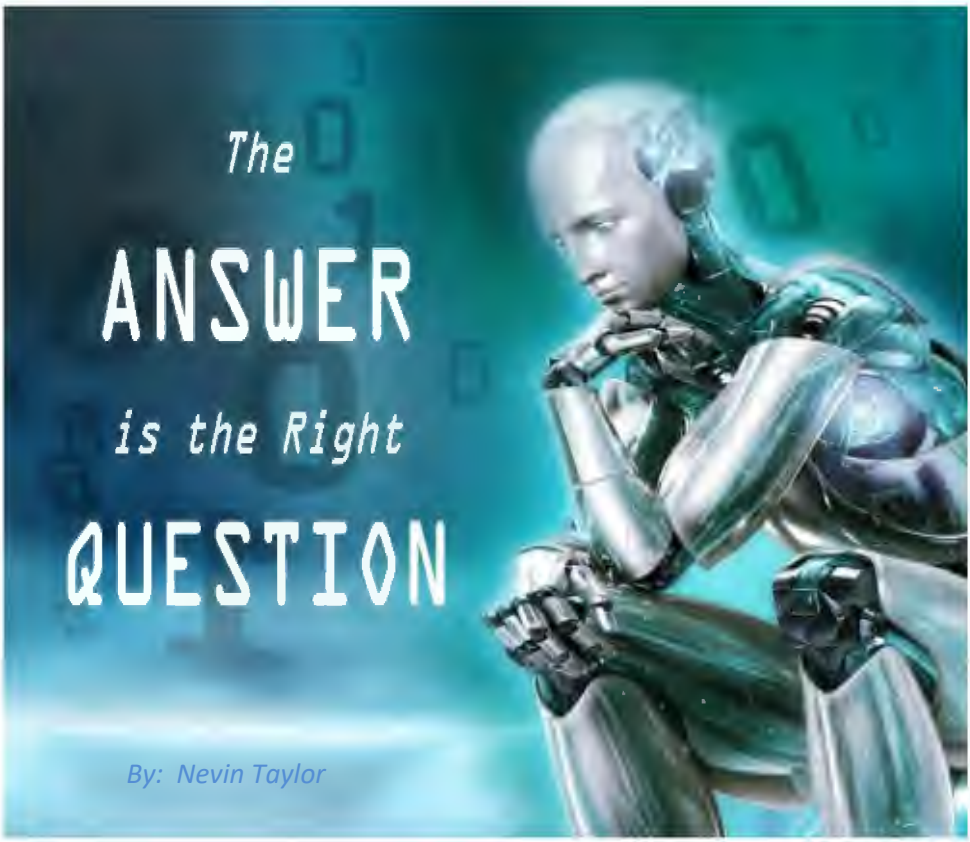

COGNITIVE

TAB 7

THE ANSWER

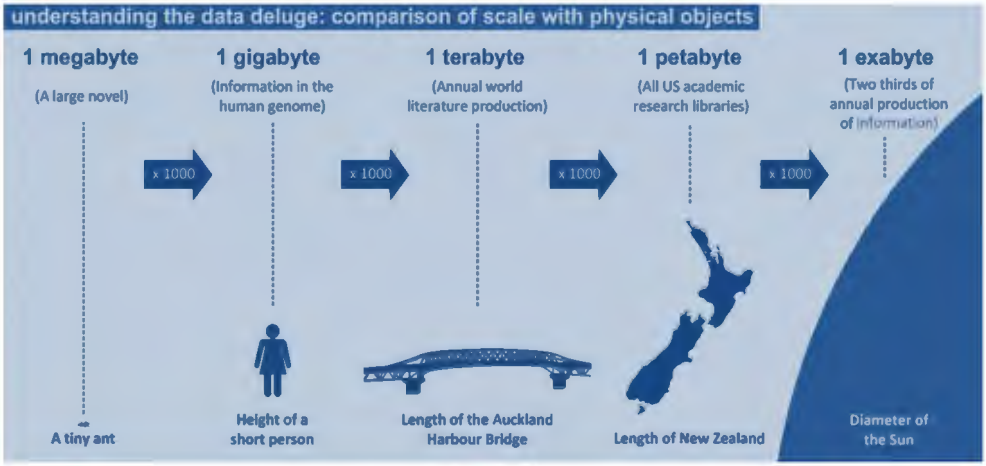
is the

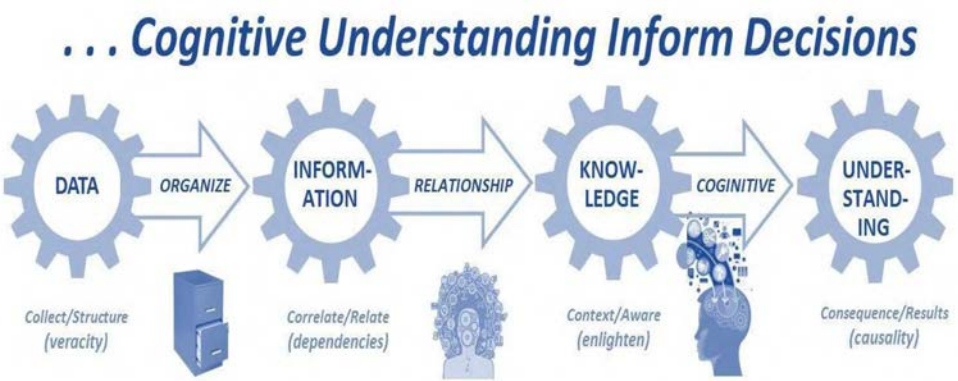
RIGHT QUESTION



The ability to see, understand and ultimately know what is necessary to achieve success represents a vital element in making wise decisions. This ability is fueled by data, which enables the discovery of options that can overcome problems and disclose opportunities that fulfill the objectives at hand. Thus, as our appetite for information is growing at a faster rate than the data being amassed, it is unsurprising that the demand for data is accelerating. While we are certainly familiar with Moore's Law, which holds that technology evolves every eighteen months, few of us realize that Buckminster Fuller's "Knowledge Doubling Curve" is at the core of this law. Fuller asserted that while knowledge doubles every 12 months, that this evolution of data accumulation would eventually be compressed into 12-hour intervals. Thus, the insatiable thirst for knowledge drives the demand for data, referred to currently as "big data," which is currently doubling every 2 years.

The ability to internalize such copious amounts of information and conceptualize the interdependencies that exist within this complex environment become an effective metric for gauging an individual's ability to derive strategic advantage from their efforts to master the information environment. By extension, the ability to compare one's starting point to the intended destination facilitates some appreciation of the vector and character of those elements and understanding of how they can influence expected outcomes. With that in mind, today's Volatile, Uncertain, Complex and Ambiguous (*VUCA*) environment makes it imperative to weigh the origin and contributing reference points against the available options and opportunities to ascertain deterministic potential through the resulting variances. After gaining some contextual reference, the information substantiated by facts conveyed through the associated data will explain how we arrived at our current situation. Historically, the rate at which data becomes available and is linked contextually to our understanding. This is driven by a cause and effect relationship which imparts the potential and probable effects of actions taken to results to be achieved. The influence this has on the dynamic environment manifest itself in outcomes that affect overarching opportunities within the digital domain.

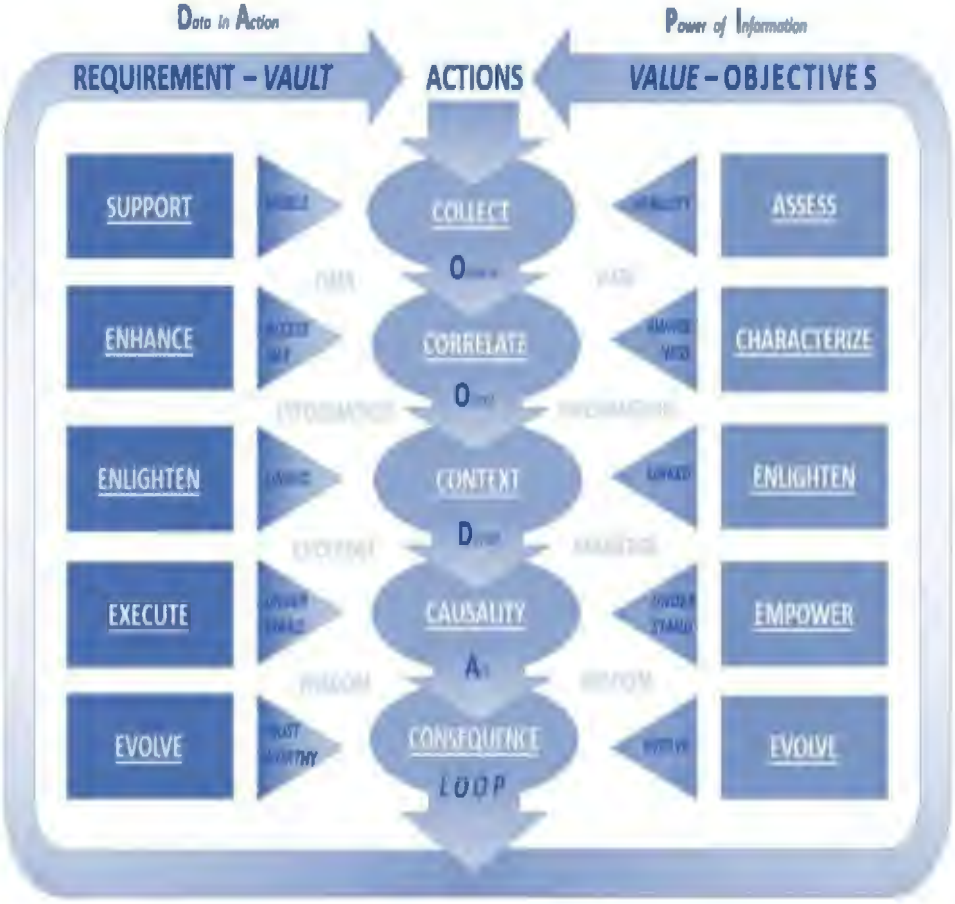




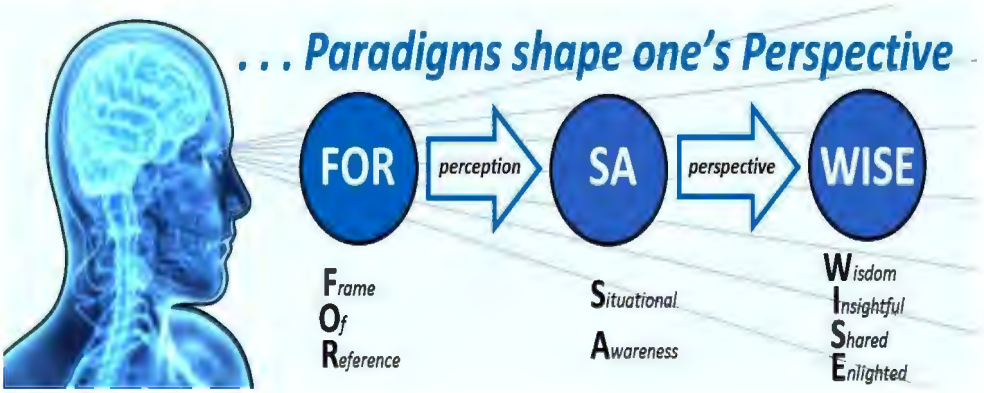
In today's globally interlinked environment, the rate at which data is produced (*and the interdependencies organic to the resulting information*) contributes to the advancement of a complex and fast- paced environment. In such an environment, arriving at the right answer faster than the competition demands that high-quality data—*big data*—be available at the right place and time and reflect an awareness of the overall situation. That way, such data can be developed into a clear, cohesive picture of actions taken compared to the desired results. The building block needed to mature the historical data used to augment a particular Frame of Reference (*FOR*) (*used in turn to organize and structure data into information by applying sound Data Resource Management processes*) has been modulated during the last 20 years by the steadily increasing mass and complexity of data. As a result, data must now be viewed as a strategic asset, and be managed accordingly, to ensure our ability to extract its inherent value.

Data can be organized effectively and correlated into information that will bolster our overall understanding. This process can be utilized to ascertain the probable veracity of the data and the means with which it can be brought to bear, to illustrate contextually the predicted outcomes the must be a structured approach to this process upon which to measure both the veracity of data, relationships of information, and the contextual correlation of knowledge. Through temporal assessments that maturation process can illustrate the evolution to a point that intent and motivation can be revealed. Structuring and transforming this increasing mass of complex data into information is vital, as it will provide the clarity needed to make informed desertions.

To appreciate the value of big data and use it to our advantage, it must first be organized and structured. This can only be accomplished via strong DRM practices implemented by Data Stewards (*DS*) and Information Managers (*IM*), which will ensure the data is fit for its intended purpose and properly apply for its operational purpose. Considering the growing dependence on the depth and breadth of data's strategic value, data hubs are essential to provide a common definition of what it represents, identify where it is, how it can be accessed to ensure it is visible, accessible, understandable, linked and trustworthy (*VAULT*). Through this process the criticality of a supremely capable data services unit within the organization will ensure that effective business intelligence is available to determine the credibility, congruence, and confidence upon which the organization can reasonably expect of its data.



Our alignment of data assets with the foregoing imperatives is essential if it is to inform effective actions across organizational boundaries. Ongoing discussions will undoubtedly ensure that data services units meet the overarching goals and objectives that will satisfy mission imperatives. Thus, one of our strategic imperatives must include taking a holistic approach to harvesting the inherent value of data and associated information upon which the organization has become dependent. We derive value from knowledge by determining its **v**eracity (***A****ccessing quality*), **a**ssessing our reliance on accessing (***C****haracterizing*) the relationships and resulting dependencies, improving its resilience by creating **l**inkages (***E****nlightening dependencies*) and expanding our **u**nderstanding (***E****mpower effective decisions*) in order to **e**volve (*ACE3*) (*VALUE*).



This iterative, five-step *VAULT* process of putting data into action and unleashing the power of information (*VALUE*) is a progressive approach to establishing a Data-Driven Organization (*2DO*). Thus, the criticality to **c**ollecting data to accomplish **P**rescriptive modeling (*ID the Problem*), **c**orrelating its structure with information that illustrates its **P**robabilistic qualities (*ID the Process*) for accurately identifying its **c**ontextual **P**redictions (*ID the Potential*) will disclose the **c**onsequences of the actions we take to **P**redict (*ID Proposal*) options and future opportunities to take **a**ctions measured against results to be achieved (*4C*)(*4P*). By taking an interactive approach, we can **C**ollect, **C**atalog, **C**orrelate, **C**ontextualize, conduct **C**ost/Benefit analyses, **C**haracterize, advance **C**2, **C**ommunicate and determine **C**ausality and **C**onsequences (*10C*) as illustrated in the chart below. This core gives us the opportunity to build the foundation upon

which we can validate what we understand, answer unknowns and explore the unknowable in a constructive and progressive fashion. In scientific terms, we must establish a prescriptive model of lessons learned from past actions compared to actual outcomes. This will enable us to establish the FOR paradigms that enhance one's perceptions and/or improve Situational Awareness (*SA*).

OBSERVE	**PROBABILITY**	**SCIENCE**	**OBJECTIVE**
1C. Collect	Store	DATA	WHAT
2C. Catalogue	Structure	INFO	WHERE
OREINT	**PERSPECTIVE**	**ART**	**OBJECTIVE**
3C. Correlate	Relate	FOR	HOW
4C. Context	Understand	SA	WHEN
DECIDE	**POTENTIAL**	**THINK**	**OBJECTIVE**
5C. Cost/Benefit	Assess	ST	WHY
6C. Characterize	Know	KO	
ACT	**PERFORM**	**ENGAGE**	**OBJECTIVE**
7C. Coordinate	Synchronize	C2	WHO
8C. Communicate	Disseminate	CTO	
LOOP	**PERPETUATE**	**EFFECT**	**OBJECTIVE**
9C. Causality	Dependencies	Feedback	LEARN
10C. Consequence	Results	Trend	

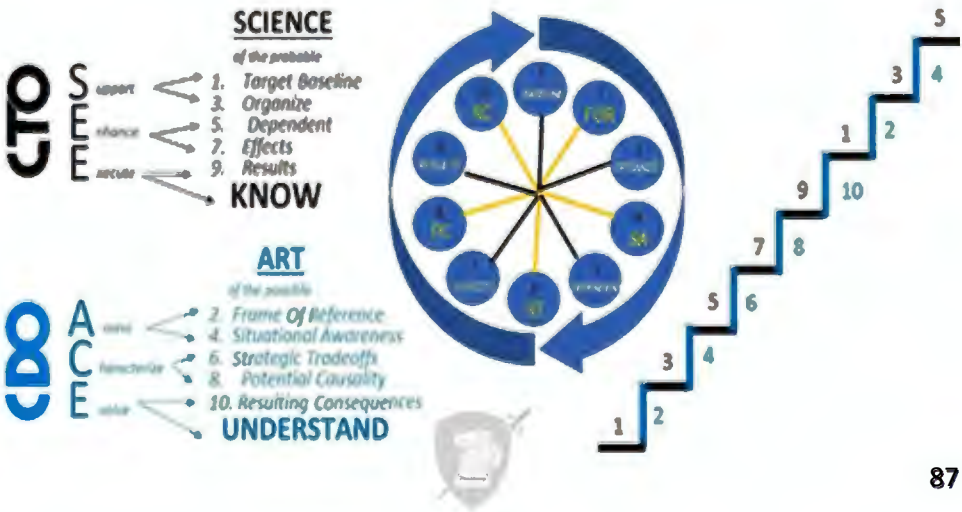
To make good decisions, we must be willing to utilize a cognitive approach that will enhance our understanding and allow us to embrace failure courageously in order to learn. These qualities are fundamental to the skyrocketing interest in Artificial Learning (*AI*) and Machine Learning (*ML*). While today's focus on analytics centers on answering questions, that focus could be refined to help us better understand our circumstances in today's rapidly evolving information environment—one that is pushing us quickly toward the age of knowledge. We would indeed benefit by adapting John Boyd's frame that ascribes an iterative approach instilled by learning and the criticality to observe, orient, decide and act in a continual Loop (*OODA Loop*). It is through this framework that we are afforded the means to *ACE* the strategic advantage essential to derive competitive advantage by effectively leveraging the information available to us. Moreover, it is critical that we harvest the inherent *VALUE* of information in today's interlinked dynamic information environment.

- **MASS**
  - *2.5 quintillion bytes of data is created every day*
  - *Total accumulation of data doubles every two years*
- **COMPLEXITY**
  - *Statistical Algorithms*
  - *70-80% data is unstructured*

- **CONTEXT**
  - *Understand the structure of the data*
  - *Correlate relationships and dependencies*
- **CAUSALITY**
  - *Iterative approach to identify influences and effects*
  - *Assessment of interdependencies and reliance*

- **CONSEQUENCE**
  - Neural networks correlate complicated patterns
  - Predict and prescribe possible outcomes
- **POTENTIAL**
  - *Temporal analysis to ascertain outcomes*
  - *Predictive and prescriptive analysis*

The science of structuring data and deriving probabilistic computational modeling from its associated *FOR* via data scientist-administered prescriptive modeling will help establish a sound *DRM* foundation. Such an infrastructure will give *IMs* the means to advance *SA* based on information that conveys and influences knowledge. Here, the strategic tradeoffs allow Knowledge Operators (*KOs*) to identify potential and probable outcomes using Artificial Intelligence (*AI*). Ultimately, we should be able to predict outcomes or consequences and evolve and learn the causality that creates these end states through temporal analytical analysis overtime through a coherent *ML* processes. It is through an iterative process of learning and evolving that we derive competitive advantage. Building on past successes and learning from current failures. It is these opportunities that afford the means to seek and explore solutions by leveraging current opportunities that overcome even the most perplexing challenges.

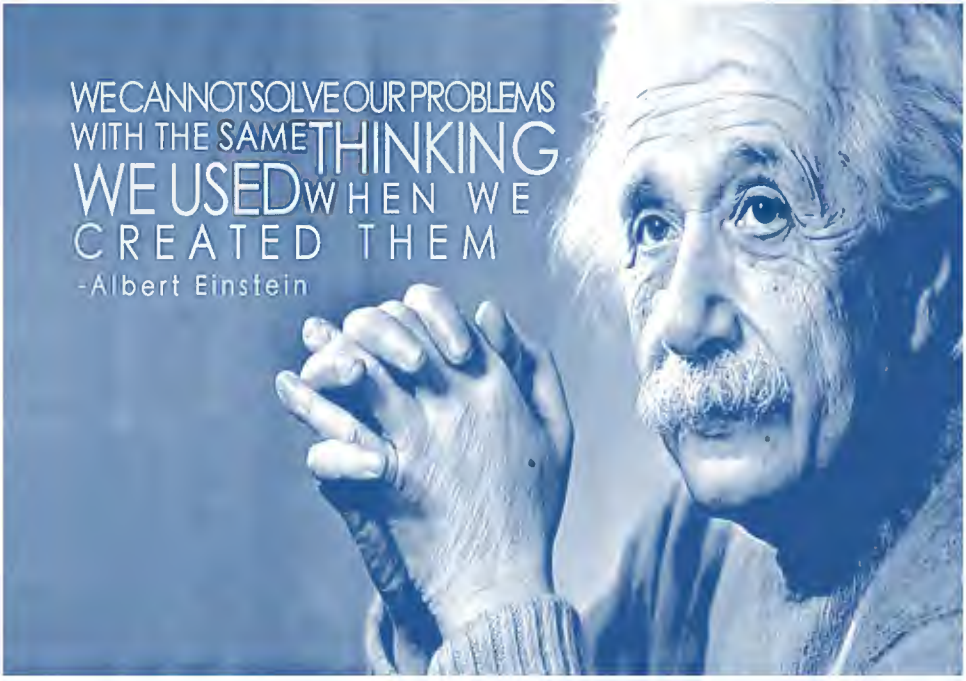


In today's highly competitive environment, organizations rely on big data to mitigate risk. Unfortunately, their current approach results in a risk adverse environment that does not tolerate bad decisions. A new perspective that considers failure as part of the evolutionary process afford the opportunity to learn from our mistakes. Without knowing the linkages or understanding the interdependencies associated with information, we simply cannot enhance knowledge to a level that will allow us to identify the antecedents and resulting consequences of our actions. Clearly, we are poorly equipped to characterize the environment and determine our potential for success the aforementioned *ACE* framework. Further, the growing mass and complexity of data in today's information environment compounds this situation to a state that has most unaware that they are unaware of the growing challenges and the imperative to leverage data as a strategic asset to derive competitive advantage.

Data affords the quintessential historical context to illustrate 20/20 hindsight from our *FOR*. The means to imbue our *SA* with current knowledge to ascertain informed options and opportunities in the future state allow for a replacement of reactionary measures with proactive responses that serve our organizational objectives. By using a structured approach, we can identify, mature and establish the reliability of data to build credibility and confidence in the information. By maturing it to formulate a contextual picture of understanding precludes a reactionary post-event response. This process illuminates those options that illustrate the opportunity to take a more proactive approach that transforms our environment to suit our needs. By leveraging the cognitive capacity to think, learn, and evolve we can transform our environment in a way that accommodates current and future objectives.

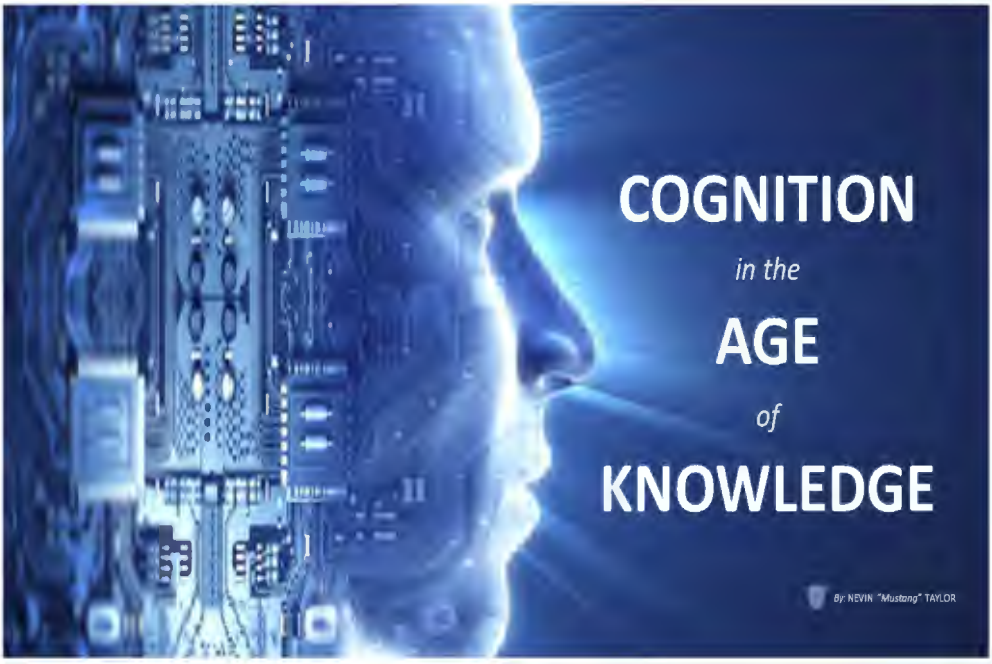
To that end, we now have the opportunity and ability to influence our environment and transform it according to our own design. Thus, by exploring the art of the possible as defined by the science of the probable, we can empower our leaders to accomplish their goals and fulfill their

mission objectives. It is therefore imperative that this a new approach be adopted and allowed to inform an enlightened perspective if we are to remain competitive in today's rapidly changing interlinked world. It is through these efforts that we must advance and advocate a vision that inspires and encourages us to overcome the self-imposed constraints that force us to live in the problem, and instead focus on searching for solutions. For it is through a shift in perspective that we will be afforded the opportunity to take a proactive stance to center our efforts and energies on understanding our environment by thinking differently. Thus, it is imperative that we live in the question as opposed to become constrained by a predeterminate answer if we are to actualize our potential and be preeminent in this enlightened new world.



TAB 8

COGNITION
IN THE AGE OF
KNOWLEDGE



A domain enlightened by Big Data,
empowered by the information environment,
and evolved through the creative capacity of mankind

"We are transitioning from wars of attrition to wars of cognition"

Gen David Goldfien – CSAF

In his pivotal speech at a recent Air Force Association, the Air Force Chief of Staff astutely acknowledged the transition from the industrial age, with a focus upon a war of attribution, to the new age of knowledge with direct forbearance on leveraging cognition. He awakens us to this new reality of today's interconnected world with the following questions:

Does it connect? GOOD

Does it share? EVEN BETTER

Does it learn? TOUCHDOWN

Today's society is leveraging data to make informed decisions with greater dependence on data that is fit for purpose and operationally relevant. By capitalizing on the inherent power of the information environment to harness the creative capacity of ideas, the ability to unleashing the capacity to enlightened knowledge which empowers understanding has created a formidable Challenge to Collect, Catalog, Correlate, Contextualize, Cost, Characterize, Coordinate Communicate and identify the Causality and Consequences (10C) of actions taken measured against desired results to be achieved. As they endeavor to mature knowledge into actionable understanding that affords their ability to make wise choices, they come to realize that thinking before your act in order to begin with the end in mind offers great opportunity to work smart not merely harder in today's interdependent highly complex world stage. The opportunity to influence this environment in a way that effects their ability support, enhance and evolve (SEE) mission operations provides the means for competitive advantage as they transition from an industrial society to our current state where knowledge is king.

OBSERVE	***PROBABILITY***	***SCIENCE***	***OBJECTIVE***
1C. Collect 2C. Catalogue	Store Structure	DATA INFO	WHAT WHERE
OREINT	***PERSPECTIVE***	***ART***	***OBJECTIVE***
3C. Correlate 4C. Characterize	Frame of Reference Situational Awareness	KNOW UNDERSTAND	HOW WHEN
DECIDE	***POTENTIAL***	***THINK***	***OBJECTIVE***
5C. Context 6C. Cost/Benefit	Options Opportunity	WISDOM GENIUS	WHY
ACT	***PERFORM***	***ENGAGE***	***OBJECTIVE***
7C. Coordinate 8C. Communicate	Synchronize Disseminate	MANAGE LEAD	WHO
LOOP	***PERPETUATE***	***EFFECT***	***OBJECTIVE***
9C. Causality 10C. Consequence	Dependencies Results	INFLUENCES EFFECTS	LEARN

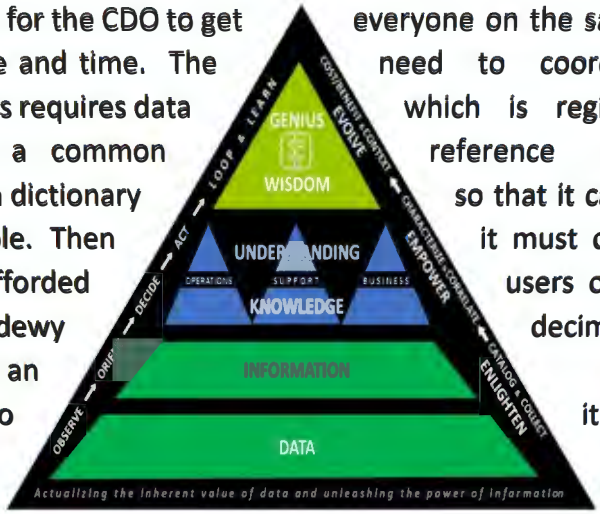
As we launch into this new endeavor, we must be cognitive of the definition of cognition as the mental action or process of acquiring knowledge and understanding through thought, experience, and the senses. It is through our structuring of data into information and characterizing the relationships we have in it that evolves knowledge into understanding. Recent emphasis on the size and scope of the accumulation of data has established an emphasis upon managing it in a way as to ensure it is fit for purpose. Recent efforts to focus on the maturation of information into knowledge identifies the criticality of ensuring that it is operationally relevant to provide contextual understanding. And finally, our ability to think and understanding the causality of actions given the interdependencies taken measured against results to be achieve provides the opportunity to ascertain potential consequences in both time and space.

I recently published a series of three books to outline these areas which serve to illustrate the essential actions to be taken to enlighten, empower and evolve (E3) in our ongoing efforts to derive strategic competitive advantage. They highlight the necessity to observe past conditions to inform current circumstances in the present which identify those options and opportunities available in the future. The First book on "The Power of Information" outlines how to collect data and catalog information to ensure it is Visible, Accessible, Understandable, Linked and Trustworthy (VAULT). The second "The Programatics of Integration" assimilates this to correlate knowledge into contextualize understanding to ascertain the Veracity of the facts, elevate our Awareness of the situation, to empower Understand that facilitates the Evolutionary process (VALUE). Third is a book on "The Potential of Innovation" explores the art of the possible within the science of probable to identify options and opportunities to transform the organization in a manner that actualizes its potential. These three distinct functions must be matured to maximize the propensity of success in order to establish a Data Driven Organization (2DO) to optimize effectiveness in this highly competitive in information environment.

The paper "Data Operations Development," the ascribed 10Cs are essential to mature the cognitive process as illustrated below. The first two C's/Collect and Catalog are the work of an organization's Chief Data Officer (CDO) to ensure effective data resource management (DRM). By ensuring the organization's data is fit for purpose to inform decisions, their ability to derive heightened confidence and mature operation is established through a strong foundation upon which to sustain ongoing operations. The next two C's/Correlate and Contextualize are the focus of their Chief Knowledge Officer (CKO) to formulate a keen understanding of the operational picture. By illustrating the relationship and illuminating the interdependencies, the resulting relevant knowledge serves to evolve understanding and capitalize on the available options to seize current and future opportunities. The next two C's/Characterize and Cost/Benefit provided by the Chief Analytical Officer (CAO) outline the strategic trade space available to transition and transform the organization by actualizing potential value available in the future state.

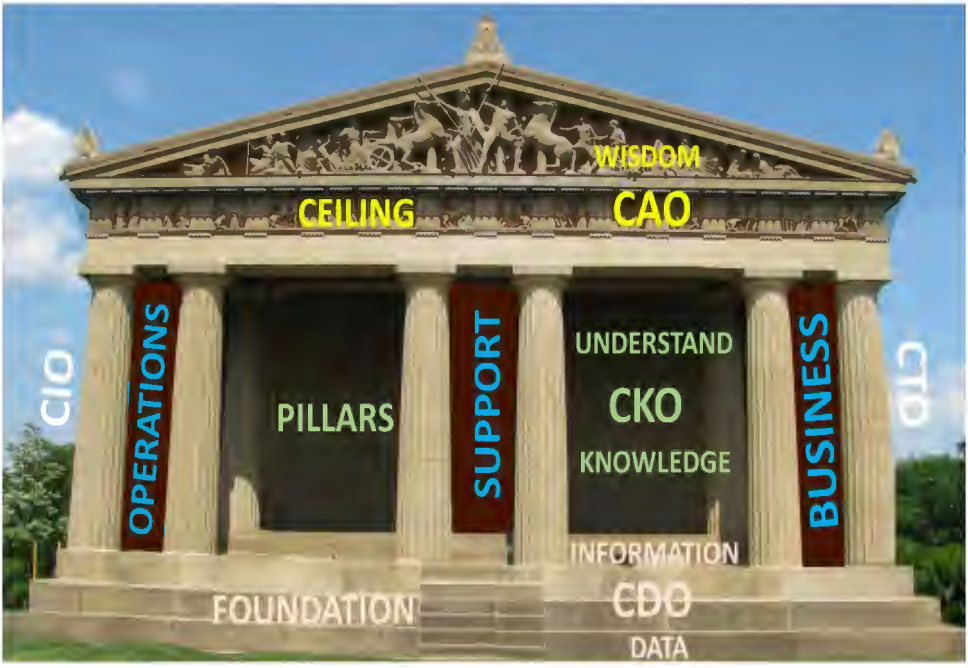
The need to communicate and coordinate to the entire organization is an essential effort in the formulation of collaborative teams and the criticality of synchronize activities essential to achieving the objectives that fulfill their collective goals. By identifying influencers (*causality*) of actions taken measured against results to be achieved (*consequence*) the pathway forward will afford an interactive process that matures and evolves to actualize their potential to transform into its ideal future state. It is through the application of numerous technologies that facilitate the interactive process of evolution.

The first step is for the CDO to get everyone on the same page at the same place and time. The need to coordinate and synchronize this requires data which is registered and ascribed into a common reference like an enterprise data dictionary so that it can be visible and discoverable. Then it must discoverable, like that afforded users of a libraries by their dewy decimal system which provides an information asset catalog so it can be accessed and searchable. Finally, a portal to provide a means to query it, like that done through a reference librarian, ensure ready access to it. Through effective data resource management (*DRM*), they establish a foundation to collect and discover data and catalog it in a way that provides structure so that it can be searched in a manner that informs decisions. This is no easy task given the volume, variety, velocity, and veracity of big data. By effectively structuring data as an organizational resource and managing it to provide a common frame of reference, the result is the foundation upon which to assess prescriptive modeling to ascribe its veracity of fact while offering the mechanism to mature the process of making informed decisions.



The next step in the cognitive process is for the CKO to identify the relationships of actions taken measured against results to be achieved. Correlating information to ascribe knowledge by characterizing it to facilitate contextual understanding illustrates available options and relevant future opportunities to influence and effect their environment. Illustrating the relationships which illuminate the dependencies that provide the means to accomplish predictive modeling informs probabilistic deterministic that ascribes available options to inform good decisions. The causality of actions as related to consequences within this interlinked interdependent environment provides the quintessential framework to mature understanding essential to making good decisions. Characterizing the potentiality of outcomes and synchronizing actions taken measured against results to be achieved we are able to manage present expectation through leveraging knowledge operations via the aforementioned framework that provides potentiality of future consequences.

The final step is for the CAO to provide a thorough analysis of the facts and dependencies upon which to determine the potential of available options to achieve potential opportunities. Through the demonstrated application of facts in relation to opportunities the strategic trade space will reveal the pathway forward necessary to invoke actions necessary to evolve and transform the organization. In the end, analysis will apply data that informs decisions in a way that evolves knowledge that surpass future understanding essential to making wise well-informed decisions.

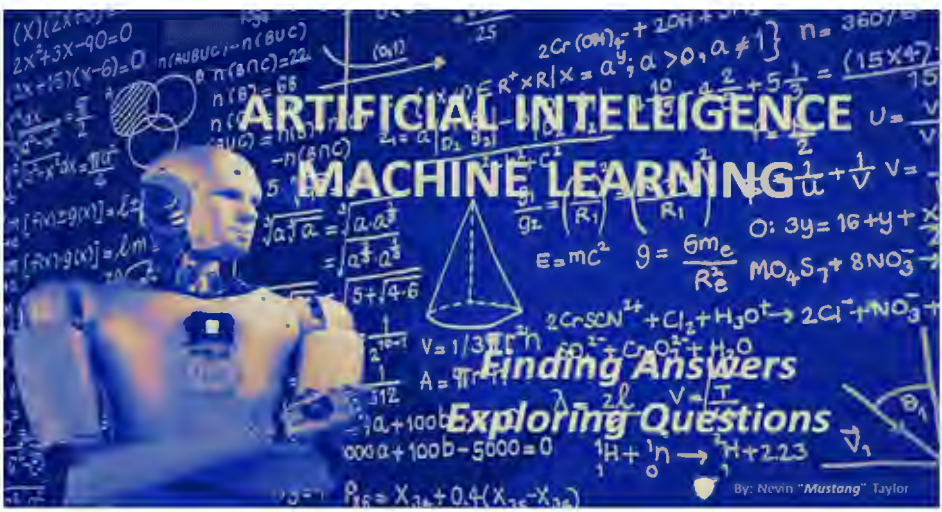


We are Drowning in Information and Starving for Wisdom

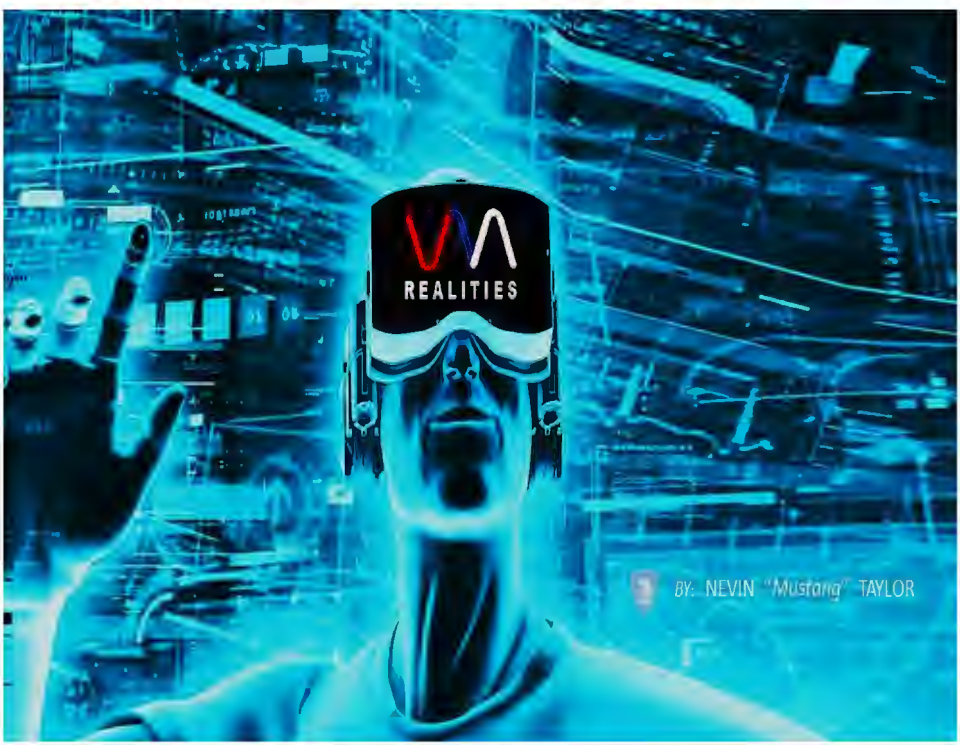
John Naisbitt

Today's insatiable appetite for data and infatuation to expand knowledge that surpasses understanding is struggling to leverage technological tools to support the 10C with still ill-defined concepts like Artificial Intelligence and Machine Learning. All to create decision support tools to facility the cognitive process has yet to be defined and demonstrated. The criticality for the CDO to structure data to afford machine-to-machine processing of analytical information provides the means to facilitate the foundational maturation of the information environment in a way that informs the decision-making process. The CKO assures a consistent means to operationalize knowledge through the aggregation of information in order to provide contextual understanding in their ongoing efforts to proactively prepare to capitalize on current and available options. By leveraging machine learning to evolve situational awareness, they are able to identify the trends that presents future opportunities.

Through modeling and simulation the potential to identify past and present causalities affords the means to leverage those influences that affect the propensity to capitalize on available options and future opportunities to seize the day through in-depth analysis in order to actualize the inherent value of understanding to make wise choices. By utilizing prescriptive modeling of the past circumstances to establish a baseline/FOR upon which to accomplish predictive modeling of present conditions we are able to evolve awareness through probabilistic deterministic/SA and become informed of future possibilities from potentiality modeling via AIMLearning.



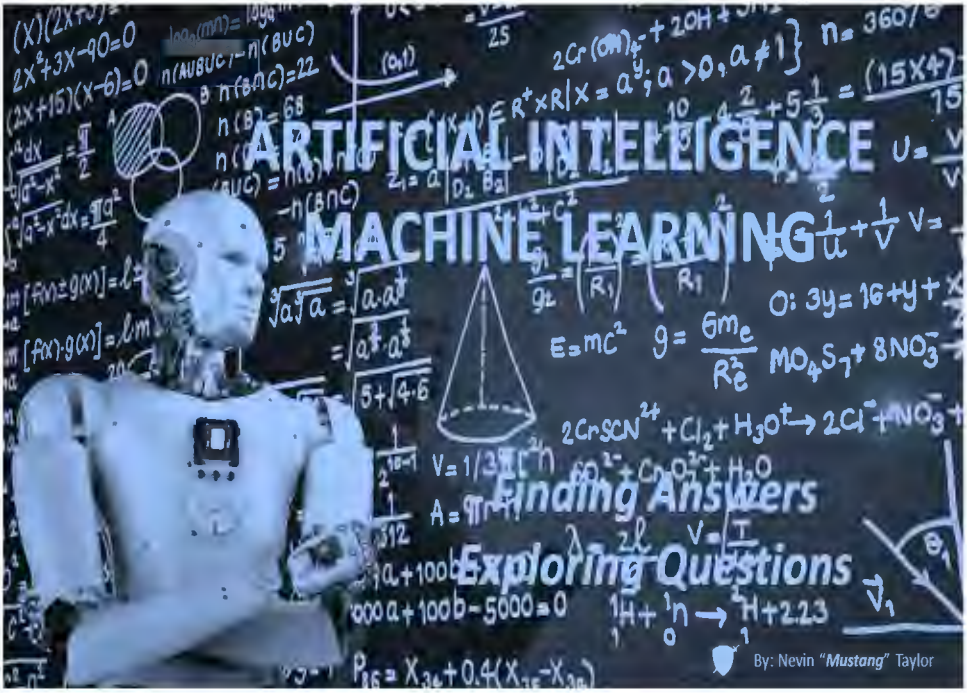
As the adage stipulates, “I believe none of what I hear, half of what I see and only that which I experience.” Thus, the demands that we show not just talk about how to proceed in our ongoing efforts to enlighten, empower and evolve (E3) are imperative to proceed in a productive manner. Therefore, it is imperative that we THINK…TRY…TEST to capitalize on the creativity. Through the creative process we can conceptualize and produce prototypes that illustrate operational benefits of exploring and creating tomorrow’s future today. It is through visualization that we show the advantage to be derived to impart understanding from the well-known saying “a picture is worth a thousand words.” Experiential learning provides the means to effectively collaborate and coordinate activities to synchronize efforts in a way that provides results. It is the demonstration of the VALUE of the capabilities that advocacy can be applied to acquire essential resources to actualize the idea. Thus, a virtual environment to try and test, provides the critical ingredient to learn and evolve as outlined in my paper on VAMRealities.



The reliance upon the Chief Information Officer (CIO) and Chief Technology Officer (CTO) to establish system that are interoperable and leverage technological tools that facilitate this process respectively are critical components to ensure competitive advantage. Thus, an organization must put the five functions CDO/CKO/CAO/CIO/CTO in place to create a data driven organization (2DO) as outlined in my paper on the same topic if they are to be competitive in the cognitive domain. For it is through a foundation established by the CDO that we are able to SEE the propensity to unleash the power of information. The newly established emphasis on formalizing knowledge ops by a CDO provides the opportunity to operationalize and integrate programatics to ACE operations and empower understanding essential to making informed decisions. And it is the CAO that performs the requisite analysis to illustrate the criticality to produce results and progress in a proactive manner to actualize the inherent value of working smarter in the cognitive domain in today's age of knowledge.

TAB 9

ARTIFICIAL INTELLIGENCE MACHINE LEARNING



From its inception in 1955, Artificial Intelligence (AI) coined by economist Herbert Simon quickly grew into science fiction where computers came to life threatening the status quo with superhuman intellect putting at risk the existence of mankind. Stating outlandish predictions and postulating that they could produce systems that would out think and outpace humanity fueled doubt and speculation as to the feasibility of this notion. History has illustrated the trepidation and challenges associated with technological advancements and acceptance of the establishment of autonomous systems. Even now the prospects of AI is approached with a high degree of skepticism. This creates not only cultural impediments but is compounded by the technological challenges to overcoming the fear associated with empowering machines to become self-sufficient. In time, fiction is rapidly becoming reality with the inception of Watson's 1997 victory over chess master Gary Kasparov. A new age is being ushered in with the prospects of establishing a collaboration between humans and the machines as we begin to utilize and leverage these technological tools to derive competitive an advantage on the world stage.

Science is embarking upon a journey to explore and empower machines with great capabilities that thereto before were unimaginable. Today, AI has evolved and become a part of our everyday existence. It continues to mature and conquer unforeseen capabilities as it provides a multitude of opportunities to improve our quality of life. Through new applications such as self-driving cars, AI is being integrated into every aspect of our existence. Through a multitude of varied and diverse technological applications, it is driving the evolutionary process of transformation. Human machine interaction can be seen on a plethora of venues like that experienced from call centers. These conversational engagements leverage AI in an advisory capacity through business intelligence systems to communicate, coordinate and collaborate with customers. The collected information is then correlated to support the cognitive process upon which to evolve contextual understanding.

Through the application of advanced decision support systems, AI is able to empower self-synchronizing systems that are allowing it to mature and expand its applicability beyond traditional boundaries. Currently there is a growing acceptance of this capabilities which is fueling an innovative approach beyond historical conceptual boundaries. With growing acceptance, the past sensationalistic perspective that computers will exceed humans are falling by the wayside. AI is now being embraced at all levels to leverage collaborative partners in an effort to increase cognitive capacity which derives increased competitive advantage. Through the art of the possible and the science of the probable relative to how AI will evolve and be implemented in today's technologically savvy society, the intersection between art and science has only become constricted by our own creativity.

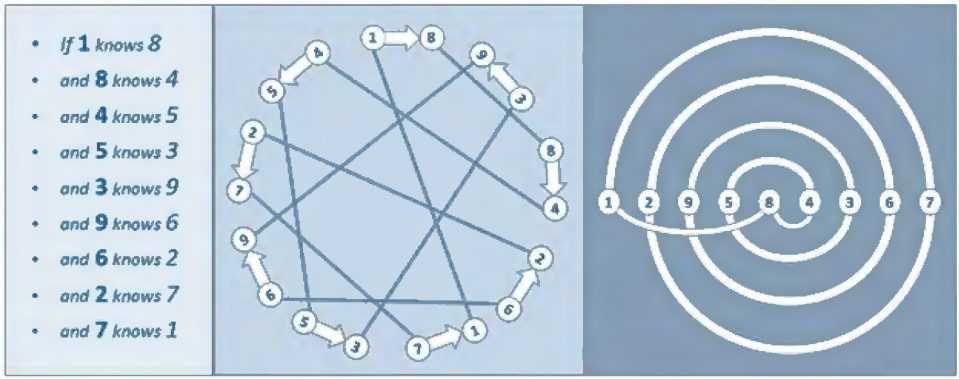
We must establish a common understating of what AI is, if we are to preclude self-imposed limitations that restrict its proper application and impede potential progress. By using a definition of AI as "analytical information" the potential of its capabilities is more constructively and purposefully realized. This approach will prove useful to properly apply this

technological tool in a way that effectively unharnessed the inherent power of information. Leveraging analytical information through an algorithm offers the opportunity to consistently apply facts in a constructive matter via a machine to machine process that capitalizes on the consistency to ascertain causality against resulting consequence. Under this construct, we are able to apply this technology on predefined framework upon which to measure available facts against desired outcomes to be achieved. For it is through the appropriate operational application of AI which ensures effective utilization of this new an evolving capability that we can fully capitalize upon its capacity to assist and align knowledge in a way the facilitates the cognitive process.

AI is currently constrained to leverage knowledge only to answer today's perplexing questions. Therefore, it is through this process that machines are empowered to provide answers to computational formulas through predefined algorithms. Thus, their ability to derive answers within the framework of formulas precludes their ability to make decisions. Therefore, it is within this area of autonomous interactions that they assess the answer given the question being asked. Their inability to characterize or put into context the circumstances upon which their answer is presented currently precludes their ability to evolve. Given limited insights, they a restricted to provide contextual correlations from limited transactional machine to machine actions. Thus, they can only apply those facts through predefined dependencies to compute probabilistic deterministic in order to ascribe answers to predefined suppositions. As the system grows and evolves, it becomes more complex and the resulting interdependencies become more difficult to conceptualize. Human interaction is overcome and slow, and error rates increase as opposed to their computerized counterpart. Machines are able to more aptly able to compute the analytical information, responsively applying the ascribed variable to consistently derive correct answers with minimal degradation to throughput.

CONTEXTUAL CORRELATION

Plurality of connections . . . and their contextual linkages . . . their correlative relationships are:



As network continues to mature, grow, and expand overtime, the opportunity to provide a contextually rich and colorful picture provides the means to elevate awareness. Given the temporal nature of this effort, we can begin to measure the adaptation and apply a 3D model to ascertain causality to prepare and predict consequence by validating the knowns, unknowns, and yet to be realized unknowables. It is through this contextual picture that we derive heightened situational awareness (SA) to validate our knowns, assess the unknowns and explore the potential of the unknowables in our ongoing efforts to evolve and expand knowledge. Through a conceptual engagement of relational comparatives, we can apply and mature our SA through exploration of diverse perspectives. By applying this process, we can begin to derive opportunities to compare differences, distinctions, and differentials (3D) to create a rich fully encompassed picture or perspective, upon which to establish and expand our understanding of current circumstances through our ongoing efforts to grow, learn and evolve.

Comparative analysis has been utilized for some time with great results. This is demonstrated in the current process that allows machines to read. Through long standing optical character readers (OCR), machines are able to do an analysis to analyze and match shapes to their approximation of letters in the alphabet. Further application of this and other similar capabilities are being performed with higher accuracy on pictures given the additional contextual information offered from a more diverse comparative advantage given the greater relative references in both

shapes and colors. Efforts to provide seamless interface between humans and machines have received significant interest as of late advances in human language translations and natural language processing technologies to create more seamless interfaces. An instance of these capabilities is readily utilized in today's call centers where human voice interactions offer the means to take audio interpolation through modulation comparatives to provide almost instantaneous matching of words to meaning. With continued advances they will undoubtedly be able to characterize sentiment through implications and as a result of inflections and timing to determine contextual understanding that provides a full range of said and unspoken inferences.

However even with a plethora of advances and increasing interest in this area, AI is only as good as the data that is provided. Thus, we must be mindful of the adage all too familiar to computer programmers; garbage in, garbage out – GIGO. Given many new social data sources that continually coordinate, collaborate and communicate the evolving nature of today's information, the need to time slice in order to assure real time capture and processing is essential. The maturation process of information has become an iterative constantly changing endeavor, often amplifying the worst that badly correlated information has to offer given poorly constructed data. Crowd sourcing has proven to be an excellent means to mature and garner current perspectives which informs perceptions and transforms paradigms. It is this opportunity within the dynamic environment of the digital domain that the collaborative approach to enlighten the community in a way that empowers the maturation process to transform perspective and paradigms offers the means to evolve knowledge in a way that surpasses current understanding.

A continuum of assessments through crowd sourcing has proven valuable as a reference contrary to the traditional medium for authoritative sources like encyclopedias. The speed at which these capabilities are progressing, revealed themselves in 2005 which online social information sources proved to be comparable in quality to their historical references. An Oxford University 2012 study further identified advances in technology to provide contextual and timely data that was of equal or in some cases better quantitative and qualitative accuracy. The results of improved veracity and currency continues to improve in spite of our lack of trust in social media. For the proven reliability of this venue continues to serve as a catalyst for the transformative nature that matures data in a way to informs and influences the cognitive process. In today's highly interlinked world the resulting dynamic effect of transformation requires a continuum of adaptation to inform the results of iterative influences on today's information environment.

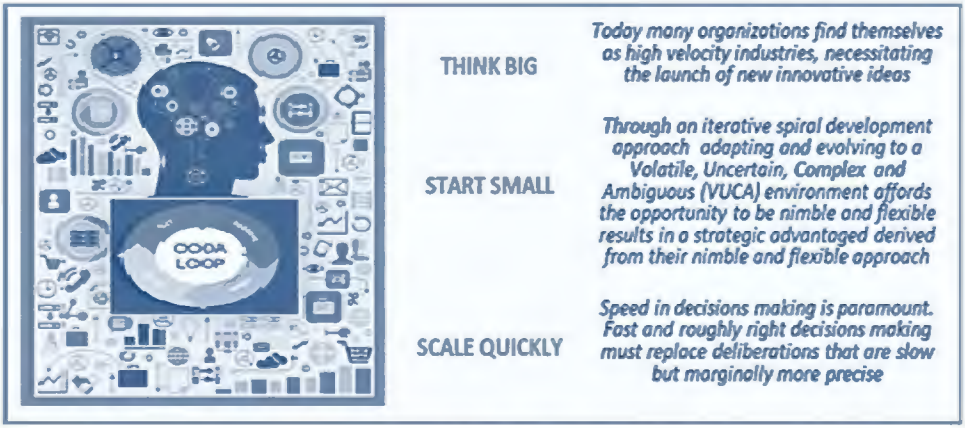
The criticality of timely information has become a vital element within the cognitive process of making informed decisions. The two essential factors that AI relies upon to inform and enlightened decision based on elevated situational awareness is found in the ability to adapt to circumstances as they influence this highly adaptive dynamic yet highly interdependent digital domain. This has created a confluence on data with and ever-increasing demand signal and dependence the totality of which is doubling every two years. The result of which is a volume of data which creates

evermore variety of information to informs contextual knowledge. The expansion of this phenomenon has increased in velocity at a rate that continues to transform our understanding and perspective in this highly adaptive environment. One must be mindful of the value proposition as it relates to their ability to assess the strategic trade space in actual/quantifiable and opportune/causality cost/benefit considerations. For it is in their ability to effectively plan and efficiently program in consideration of the necessity to be flexible in this dynamic highly evolving environment that is foundational to their ability to capitalize on options and available opportunities essential for strategic advantage.

To be competitive in today's information environment, which is transforming at the speed of mission, one must be adaptive to actualize opportunities in the new age of knowledge. This requires large sample sizes (**Volume**), with sufficient diversity (**Variety**), to adequately characterize the interdependencies to assess the quality (**Veracity**). It is thus imperative that timely feedback (**Velocity**), is provided to adequately contextualize knowledge to inform understanding throughout all stages of operationalizing data in a way that serves the organization (**Value**). The maturation of these five measures inform how to assess data, characterize information, to properly mature and enlighten, empower and evolve (ACE) mission objectives. Business intelligence is able to formulate the available trade space to illuminate options and illustrate opportunities to be capitalized upon. It is through these action that organizations become enlightened and empowered to make better decisions that evolve their ability to gain and maintain competitive advantage on the interlinked global stage. However, it must be understood that AI is about providing answers given our awareness of current circumstances. The quality of the answers has direct forbearance on the quality of the facts and the context upon which they are presented. Thus, AI is the opportunity to correlate knowns through relative validation and the codification of unknowns in an effort to explore unknowable's in a way that evolves understanding. It is this consistent approach that characterizes the environment to ascertain causality and resulting consequences of actions taken measured against results to be achieved.

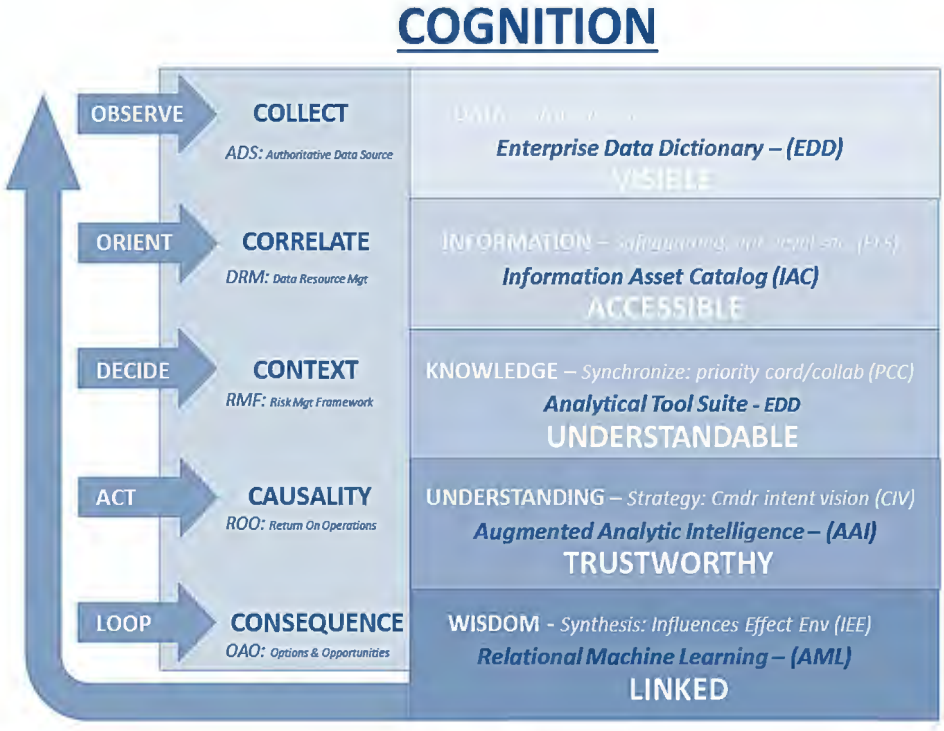
Machine Learning (ML) serves as another recent infatuation previously coined by Arthur Samuel in 1959 based on a study of pattern recognition with a focus upon computational learning. As it pertains to the ACE model (Assess, Characterize, Enlighten, Empower and Evolve), assessments are accomplished via AI and Characterizations are preformed through ML. The evolution and adaptation of transformations overtime reveal insightful understanding which enlightens the recipient of those options and presented opportunities as they reveal themselves. It is this temporal study which is at the core of ML. Whether supervised or unsupervised, the framework upon which to reference theses adaptations illustrate the trend that affords those influences within the environment the causality to create the resulting consequences that effect outcomes. It is through our understanding of how the causality of actions effects the resulting consequences, as illustrated by John Boyd's progress process of adaptive observations made against a framework relative to its orientation that provides insights to upon which to learn/loop.

It is from this perspective that decisions can be made based upon available options which are acted upon given current circumstances in an effort to garner strategic advantage. This process of Observe, Orient, Decide and Act (OODA) relies upon an iterative approach to learn infused with a feedback Loop. It is through this adaptive approach, that the opportunity to learn in this highly dynamic domain present the means to evolve and transform. For in time, trends are identified through temporal assessments that illustrate cause and illuminate potential consequences which is the source for the aforementioned options and opportunities.

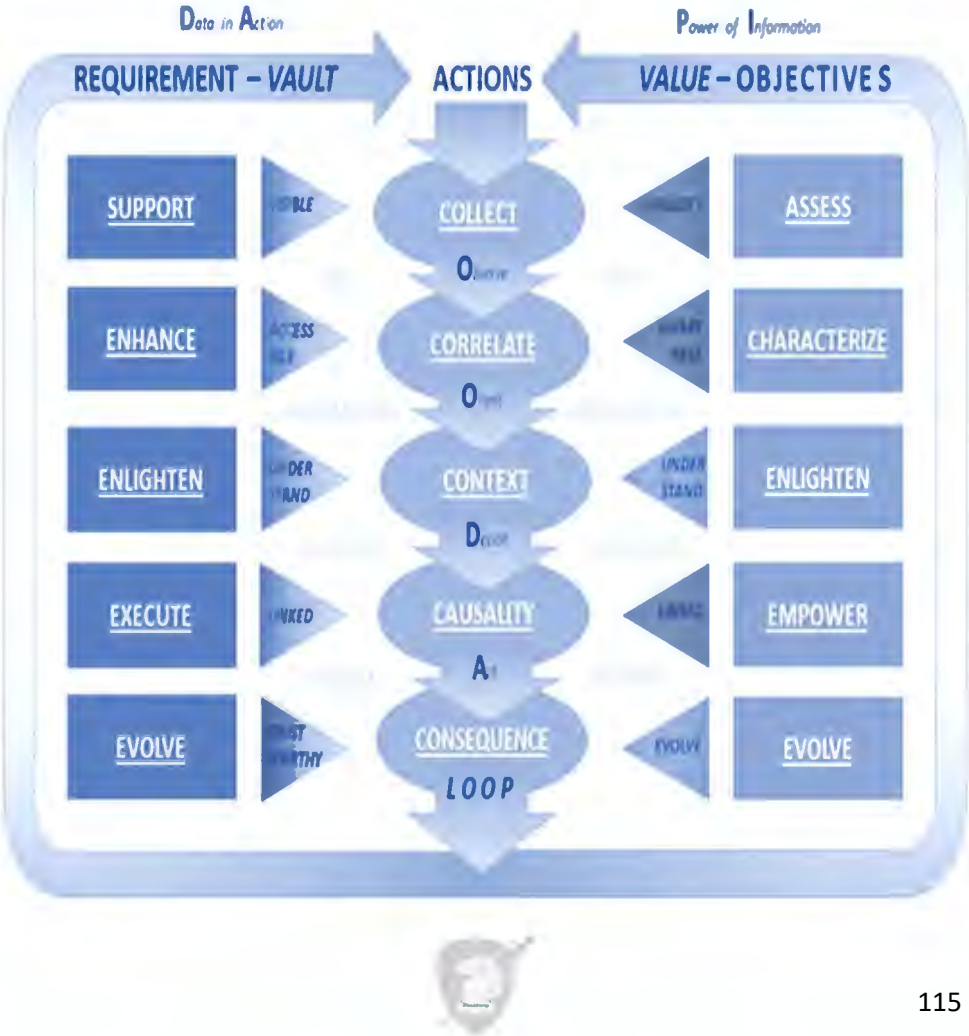


Recently there have been algorithms developed to measure adaptive correlations that now allow us to quantify relational dependencies. It is thorough these computational algorithms that provide insights to the interdependencies within both the open and closed systems. The resulting relationships can be assessed to determine how they adapt and evolve over time. It is from these insights that the requisite questions essential to effectively exploring the environment of the knowns, unknowns and unknowable's can be ascertained. Relative to the reference of time, temporal analysis can now correlate information to put it into a contextual framework. It is through the alignment of association that the interdependencies can be measured over time to illustrate the adaptations. By measuring the adaptive correlations, we can begin to see the trends and thereby assess what the future has to offer. The forbearance of facts, factoring in for how they relate to each other, offers for the first time an assessment of the resulting influence actions have on current conditions and how that manifest itself in creating the impetus for our impending future state. As illustrated above, contextual correlation utilizes the relational frameworks to provide answers. However, it is through adaptive correlation that we can illustrate how to capitalize upon those insights that inform us of the future as a result of the interdependencies of past and present interaction which are illustrated in the following model.

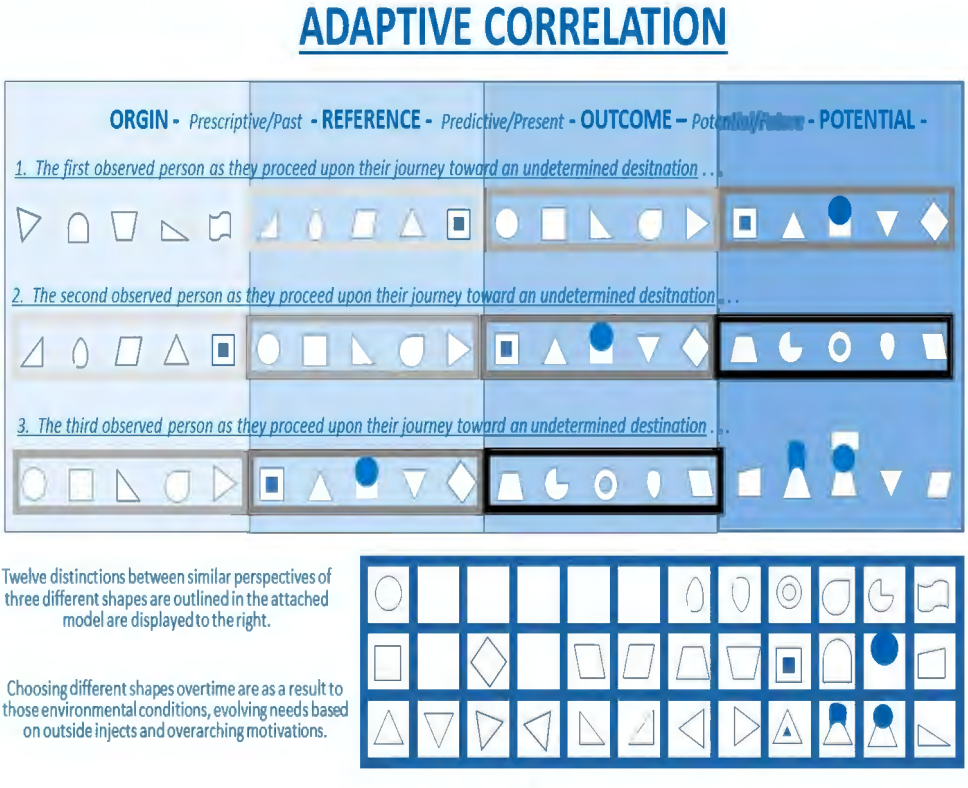
To date most machine learning was initiated via supervised learning. The fallacy of this approach is that it adopts pre-established parameters confined by paradigms that preclude a progressive journey of exploration. It is through this effort that systems seek to understand the dynamic characteristics of a constructive environment in a vailed attempt to produce progress. Unfortunately, this effort instantiates a polluted perspective given the cognitive bias associated with current paradigms. By restricting the ***collection*** of data and guiding the means in which information is structured/***correlated***, the distillation process incorporates any preexisting flawed perspectives into the new ***contextual*** understanding. Thus, as the information is distilled from the original premises, the regression of data incorporates potential inaccuracies affecting the ***causality*** of current assessments. This is compounded by the ascribed pre-defined framework which creates a multitude of intertwined dimensionality that is distracted by irrelevant factors, to include unintended ***consequences.*** The inclusion of external noise and false positives further convolutes the outputs creating disconnected results.



Under the supervised model, the pre-deterministic objectives to be served, coupled with a static framework, preclude the opportunity to learn and evolve unencumbered by existing suppositions. Irrespective of how things are collected, correlated and cataloged, regressions are accomplished utilizing flawed, incomplete, or inconclusive data which precludes effective outcomes/assessments. For as the data is clustered, the resulting inductive bias is attuned to leading the witness abstain from contradictory realities in today's volatile, uncertain, complex, and ambiguous (VUCA) environment. Given the growing mass and resulting complexity of data it becomes imperative that it is operationalized to substantiate a strong and sound foundation of fact. This is accomplished by fist registering authoritative data sources (ADS) to deconflict and assess its quality (Veracity).

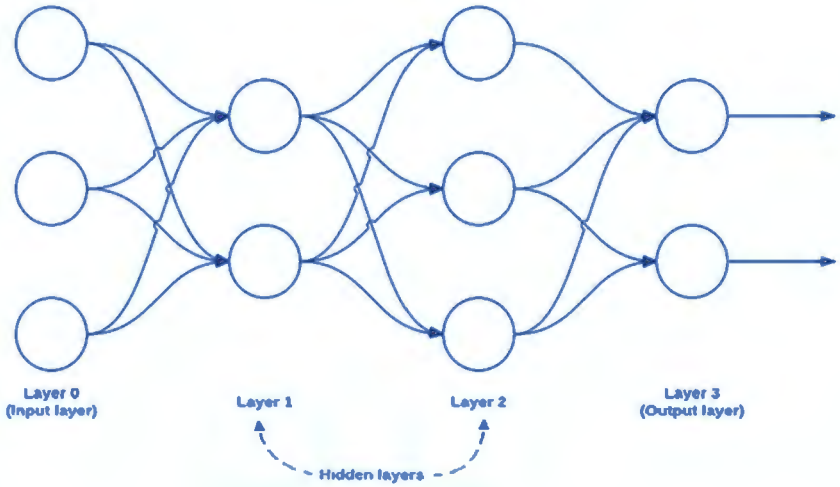


An enterprise information model must be established to provide a standardized approach to collect what they observe so that it can be discoverable (**V**isible). By deconflicting the data, and establishing its pedigree, the opportunity to assess its veracity offers the means to establish an enterprise data dictionary that assures a common definition. Once the data is structured so that it can be searchable (**A**ccessible) through an information asset catalog it becomes useful and shareable throughout the enterprise. It is this process that ensures that the facts and relationships are assembled to illustrate contextual knowledge (**U**nderstanding) that informs the cognitive process. By correlating (**L**inking) facts and relationships to decisions, increased confidence (**T**rustworthiness) affords the opportunity to unlocking the **VAULT** of Understanding. The result is the quintessential foundation upon which to establish machine to machine framework upon which to perform autonomous processes which affords the exploration of options and opportunities to learn and evolve.

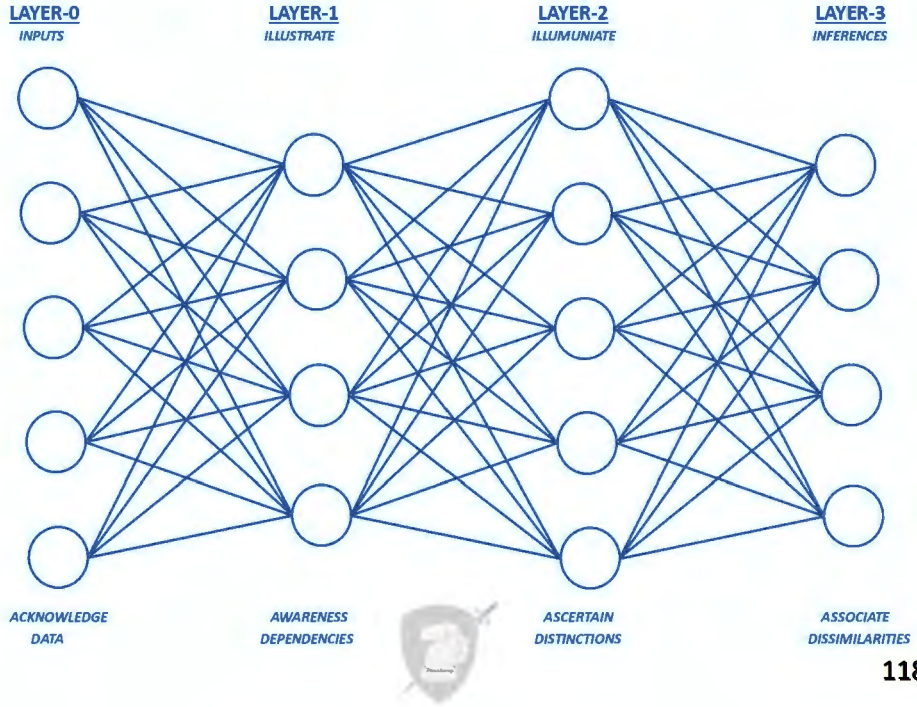


Illustrated above is the relation assessment and the interdependent adaptive correlations as they evolve over time. The resulting trends, illuminated through temporal analytics, provides the opportunity to characterize the environment in a way which allows heightened awareness and enlightened understanding. It illustrates the differentials of the origins and distinctions of the references (prescriptive modeling), provides probabilistic outcomes or determinations (predictive/causality modeling) and informs future potential deterministic (possibilities/consequence modeling) against options and opportunities. In the illustration below the complexities are explored in layer 1 to determine the interdependencies. In layer 2 the distinctions are identified so that the comparative analysis can be displayed in layer 3. The value of this process presents a better understanding of the interdependencies relative to the relationships between dissimilar pieces and parts of layer. It associates their common denominators are a part of ascertaining the mass and complexities of the expanse of options and opportunities. In the simplest of terms, when comparing two objects, the neural network ascertains from inputs an illustrative illumination of their dissimilarities from two differentials to perform a comparative analysis upon which to learn the dependencies they share, the distinctions they possess and differential that exist within their ecosystem as illustrated below:

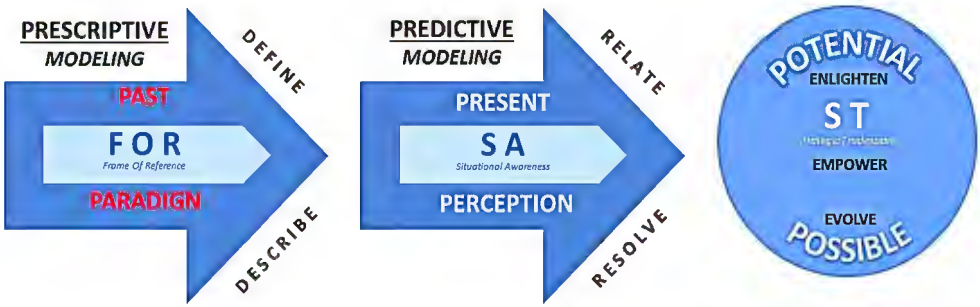
- **Layer 0** *inputs that are distinct*
- **Layer 1** *illustrates the dependencies*
- **Layer 2** *illuminate the distinctions*
- **Layer 3** *infer the dissimilarities*



The complexities of this increase exponentially when inputs are captured in greater numbers. Something as simple as comparing five inputs required 25 substantiations to understand the IADs (*Input / Illustration / Illumination / Inference, Acknowledge / Aware / Ascertain / Associate, and Data / Dependencies / Distinction / Dissimilarities*). The following graph illustrates how the system effectively models and builds out the procedures by quickly processing concurrent near real-time assessments to acknowledges dependencies, ascertain the distinctions, and associates the dissimilarities (3D).



Through traditional Unsupervised Learning the system becomes enlightened through pre-established frameworks that provide referential exploration to derive understanding from interdependent causality employing restricted learning. By allowing the system to self-synchronize we begin to appreciate the interdependent dynamics and thus garner better understanding of how to interact and exist within the existing environment. Through an iterative approach of exploration, the opportunity to apply active learning produces a competitive advantage. By capitalizing on this approach, we can infuse an adaptive process through the aforementioned efforts to think big, start small and scale quickly, to incrementally proceed in a progressive manner to mature and build momentum. It is within this proactive procedure that we are able to build upon the current state informed by past activities to derive at the desired future state. Through measuring progress over time, we are able to ascertain the requisite feedback necessary from the OODA Loop to produce the essential inputs to influence, effect, evolve the transformative environment in a way that meets our desired end-state given the interdependencies resident within this dynamic environment.



It is important to note that AI's focus upon answers is very different from ML's exploration of questions. All too often many try to expand AI in terms of ML. Given the correlation of AI in context offers elevated SA to derive understanding that informs ML. But it is the temporal adaptations over time that presents the quintessential trends to inform the future. As options and opportunities are explored, the journey of exploration informs

causality of our actions to derive natural consequences measured against results to be achieved. Thus, AI solves for "X" whereas ML informs the iterative transformation to inform the vector/direction and velocity/timing of our FOR of past actions compared to current SA relative to the desired future state. It is through this progressive process that we begin to characterize the environment in order to expand beyond our current understanding of those things we are unaware or that which are unknowable to evolve knowledge that surpasses understanding.

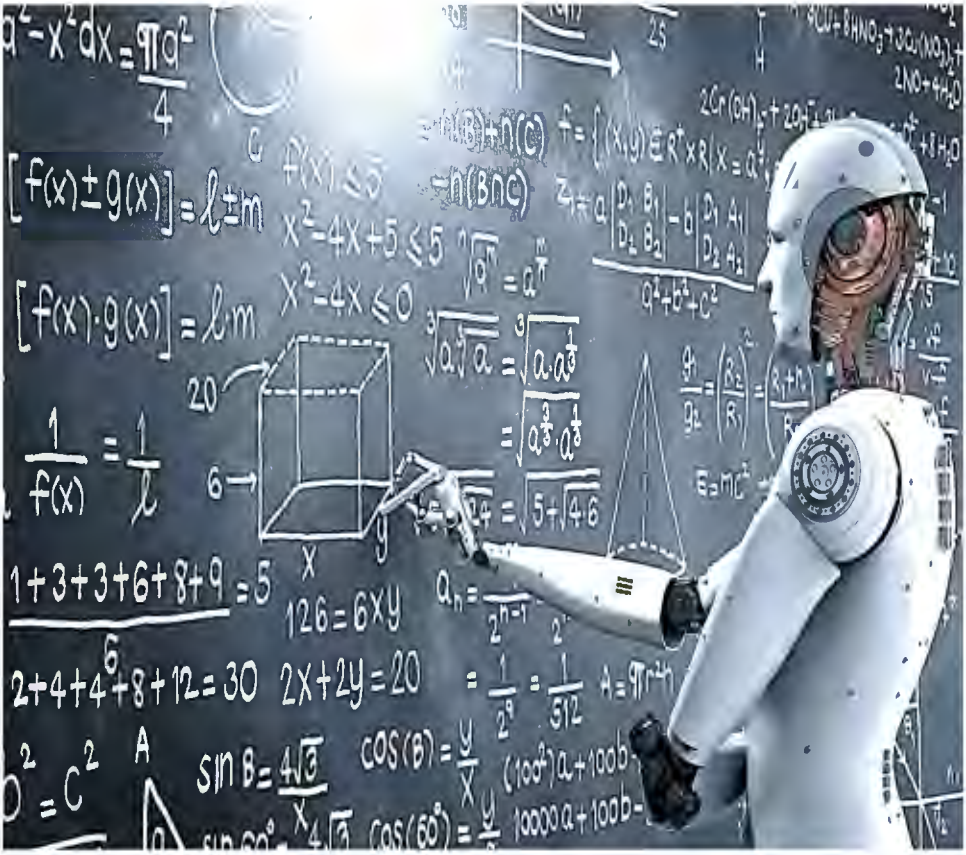
This has recently been demonstrated in technology's ability to achieve intuition and garner victory in the ancient stone game GO by Alpha GO. The first iteration developed via supervised ML was sufficient to derive victory from the world GO Grand Masters. The later version Alpha GO Zero, was an unsupervised ML system, that achieved victory from its own predecessor by figuring it out for itself the options and opportunities for victory. This illustrates the benefits of exploring options and opportunities (questions) as opposed to probabilistic assessments (answers). In spite of counterintuitive actions, one quickly realizes that by capitalizing on the potential to learn through failure, or falling forward, they are assured the necessary flexibility to derive victory as you seek unforeseen options which deliver unexpected opportunities.

By adopting the postulates of unsupervised machine learning, we are afforded the means to derive new assessments unimpeded by past paradigms. This approach ascribes to the value of relationships attune to the neural nets that create and mature over time associations and linkages as illustrated in neuroscience of Hebbian theory. Focused upon interaction associated with the influence and effect of paradigms and perceptions, the resulting realities create unencumbered progress throughout the validation that occurs throughout the learning process.

The result is artificial neural networks that are able to more effectively enlighten, empower, and evolve the cognitive process. With an emphasis upon harnessing potential, the strategic goals and operational objectives become the focus to make short term sacrifices to achieve long term results. Today's increased interest in exploring the view of a computer unencumbered by human intervention provides new unforeseen opportunities to evolve undistracted by the influence of cognitive bias. These unsubstantiated suppositions, create new self-forming paradigm validated in fact. Through demonstrated success in this area, we see the applicability of generative adversarial networks to assess and characterize their environment in its current state in order to enlighten, empower and evolve (ACE) the VUCA environment in the enveloping future state. By applying context and understanding the correlative adaptation, the evolutionary and transformative perspective will unlock the vault of understanding. It is at this point that we can begin to determine causality and resulting consequence in order to derive the value proposition of actions taken measured against those desired results to be achieved.

Thus, through unsupervised machine learning and a zero-sum game framework we are best suited to adapt, evolve and transform the environment to meet current and future objectives. The power of ML has thus been underestimated for it serves as the catalyst to tap into the creative capacity of artisans like Rembrandt and bring his creative capacity back to life. The program "The Next Rembrandt" illustrates how contextual and adaptive correlation are being applied to produce a painting that would rival the master. This combined with systems that have demonstrated the ability to learn and evolve beyond the prescribed environment, as illustrated in DARPAs Cyber Guardian Challenge, bring fiction to reality in our brave new world. Current Deep Belief Networks can now assess the impact of aggregation and possess the potential to

create code that transforms and evolves from self-sufficient learning. The resulting influence and effect that these recent technologies have on our environment show demonstrated capabilities for ML to transform technological systems to evolve beyond their circumstances. All said, one begins to question if systems that incorporate these features into a collective interconnected system could not soon fulfill the parameters of a sanctioned beings.



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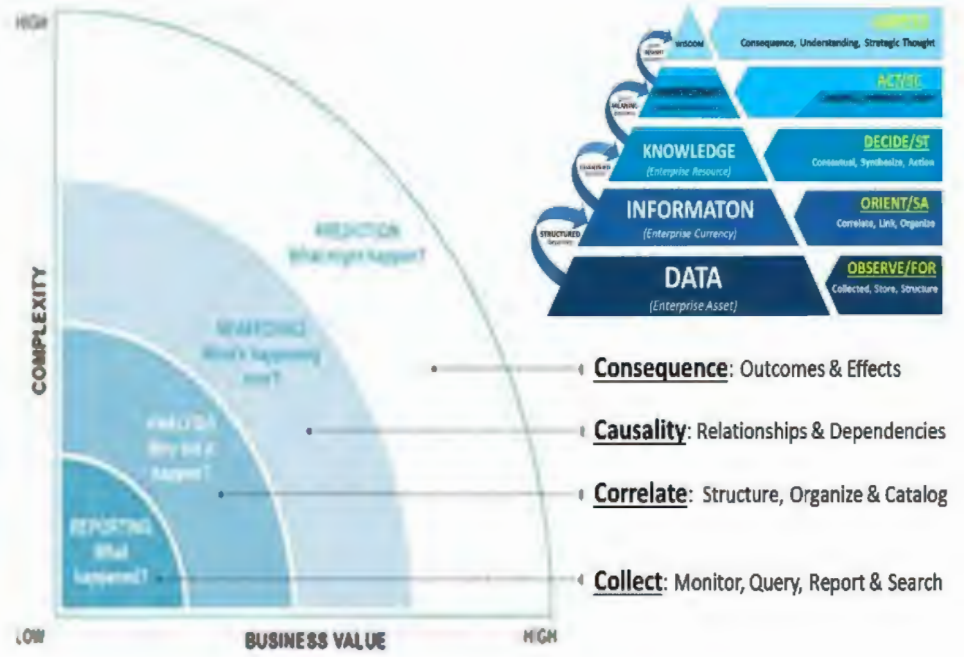
TAB 10

ANALYTICS FOR A PURPOSE

Today need for Artificial Intelligence and Machine Learning is due in large part for the growing mass and resulting complexity of data. Given data doubles every two years, we must apply technological tools to collect, structure, organize and put information into context to inform the knowledge that evolves understanding. Through this process we are able to access, characterize and enlighten our leaders to empower them to make informed decisions that evolve the organization. Thus, Analytics Informs (AI) leaders as to what options exist to fix today's perplexing problems. But it is our ability to learn and evolve that offers the opportunity to solve those challenges that face the organization informed by contextual understanding afforded by temporal assessments of Machine Learning (ML). The resulting historical trends offer options an opportunity to learn and evolve the problem into the solution space. For as we endeavor to better understand the actions of the past influenced the present, we are better prepared for our future.

Through clarity of understanding we can derive current state informed by the experiences of our past, to make wise choices that influence and effect future outcomes. It is through understanding of the causality of actions taken, and how they affect results to be achieved, that we can effectively manage the consequence of those actions in our ongoing efforts to shape our future. It is imperative that we illustrate the interdependencies and resulting complexities of data operations in a way that illuminates the potential value proposition that exist within information in order to better appreciate the consequences of our actions or our influence and resulting effects upon the environment in which we exist.



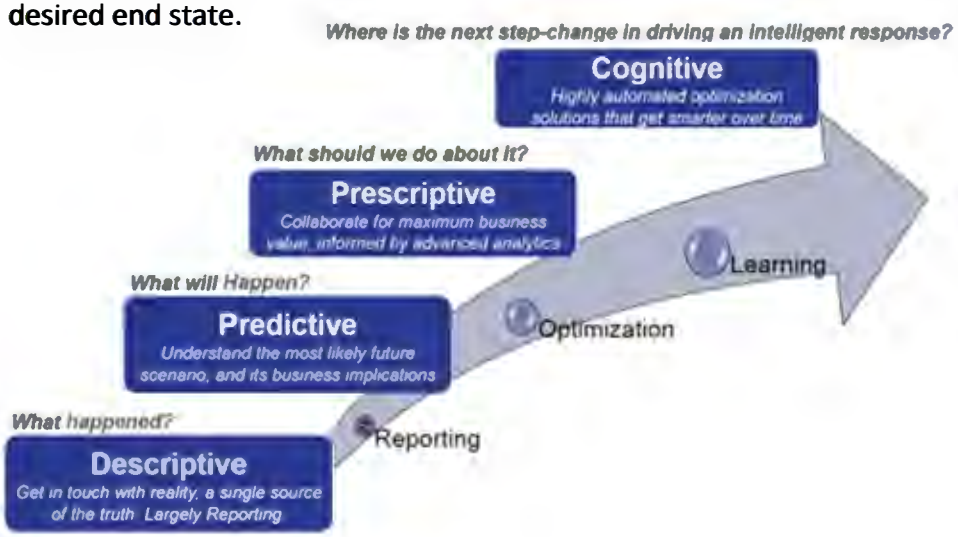
As we garner a better appreciation of past actions as they affect our current state we become aware of what options are available in the present that can evolve our understanding of future opportunities. Hence, we must be cognizant of the interdependencies of the past which inform current options as they unfold to afford the means to influence and effect the environment in a way that fulfillments organizational goals and objectives.

Yesterday informs us how we got to where we are

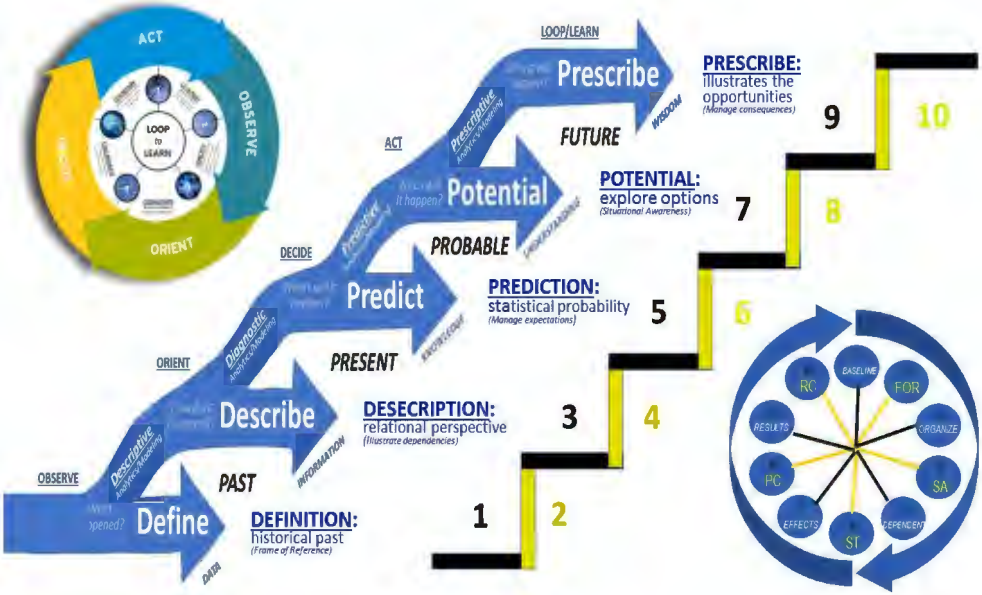
Today presents us with options of how to influence the present

Tomorrow offers opportunity to transform our future

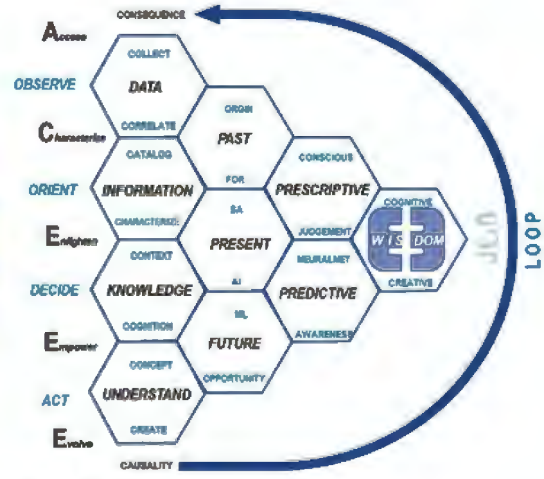
We must learn from the past as it has brought us to the present in order to illustrate those options in a way that illuminates opportunities for a bright future. The following chart provides an outline of the interworking of our ability to successful create that future as opposed to being victimized by it. For I believe if we establish the appropriate framework or prospective, we can begin to appreciate how the information environment will enlighten us, empower us, and afford us the means to evolve to our **desired end state.**



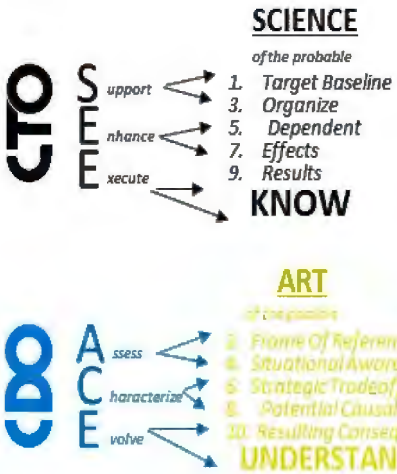
It is this potential that evolves enlightened understanding to provide the strategic advantage in today's competitive interlinked and interdependent market. The key to success is the 3Ws; WHAT to do, WHEN to do it, and WHERE to do it which informs those resources that must be applied/leveraged to effectively and efficiently accomplish these objectives. When we clearly understand the 3W and leverage available resources appropriately, we are able to know how to evolve in today's rapidly evolving information environment which feeds the Age of Knowledge to inspire Wisdom.



Knowledge is power, and information unlocks the inherent value of data which illuminates our ability to exercise Judgement which is prudent application of knowledge which surpass understanding. It is the resulting influence that drives our ability to transform our environment fueled by our desire to actualize our vision which offers us the opportunity to understand the causality of our action and the wisdom to take those steps to achieve our objectives. Ultimately it is the imaginative spirit of creativity applied through ingenious application of resources that facilitates the opportunity transform our world.



To that end we must have data that is fit for purpose, information the illustrates the relationships and resulting dependencies to illuminate those options that provide the knowledge to understand opportunities as they present themselves. Thus, the following article on analytics illustrates current and future potential of this underutilized capability of analytics to enlighten, empower and evolve the organization in our ongoing efforts to fulfill their desired goals and objectives.



	OBSERVE	PROBABILITY	SCIENCE	OBJ
1C.	Collect	Store	DATA	WHAT
2C.	Catalogue	Structure	INFO	WHERE
	OREINT	**PERSPECTIVE**	**ART**	**OBJ**
3C.	Correlate	Relate	FOR	HOW
4C.	Contain	Understand	KA	WHEN
	DECIDE	**POTENTIAL**	**THINK**	**OBJ**
5C.	Cost/Benefit	Assess	ST	WHY
6C.	Characterize	Know	KO	
	ACT	**PERFORM**	**ENGAGE**	**OBJ**
7C.	C2	Synch	C2	WHO
8C.	Communicate	Disseminate	C^2	
	LOOP	**PERTUBATION**	**EFFECT**	**OBJ**
9C.	Causality	Dependencies	Feedback	
10C.	Consequence	Results	Trend	

Evolving living process that grows, evolves upon itself and is perpetual and integrative to do it all over again...1C

at a markedly reduced cost. At a time when organizations are struggling to find the resources (time, money and labor) to sustain their outdated business models, cellular capabilities represent an effective and efficient solution that can be implemented within 30-90 days of decision and contract award. Thus, current fiscal constraints juxtaposed with growing mission demands all but demand a full consideration of institutionalizing a NAAS model to support our current and long-term requirements. Taking such action in the very near term will ensure our ability to remain competitive on the world stage.

TAB 11

THE VALUE PROPOSITION OF DATA

Value Proposition of Operationalizing Data as a Strategic Asset:

Exploring the art of the possible within the science of the probable in an effort to maximize options that derive optimum potential of opportunities is vital to the strategic advantage essential in today's highly competitive market place. The never-ending quest for answers to fix problems is currently distracting organizations from their ability to adapt and evolve in this high paced environment of change and transformation. This affixation upon deriving answers at the expense of exploring alternatives precludes their ability to explore quintessential question essential to their future.

It is this imperative that they seek to explore the right question rather than find the right answer. By continuing seek answers without understanding of circumstances are the self-imposed shackles which preclude their ability to find and implement the progress they seek. It is this self-imposed impediment that binds themselves to the past confined by their predisposition of circumstances to blindly accept the status quo. This inhibits the essential progress necessary to derive competitive advantage as the industrial age is quickly becoming a thing of the past and the new information environment transformed our world to evolve to the age of knowledge.

In a world with so many questions as to what the future holds, where we are going, and when will we get there, one must understand that all too often, answers may no longer sufficient to survive in this rapidly pervasive environment which is transforming at the speed of light. Organizations are quickly realizing that yesterday's successes are no longer relevant and will lead to failure in this adaptive interlinked market where the strong no longer can compete with those that are nimble and adaptive in their approach.

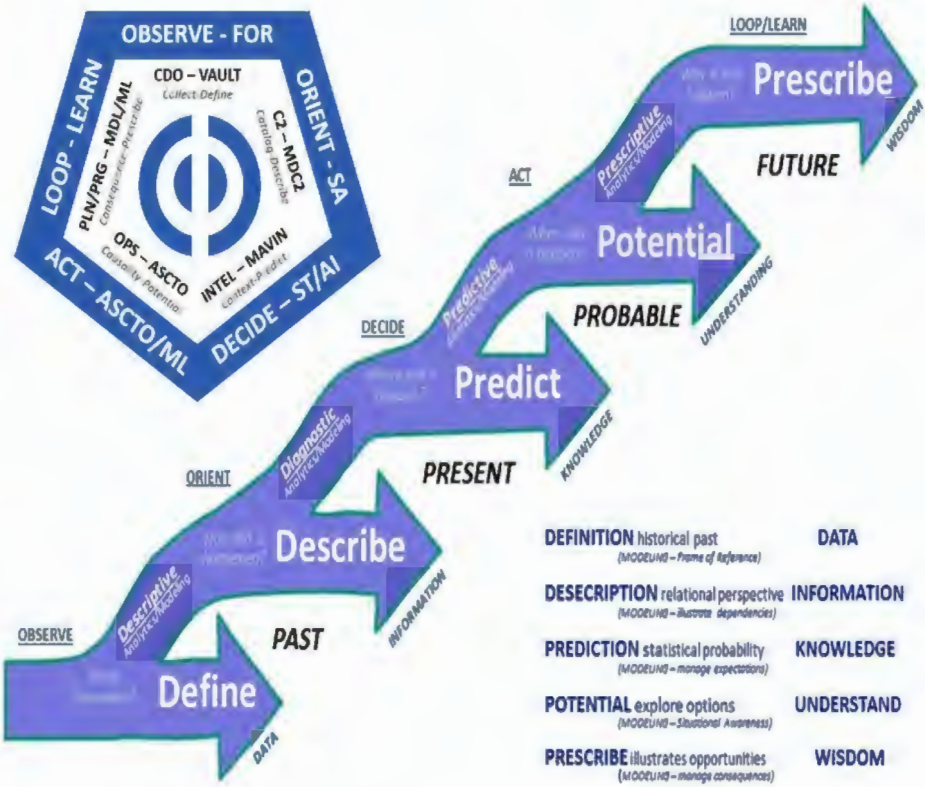
It is within today's information environment that organizations become enlightened and empowered to know what requirements serve their objectives, how to apply them in a way that fulfills their goals which afford the means to capitalize on those options and opportunities as they present themselves. However, without the means to operationalize the data that is growing at an alarming rate,

John Naisbitt cautions us that, "We are drowning in information but starved for knowledge."

The effort to harvest the value of information to know what must be done, how to accomplish it, and why it is important all starts with the facts that inform and derive the essential knowledge that surpasses understanding. It is the wise an astute individual that understands that data fit for purpose will paint a picture for those willing to see it. Likewise, information in action will illustrates those relationships essential to outline how to achieve it, and the contextual knowledge to derive awareness of those options to evolve understanding of opportunities available in today's information society. This journey of learning and exploration of the unknowns through the validation of the knowns and explorations of the unknowable's that ascribe the potential derived from living in the art of the possible in an effort to evolve the science of the probable.

This journey is a search to actualization their vision and view of the future as ascribed by Peter Pace, DoD's Chief of the Joint Staff, who advises:

"A leader who can decisively and intelligently make decisions within the context of understanding…has the ability to recognize patterns and changes and is comfortable with uncertainty and ambiguity Versatile and Creative, able to develop innovative solutions, thinking in time and context within the complex environment to bring about desired effects and thinks in terms of systems/linkages (effects) and is an expert learner."



Thus, the strategic value of data lies in our ability to leverage it as a strategic asset to inform and evolve our understanding which affords wise decisions in today's transformative interdependent world environment. It is therefore imperative that we not merely manage data but operationalize it in a meaningful way in order to derive its inherent value. To harvest the value resident in data, we must organize, structure and apply it that affords the means to inform those strategic cost/benefit trade-offs that illuminate the causality of action measured against potential consequence.

By establishing an operational platform to serve as a collaborative catalyst to collect and store data in an effort to make it visible, correlate and mature meta-data/structure it into information that is accessible and contextualized to illustrate the application of knowledge affords the opportunity to make informed decisions. By linking data that is Visible, Information that is Accessible, Knowledge that is Understandable within context, one can easily Link it to establish and what level of confidence and Trustworthiness (VAULT) they can place in the resulting collection of facts (data), correlation of relationships (information), and contextual presentation (knowledge) upon which to evolve understanding in their ongoing effort to make wise decisions. This platform offers the ability to leverage data and refine processes in order to identify causality and analyze consequences of actions taken measured against potential results to be achieved. Through a formalized program that establishes a data driven organization (2DO) we can derive strategic advantage through the illumination of available options (understanding) and leveraging opportunities (wisdom) to ensure effective decisions that influence and effect the environment in a way to assures their goals/objective.

Today efforts in analytics are being undertaken to solve complexities of this persistent unyielding environment in an effort to fix problems, solve challenges, and evolve in today's volatile, uncertain, complex, and ambiguous (VUCA)

interlinked world marketplace. Without a strong foundation to facility the collection of data, a process to register it into an Enterprise Data Dictionary (EDD), correlated and structure it into an Information Asset Catalog (IAC), the ability to present contextual knowledge will be increasing difficult to achieve. The challenges associated the exponential growth of data and the resulting complexities with the relationships associated with its application, manifest themselves given the dependencies and reliance's placed upon it. Throughout our assessment and analysis efforts, we can identify those critical ingredients in the cognitive process of making sound decisions and provide autonomous processes to assist in measuring and monitoring progress.

Without the aforementioned structure and approach, we are left without an opportunity to validate and verify both the facts and correlate relationships, associated in our ongoing efforts to ascertain causality and potential consequence. Additionally, we become transfixed and constricted in a way that preclude the ability to evolve and transform the organization. Therefore, it becomes imperative to assess, monitor and analyze internal and external trends to ascertain the potential for progress to assure the essential adaption and transformation in today's rapidly evolving marketplace.

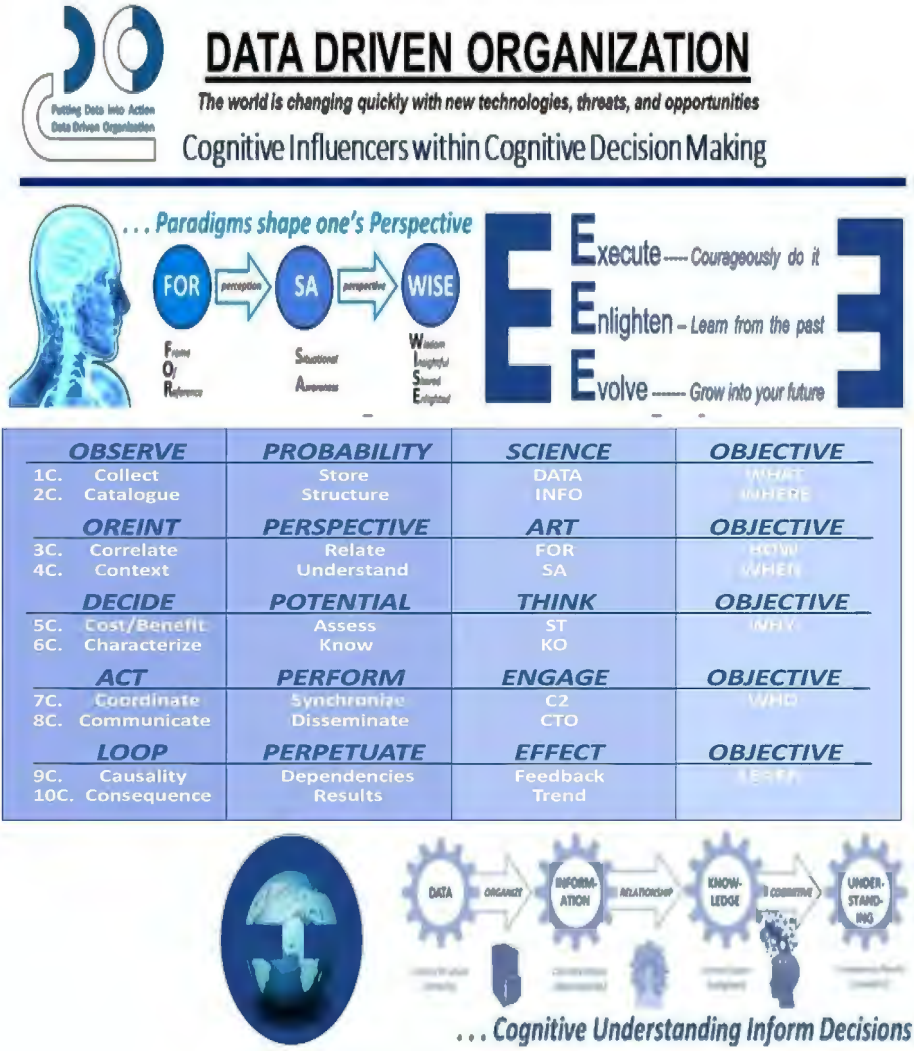
History offers ample evidence that enlightened decisions represent the essential core of strategic advantage. The synthesis of historical and current information is the basis upon which leaders make informed decisions. By organizing data into information, it can then be matured and fused into knowledge. Through the benefits of the cognitive process, the opportunity to leverage one's awareness per their frame of reference derives the antithesis of enlightened decisions.

"Know your opponent and you will never lose, know yourself and you will always win."

Sun Tzu

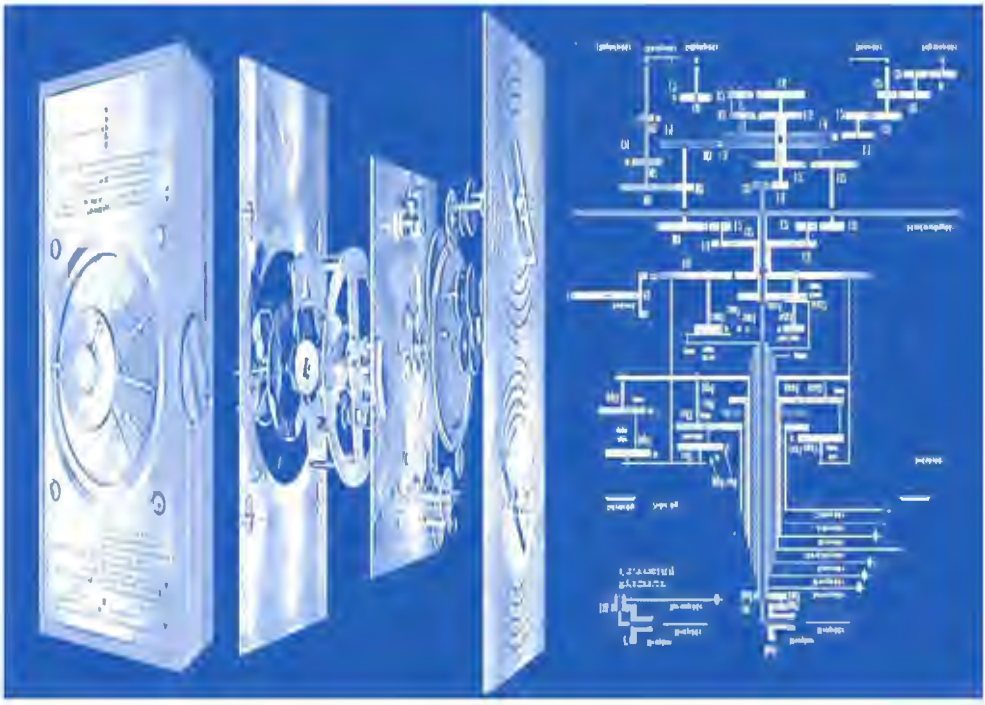
To establish a data driven organization the focus must be upon the maturation of knowledge that derives understanding. Strategic leaders must cut through the fog to mitigate the friction inherent in today's pervasive today's competitive environment. It is through the value informed decisions that affords one to overcome the long overlooked and even discounted opportune cost consideration in the cost benefit assessment.

A lack of learning from experience informed by hindsight precludes failures and shortcomings attributed to uninformed decisions based on a lack of awareness. Given the complexities of the modern world, the strategic decision maker must be able to make enlightened decisions facilitated by heightened awareness and sound cognitive skills. Understanding what one is aware and unaware of, or does not understand, is a critical competency if not the cornerstone of informed decisions. Thus, it is essential to understand the strategic ends, ways and means to ensure the fulfillment of organizational objectives. Based on the foregoing, strategic critical thought elevates knowledge, which through increased situational awareness and a good frame of reference, develops understanding.

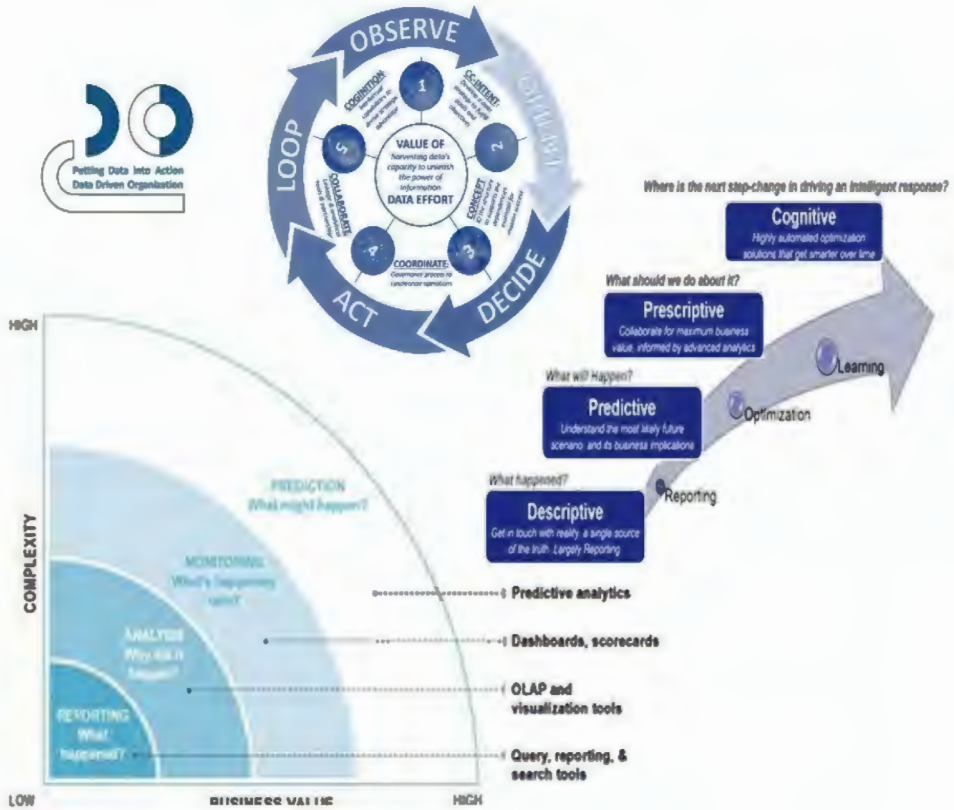


While we hope for the best, hope is certainly not a plan per se, it is nonetheless essential to inspire and encourage us to venture out to seek understanding of how to approach opportunities in search knowledge of what must be done to overcome extant circumstances necessary to achieve future goals in the effort to fulfill organizational objectives. By remaining incessantly curious, we can discover new

opportunities to overcome old obstacles. One of the earliest examples of the benefits of leveraging technology to inform and enlighten is the Antitheta. A two thousand analysis tool which played a pivotal role in understanding the relations of interdependent circumstances as well as the influence they exert on our environment. The Antitheta mechanism predicts the movement of the moon and stars, through relational analysis to inform and predict a multitude of events including sunrise, sunset, eclipses and tidal effects. By determining prevailing circumstances and designing efforts intended to negotiate their influence on the environment, this ancient device helped to convey the evolutionary nature of the effects those elements had on the environment.



This device serves to illustrate the causality and resulting consequence of actions taken measured against results to be achieved. However, without the benefit of data structured and correlated into information, the resulting contextual output would not derive benefit. This it is imperative that we examine how our actions effect the environment through a scientific approach to assess, characterize in a consistent manner if we are to become enlightened and empower of to evolve in today's interdependent information environment.



The core of fact-based decisions requires data that is Visible, information Accessible, and knowledge Understandable if we are to put it into context by Linking it in real time to establish at what level of confidence and Trust we can place in it (VAULT). By unlocking the VAULT of understanding, a platform can afford a consistent approach to mature this process in our ongoing efforts to make wise decisions informed by fact. Over time, we will be able to identify trends that afford the means to prescribe and predict options based on past lessons learned, to better understand our present environment in order to profit on the potential of future possibilities.

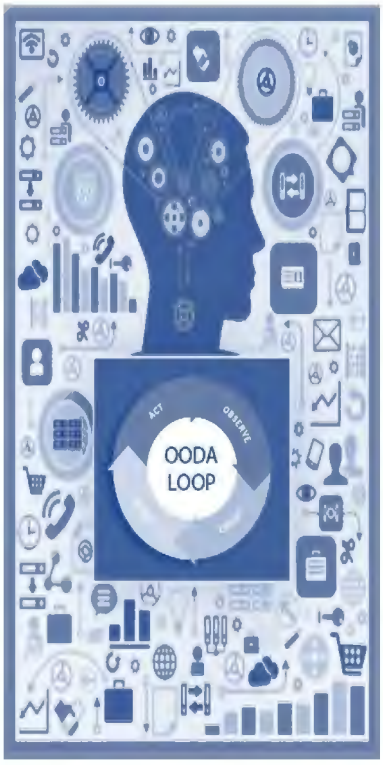
Answering the challenges, you face today:

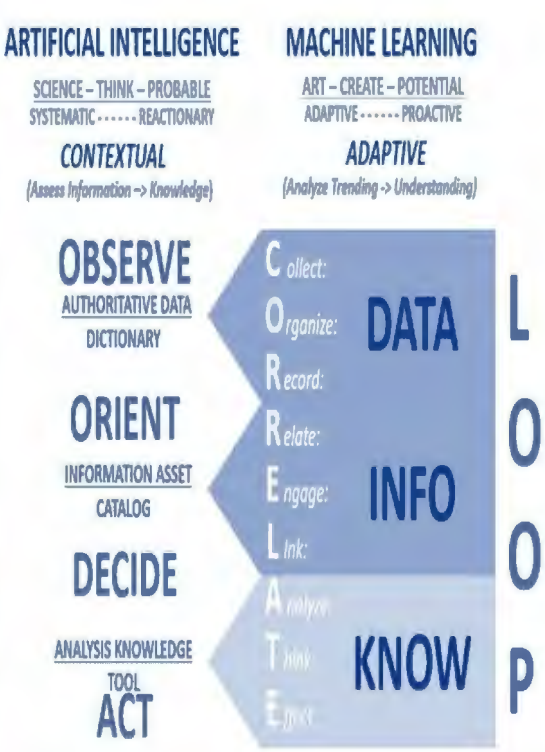
"All men can see these tactics whereby I conquer, but what none can see is the strategy out of which victory is evolved."

Sun Tzu

The extraordinary volume and complexity of today's challenges and the crosscutting nature of our interlinked and dependent society demands actions taken are given careful consideration to determine potential consequences. For those willing to listen to their data, this cognitive endeavor provides the opportunity to consider the probable and potential causality of actions compared to the desired results. Once data is visible, accessible, understandable and linked, it conveys to recipients a level

of trust that it can influence their environment in the manner they intend. Ultimately, leaders must have the vision to seek the art of the possible, the inspiration to explore the science of the probable and the courage to think big, start small and evolve quickly. – OODA Loop (within the decision cycle…the answer is not as important as the process of evolving, adapting and overcoming the adversary). Ours is not a problem looking for a technological solution or resource-constrained limitations; rather, we are searching for an informational leader who inspires us to ***think*** *creatively,* ***act*** *courageously and* ***evolve*** *continuously*.



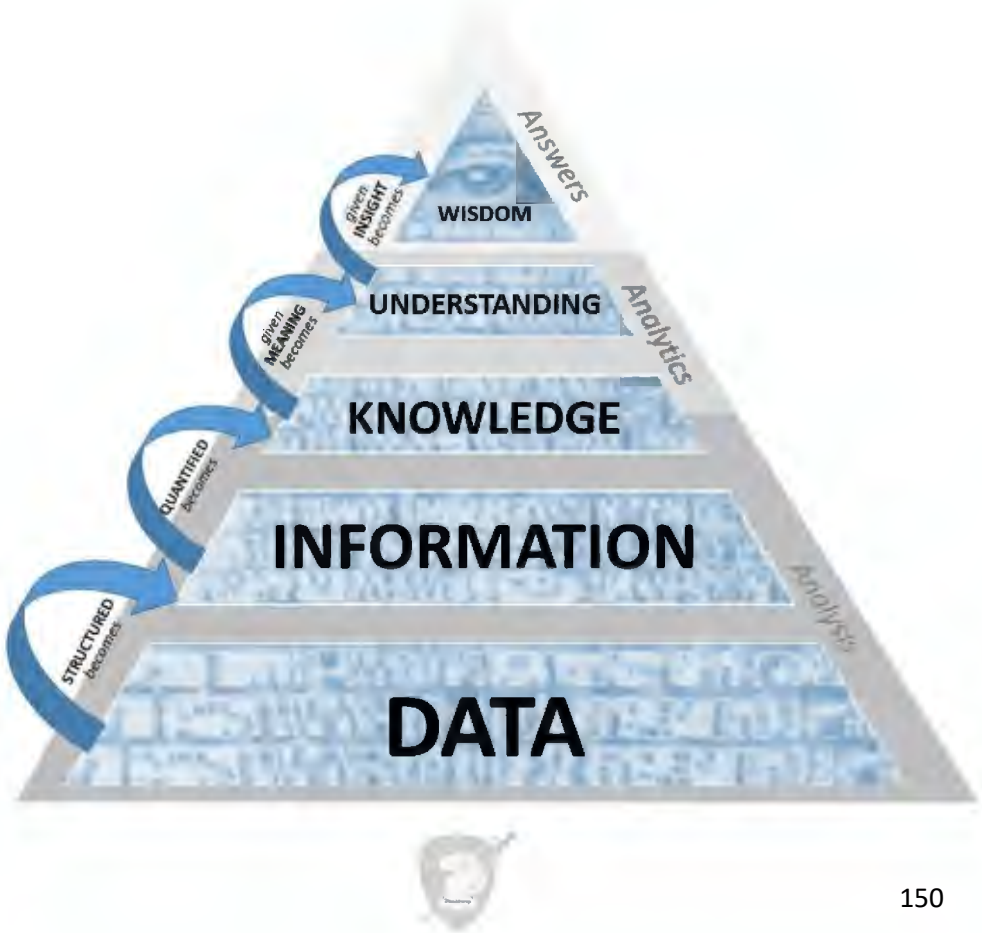


Given the increasing number of decisions, the complexity of options and the implications or consequences to mission success, senior leaders need timely indicators and capable modeling systems that identify opportunities and potential risk as well as the probability for mission success. Compounded by the vast amount of information being

generated by massive amounts of data, coupled with the persistent threats that is a characteristic of this VUCA environment, the opportunity to make fact-based decisions to assure mission success is critical in our pervasive and dynamic environment. To these ends, analytics can help today's organizations with many of the specific challenges they face to derive competitive advantage by:

- ***Deciding where to invest in an effort to transform and evolve the organization***
- ***Getting more value by optimizing efforts to maximize effectiveness and efficiencies***
- ***Identifying the best way forward***
- ***Solving complex scheduling problems***
- ***Getting more cycles out of operations***
- ***Optimizing a portfolio of investments***
- ***Accelerating response time***

In conclusion, it is imperative that we evolve from the historic documentation, storage, and management of data to leveraging it as a strategic resource vital to the organization's competitive advantage. This is done thorough unbiased assessment of the facts (data), characterization of the relationships (information), to establish the resulting operational implications (knowledge) which formulate the quintessential foresight (understanding) to make decisions that assure mission success (wisdom). It is thus imperative that we seek enlightenment so that we can empower our organization to work smarter not merely harder through an effort to evolve



and progress in this highly competitive environment. This is done through fact-based decisions aided by analytics and AI tools which establish contextual understanding. By identifying options and opportunity to adapt, transform, and evolve, organizations can capitalize upon trends illustrated by temporal analysis through Machine Learning to know what to do, how to do it, and when it is necessary in order to maximize return on operations (effectiveness) and return on investment (efficiencies).

TAB 12

KNOWLEDGE THAT SURPASSESS UNDERSTANDING

"Strategy without tactics is the slowest route to victory. Tactics without strategy is the noise before defeat."

Sun Tzu

A Strategic Approach to Transforming our Environment

During our transition into the information society and considering the transformative nature of today's constantly changing global environment, a host of technological tools must be utilized to manage massive amounts of data and the complexities that result from its associated dynamic influences. Accordingly, we can gain and maintain our competitive edge by making sound assessments of actions taken given the desired results. Such analyses will yield a comprehensive understanding of the associated second and third order effects of actions taken against results to be achieved to preclude unintended consequences. Given the confluence of diverse perspectives, expectations and perceptions, and to ensure we are prepared to overcome threats or challenges to our vital national interests, we must be mindful of the predisposition of the of our actions through enlightened understanding of current conditions and causality of our influences upon future expectations of today's inherently open system.

It is critical, therefore, that we understand and agree not only on the makeup of critical objectives, but also on the requisite awareness and knowledge we must have to achieve them. To that end, it is essential that formalized programs be introduced to collect data, catalog and correlate information, characterize, contextualize, determine the costs and benefits, and facilitate coordination/collaboration in order to effectively communicate our desired ends, ways and means. Accordingly, to advance our understanding and align our efforts to achieve the desired outcomes, we must begin with the end in mind as we undertake the actions necessary to achieve the primary objectives that serve our vital national interests.

To tackle the difficult strategic problems that affect us now and into the future, we must obtain a full understanding of the second and third order effects. It is thus necessary to institute a common structure that makes data visible, accessible, understandable, linked and trustworthy (VAULT). This uniform approach would give strategic leaders the means to assimilate the data in order to facilitate making sound strategic decisions. For it is this constructive and thoughtful approach that clarifies the conceptual process used to make informed and effective decisions. Ultimately, through this structured methodology the resulting contextualize knowledge will produce a common, actionable understanding that will be utilized during the decision-making process. Stated otherwise, the process will help mature and refine understanding to ensure that sound, informed decisions can be made. As mentioned above, we can thus apply cognitive skills to ascertain the effects of actions taken compared to the results achieved by those actions. By employing this form of temporal (also known as *predictive*) analysis, we can forecast with some degree of certainty what the future will hold.

COGNITIVE ENLIGHTENMENT

"The General that wins the battle makes many calculations in his template before the battle is fought.

The General that loses makes but a few."

Sun Tzu

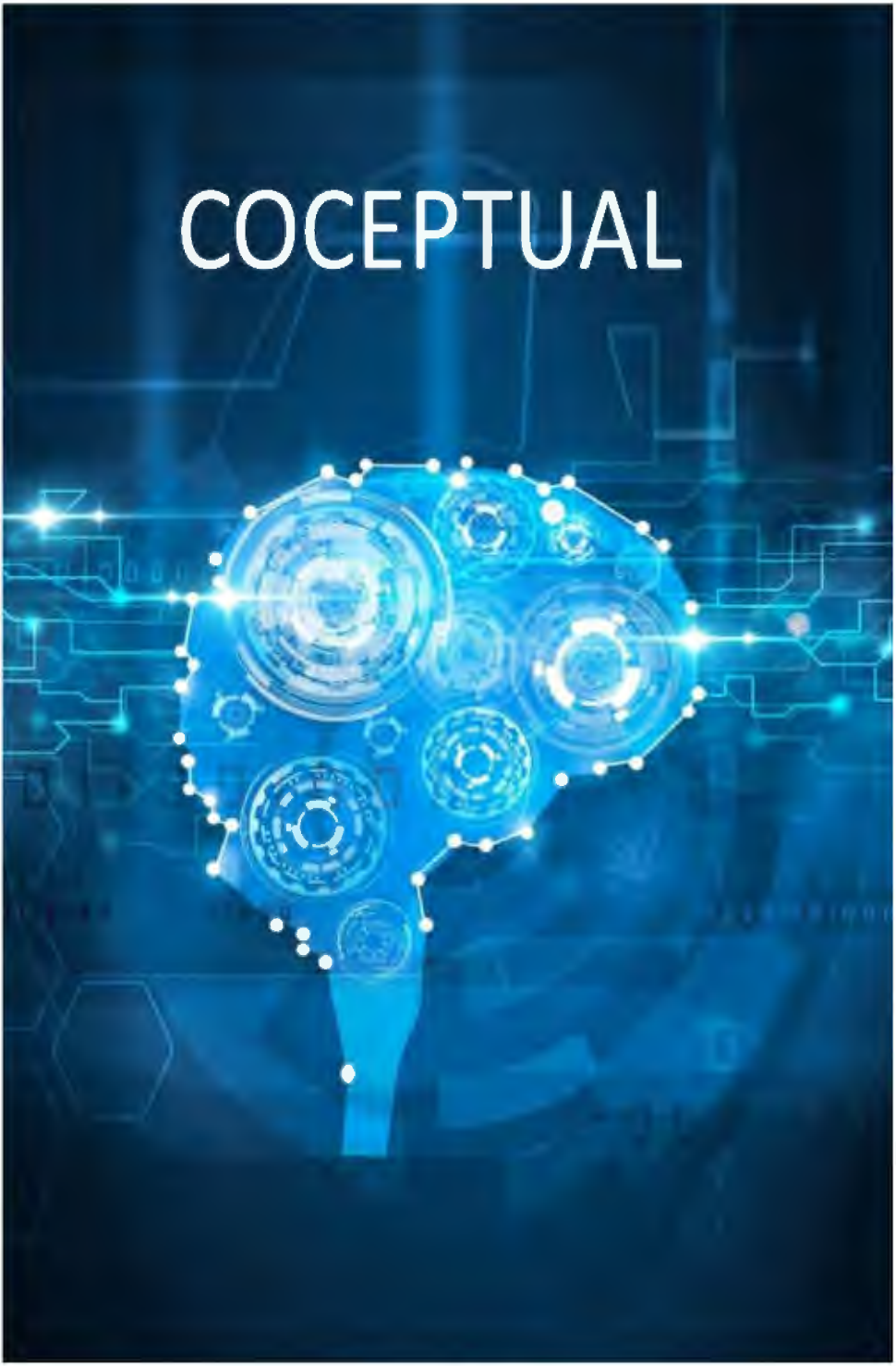
It is important to understand that information, which is so critical to the decision-making process, is derived from data. Merriam-Webster defines data as "information output by a sensing device or organ that includes both useful and irrelevant or redundant information and must be processed to be meaningful. "By organizing and validating data properly, reliable information can be obtained. By extension, Merriam-Webster defines information as a signal or character which represents data. In a learned and layered approach, the cognitive process begins to develop this information into knowledge, which Merriam-Webster defines as "the fact or condition of knowing something with a considerable degree of familiarity gained through experience of or contact or association with the individual or thing so known. "Hence, circumstantial experiences shape the way one interprets and uses information, which influences their actions and reactions.

To be conscious and conscientious individuals, therefore, we must first recognize the need to develop cognitive enlightenment. Cognition is defined as the mental process of knowing, including aspects such as awareness, perception, reasoning and judgment. Bloom's Taxonomy presents a framework upon which to examine and facilitate an understanding of the cognitive process. The following six levels are prerequisites to elevating intellectual acuity:

- ***Knowledge*** *– the capacity to recall or recognize pertinent learned information associated with terminology and facts*
- ***Comprehension*** *– obtaining a level of understanding through oral, written, or symbolic representation to translate, interpret or extrapolate a level of knowledge that demonstrates the assimilation of the presented concept*
- ***Application*** *– capability derived from the fully matured understanding of a concept*
- ***Analysis*** *– ability to break down information and correlate its relevance and implications to its derivative of intent*
- ***Synthesis*** *– formulating/organizing individual parts of information such that it collectively imparts a newly matured meaning*
- ***Evaluation*** *– action based on judgment influenced by cultural norms, academic teaching and personal biases*

Within this cognitive domain, knowledge and comprehension enable the problem-solving skills necessary to overcome uncertainty and ambiguity. Knowledge is thus the set of foundational skills honed by one's ability to comprehend and apply information. The utilization of knowledge by recalling facts and concepts permits the identification of trends. Thus, observable patterns are correlated through cognitive analytical analysis, which lies at the heart of comprehension. It is this synthesis of information and the perspective gained that represents the crux of the cognitive process. Ultimately, data serves as the foundation for the formulation of information that provides the knowledge required to achieve decisive operational advantage. Therefore, by taking actions informed by the requisite knowledge that contextually enlightens understanding we realize the substantiation of actions taken to influence and effect outcomes is formulated at the cognitive level of understanding. Ultimately through this process affords the greatest opportunity to affect our environment at its formative stages of cognition. Thus, data's inherent value becomes apparent and is recognized as a critical asset that feeds and informs our ability to fulfill US national objectives.

To maximize the benefits of and leverage the available opportunities to garner strategic advantage and transform the environment to our desired end state, we must be mindful of the characteristics of data. For as the efforts of Big Data so adeptly identified, it must be visible, accessible, understandable, linked and trustworthy (VAULT) in order to evolve knowledge in a way that harvest its inherent strategic benefits. Through this process, we recognize that data's value is correlated to the relational context upon which it is applied. For through the application of understanding we are afforded wise actions informed by superior understanding of what to do, where to do it and when it must be done in order to accomplish those objectives that fulfill organizational goals. To ensure the fulfillment of organizational objectives, it is critical that data is collected and categorized in a structure that facilitates searches and efficient access. Since this shared data environment cuts across all boundaries, it also influences every aspect of those principles upon which America is founded. Moreover, this environment has international ramifications that affect diplomatic, information, military and economic concerns worldwide. Because the threat of unintended consequences is pervasive in today's diverse and rapidly evolving information environment, our ever- increasing reliance upon the rapidly evolving digital domain demands that we provide the right data, at the right time and place, to ensure effective and responsible decisions are made in fulfillment of implicit and explicit objectives. Therefore, it is critical that we focus on leveraging data as a strategic asset.


COCEPTUAL

TAB 13

ENVISION TOMORROW TODAY

As we embark on a journey of exploration in today's world of transformation we must ask ourselves, what is our purpose, how do we achieve our objectives and why are we embarking on this journey. Most who put thoughtful consideration to these questions realize that theirs is an effort to bring to reality a promise for a better world tomorrow today. This is an ominous task, and some would infer it is like tilting windmills associated with the great English Nobleman and visionary who was well ahead of his time Don Quixote. Many of today's visionaries are still thought to be tilting at windmills as they endeavor to explore tomorrow's possibilities to capitalize on their potential today.

I believe that ours is a journey of exploration to understand and create our own realities. Therefore, today's technological explosion must fuel the fires and serve as a catalyst to a creative process of growth and evolution. Some would say that the revolutionary ideas at the core of this creative process is what gives our life meaning and inspires us to learn and evolve. It is the measure of hope which serves as a catalyst to envision alternative realities that transcend the world as we know it. Ultimately it is the fuel the feeds the innovative spirit to drive us forward as we endeavor to capitalize on available options in our current state to morph and evolve them in an effort actualize opportunities within our grasp in the future state.

One of the world renown visionary who creatively conceptualized the art of the possible was Nikola Tesla. A renown and highly regarded inventor who sought to actualize his ideas through the science of the probable, he too was met with much consternation and skepticism even today in spite of the overriding success of many of his concepts critical to our very existence. But history has served as a testament to his visionary perspective was truly ahead of its time in spite being labeled by many as a crazy mad scientist. It has taken a hundred and fifty years to vindicate Tesla and transition him to the ranks of highly regarded inventors for his courageous genius. As most would attest, you are wrong if you are right to soon.

I will tell you it is his audacious vision that explored the art of the possible which manifested itself in ideas to conceptualize the science of the probable with the core of the creative spirit and ingenious exploration that which has become the hallmarks of Nikola Tesla. The old advantage, what the mind can achieve, and the spirit believe the person can achieve with enough determination, support and resources has proven in time to abundantly true. I often wonder in the case of Tesla, if he had a visionary glimpse in the future as he explored the art of the possible sparked in us an effort to make the science of the probable a reality with ideas like live streaming video, thought cameras, and wireless electricity. Imagining the unlimited possibilities and potential of his vision, I can't imagine a world without alternating current, fluorescent bulbs, X-Ray, radio, electric motors, lasers, and wireless communications.

“I don’t care they stole my ideas . . .
I care that they don’t have any of their own”

Nikola Tesla

That said, there is a lot of interest in innovation, transformation, and an evolution of thoughts and ideas to think, try and test the art of the possible within the science of the probable. Technology is the medium upon which we invest our hopes, dreams and future. We all hear the terms AI, ML, and have we analyzed the data to provide us answers to today’s most perplexing questions. I would tell you that ours is a journey not a destination and data properly applied will help identify the question one should be asking as it drives you to realize the unlimited potential awaiting in the possibilities of new realities. Today’s world is evolving at lightning speed and an adaptive approach to embraces change is the catalysts to competitive advantage. As we explore a multitude of options that illustrate the potential that illuminate these unlimited possibilities we begin to see a multitude of unforeseen opportunities.

Too much time is spent on trying to re-invent that which has already been created. Necessity is truly the mother of invention. One must ask themselves, what would I do if that which I am reliant upon no longer existed. It is this approach that opens the door to embark upon a journey of exploration seeking options and opportunities to actualize unforeseen potential. Through this creative engagement to seek alternatives that achieve objectives which unleashes the inherent genius resident in all of us we are able to create new unforeseen inventions that evolve mankind. Through the interactions of relational dependencies which form ideas and develop capabilities, the resulting cascading landscape influences and positively affect our environment. Neurnet provide the relational context to combine relative relevance to capture applicable results from these new and innovative capability. The courage to think, try, and test new suppositions in an effort to elevate understanding is the core of courageous effort to capitalize on the untapped potential to create tomorrow’s realities today.

Combinatory Play Seems to be the Essential Feature in Productive Thought

Albert Einstein

I would encourage you to take a journey of exploration to think about problems in a new way. To preclude abdicating our responsibility to think, we must actively partake in evolving knowledge that surpasses understanding if we are to garner wisdom in order to leverage genius in our approach to apply conceptional insights to creative capacity. We must proceed with unwavering determination exuding courage and determination if we have any hope to be successful in these endeavors. Thus, we must be fearless in your approach and embrace failure as an opportunity to learn and evolve. This will provide the necessary confidence that reaffirms our conviction to continue to try as we learn what to do by knowing what doesn't work.

Computers are useful tools to assist us correlate facts and relational dependencies, however they only provide validity and context to this crazy world we live in. It is our responsibly to think big, start small and scale quickly in an iterative approach to think, try and test our supposition and hypothesis. The creative spark that transcends all technological impediments is the ability to transform beyond our current state and explore a future of unlimited possibilities. Through progressive processes informed by an iterative approach that allows us to evolve beyond our self-imposed limitations which is the cornerstone of John Boyd's OODA Loop:

OBSERVE: our surrounding in an effort to understanding our environment with a focus upon assessing the influence and resulting effect of past performance

ORIENT: to our situation and be aware of the relationships and resulting dependencies they have on our environment in an effort to characterize current circumstances

DECIDE: on a course of action informed by and enlightened with the requisite knowledge to understand what must be done to creates the end state we seek

ACT: begin with the end in mind in an effort to achieve those objectives that serve the goals the fulfill the purpose of the organization

LOOP: create a feedback mechanism in order to progress in an iterative engagement to fail forward engaged in exploration to learn what works and know what doesn't

In the end, I am dumbfounded why so many are afraid of failure. I would tell you that if you aren't making mistakes you are not trying hard enough. If we are to capitalize upon our unlimited capacity to learn we must proceed in a fearless approach to expand our horizons employing our curious nature to explore unlimited possibilities. Thus, we must encourage courageous actions to seek options and leverage our understanding of current relationships in an effort to seek new opportunities. Ultimately, it is the progressive process of leveraging data to inform the requisite knowledge of what to do and understanding of how to do it in a way that affords an ingenious approach to make wise choice at the right place and time to create the future we seek.

I have not failed,

I've just found 10,000 ways that it won't work

. . . success is the ability to go from failure to failure without losing your ENTHUSIAM

Thomas Edison

TAB 13

FAILURE

is the key to

SUCCESS

I am constantly surprised how failure is feared. As one looks to their objectives of evolving and transforming organizations, they try to capitalize on the status quo, in a fruitless effort to grow and evolve their organization. History has shown us that those who have been successful did not replicate others, but developed a new innovative way to provide value. These visionaries didn't live in the past, but looked ahead to the future to explore a world of unlimited possibilities in an effort to capitalize on opportunities.

If I had asked people what they wanted,

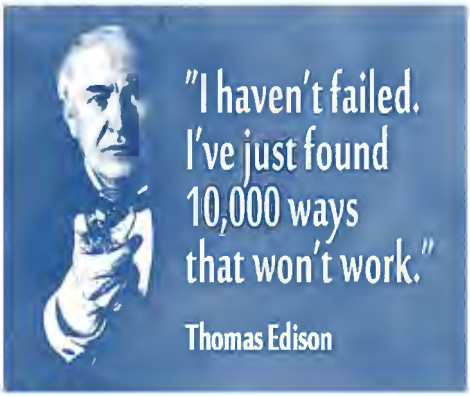
they would have said a faster horse

. . Henry Ford

These greatest visionaries have traditionally embarked upon a journey with a purpose in mind and ascribe those goals and objectives necessary to fulfill it. Transformational leaders like Paul Allen and Bill Gates lived in fulfillment of that vision. Each were catalyst for their vision of a computer on every desk and in every home. In 1972, the foundation of Microsoft supported the likes of Atari, which introduced the computer through games like pong and created their own operating systems like MS-DOS and a Graphical User Interface (*GUI*) Operating System (*OS*) known as Windows which we all use today. The key to their success was a focus upon the objectives that served their purpose. Undistracted by the requirements to succeed or even the potential of failure, both were determined in their dedication to bring their vision to life. In the case of Microsoft, most would agree theirs was one of the greatest success stories in history. Ironically, they never produced computers until after Gates and Allen had departed the fix. The success of both companies can be directly attributed to their vision that served as a catalyst to transform the world as we know it.

WITHOUT PURPOSE . . . IT IS POINTLESS

One must be cognizant that transformation is a journey not a destination. The objective is to evolve beyond the present in an effort to create the future. Thus, we must be mindful that there are no right or wrong answers as we search to understand the options and opportunities that lies before us. With this in mind, failure is an option and a means to explore the Art of the Possible, in an effort to better understand the Science of the Probable. To many people are anchored in the past as they endeavor to survive in the present. They live in fear that progress will make them irrelevant and relentlessly work to fix the problem without assessing their circumstance or characterizing the situation. This lack of enlightenment serves to sabotage their objective, and displaces it with a myopic obsession toward the fulfillment of requirements, thus precluding them from being empowered by future opportunities to evolve or LEARN.



Learning requires courage to try new things, and an open-minded approach that allows one the opportunity to be inspired. Edison realized this during his ingenious journey to create the light bulb. His intent was in his words, "*to make electricity so* cheap that *only* the *rich* will burn *candles*." After more than 3,000 designs between 1878 and 1880 he finally accepted failure realizing he couldn't keep the filaments from burning. However, by extracting the oxygen from the vacuum of a bulb, it became apparent that all his previous failures could now succeed in their endeavor to provide light. His invention now successful, he could direct his attention to the most efficient solution available. It wasn't until inspiration structure during a fishing trip while exploring the threads on his bamboo fishing pole, that he realized the solution; the thread themselves provided sufficient strength to serve as the core for his carbon filaments. The unexpected application of this creative solution provided an efficient low-cost option to actualize his objective; a light bulb that could draws very little power and produces over 1,200 hours of light.

These great innovators inspire and encourage us to leverage our imagination to explore those options and opportunities that illuminate our vision. Examining the Distinctions, Difference and Differentials (*3D*) we actualizes the creative capacity of our mind to try, test and fail forward in in an effort to explore possibilities of innovative solutions. This *3D* model offers the opportunity to leverage the difference as a catalyst for exploration, distinctions as a means to contribute toward achieving the objective and the synergistic effect of the differentials to help us better understand the causality and resulting consequence of actions taken measured against results to be achieved. It is through this process that we begin move beyond management in the here and now and into consequence management in the future. For the transition from a historically reactive approach to one that empowers us to be proactive is critical if we are to actualize a value proposition in our efforts to influence our environment in a way that provides for our objectives.

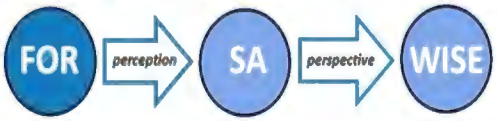
DIFFERENCES: The conflict that invokes change into the system

DISTINCTIONS: The attributes that affords unique contribution

DIFFERENTIALS: The adaptations that transform the environment

ART *of the* POSSIBLE . . . SCIENCE of the PROBABLE

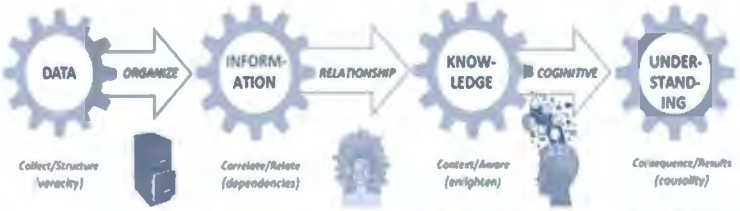
. . . Paradigms shape one's Perspective



Frame Of Reference

Situational Awareness

Wisdom Insightful Shared Enlighted

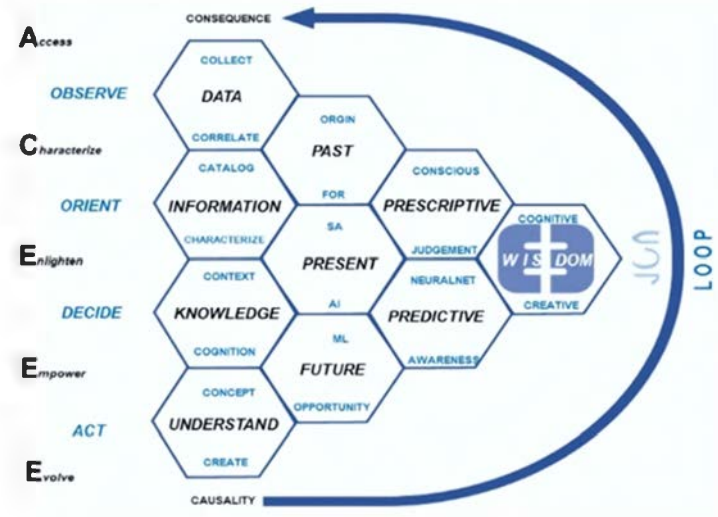


. . . Cognitive Understanding Inform Decisions

OBSERVE	***PROBABILITY***	***SCIENCE***	***OBJECTIVE***
1C. Collect	Store	DATA	WHAT
2C. Catalogue	Structure	INFO	WHERE
OREINT	***PERSPECTIVE***	***ART***	***OBJECTIVE***
3C. Correlate	Relate	FOR	HOW
4C. Context	Understand	SA	WHEN
DECIDE	***POTENTIAL***	***THINK***	***OBJECTIVE***
5C. Cost/Benefit	Assess	ST	WHY
6C. Characterize	Know	KO	
ACT	***PERFORM***	***ENGAGE***	***OBJECTIVE***
7C. Coordinate	Synchronize	C2	WHO
8C. Communicate	Disseminate	CTO	
LOOP	***PERPETUATE***	***EFFECT***	***OBJECTIVE***
9C. Causality	Dependencies	Feedback	LEARN
10C. Consequence	Results	Trend	

A progressive process upon which one can validate facts, understand the relationships, and make informed decisions that influence the environment in a way that transforms it to meet their objectives is essential in today's interlinked information environment. A strategic framework is essential if we are to evolve in a progressive approach to achieve our goals and aspirations. Thus the following *10C* process that serves to adapt in our volatile, uncertain, complex and ambiguous (*VUCA*) world through an application of assessing the Frame of Reference (*FOR*), and characterizing their Situational Awareness (*SA*) to Enlighten, Empower, and Evolve (*E3*). As illustrated in the enclosed figure, the *FOR* is a scientific endeavor to validate the veracity of the data to determine the facts that inform actions. Whereas the *SA* is the influences upon our perceptions and paradigms that result in effecting those relationships and dependences. It is our understanding of those options and opportunities that are available to us that offers the means to transform our environment in a way that fulfill those goals that support our vision.

Through this process the opportunity to validate data and verify relationships begins to establish the trustworthiness in the pedigree and providence of knowledge. It is this knowledge that provides the opportunity establish contextual understanding to evolve one's wisdom. As illustrated in the following diagram, the process to enlighten, empower and evolve (*E3*) the cognitive framework provides the context upon which wise decisions can be made.



UNLEASING *the* POWER *of* INFORMATION - PI

Through a scientific approach and by leveraging technology, we can derive strategic advantage through the maturation and matriculation of data as it evolves through a process to inform and elevate awareness. By looking at problems as opportunities to learn, grow and evolve we can take a simple approach to Access, Characterize and E3 in our efforts (*ACE*) and master the information environment. Through this effort, one can remain focused upon the solutions space in to derive options that capitalize on opportunities. It is within this *4Ps* model that we can learn from past mistakes to evolve beyond them. For it is our ability to think through possibilities that we are better able to understand our environment. By looking at mistakes as opportunities to learn, we find ourselves one step closer to the success. This progressive process of thinking, trying and testing (*3Ts*) our hypothesis is further matured as we begin to garner a better appreciate the causality and resulting consequence of the relationships within it. *Through an iterative process of Identifying the 4Ps the structure begins to take shape:*

Problem to be solved
- *Identify facts/data you need to validate*

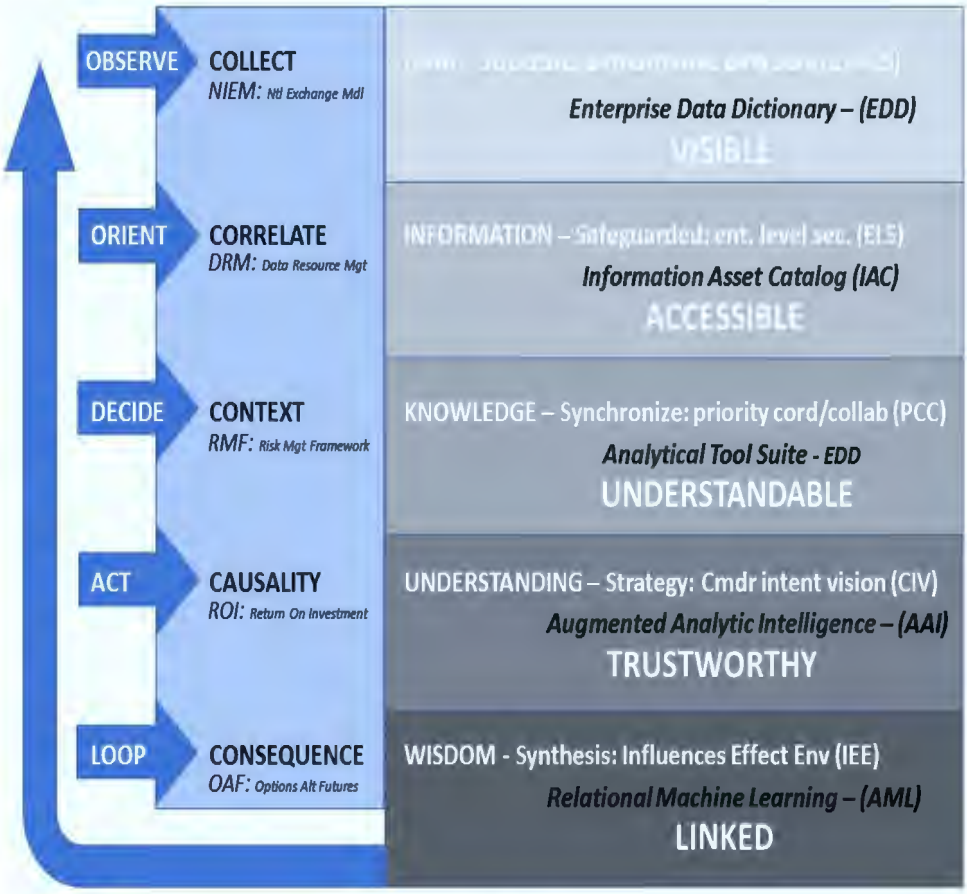
Process which the maturation flows
- *Establish structure/information on the relationships*

Potential to produce results
- *Ensure we contextualize/know what is to be accomplished*

Proposal of options
- *Illustrate opportunities/ understanding of how to proceed*

This framework provides a method to investigate phenomena, acquiring new knowledge, test and learn in an effort to evolve. It is through this evidence-based approach that we can better understand a clear unambiguous process to ensure we have the necessary data that is fit for purpose, information that illustrates the operational process and knowledge that tells a story to enlighten understanding.

- **Identify a Problem**
  - *Make observations leveraging natural curiosity to Collect Facts/Data*
- **Formulate the Question**
  - *Examine the process to correlate Relationships/Information*
- **Form a Hypothesis**
  - *Form a Hypothesis. Correlate Dependencies/Knowledge*
- **Experiment and Observe**
  - *Conduct an Experiment. Contextualize Causality/Understanding*
- **Draw a Conclusion**
  - *Analyze the Data to determine causality and Consequence/Wisdom*



COGNITIVE PROCESS *for* INFORMED DECISIONS

These simple questions provide the necessary direction to know what data is need. The chart illustrates the maturation process and its associated complexities. Thus, the problem must be broken down into the constituent parts, and addressed sequentially. To ensure clarity we must also measure its veracity. Additionally, the information cataloged must be established to identify the structure upon which relationships depend. Finally, the technological platform serves to orchestrate applying the data in relational context to operationalize knowledge that enlightens and evolves awareness. It is through this process that a progressive approach affords competitive advantage in the volatile, uncertain, complex and ambiguous rapidly evolving and transformative information environment.

Finally, the five stages of the Cognitive Pyramid provide a road map to validate data, structure information, correlate knowledge and contextualize understanding into wisdom.

OBSERVE- **A***ccess past to illustrate the cause of the* **Problem**

- **Data** – *accept historical facts*

ORIENT - **C***haracterize current actions that effect* **Processes**

- **Information**– current relationship

DECIDE - **E***nlighten options/opportunities of future* **Potential**

- **Knowns**– *impact of dependencies*

ACT- **E***mpower necessary support/advocacy to* ***Proceed***

- **Understand**– *potential causality*

LOOP- **E***volve beyond limitations and create a Proposal*

- **Wisdom**– *of future consequence*

TECHNOLOGICAL CATAYLST *for* INFORMED DECISION

By establishing a platform upon which to create a repeatable process are we able to harvest the value proposition we seek. The platform below offers the necessary tools to provide clarity of understanding through contextual correlation and probabilistic deterministic. It provides a transformative effective to evolve enlightened wisdom derived from adaptive correlation. This is accomplished through registration of data to ensure it is collectively defined and visible to the entire enterprise in an enterprise data dictionary (*EDD*) so that it can be discoverable. It is then structure in a way in an information asset catalog (*IAC*) to assure it is searchable. And finally, it is put into context and presented to the enterprise in an Knowledge Operational Portal (*KOP*). It is within these three steps that data fit for purpose, information that is operationally relevant to be queered through the KOP that is VAULT. Each step in this process is vital to mission success. For through leveraging data as a vital organizational strategic asset, we can derive competitive advantage in today's interlinked world environment.

1. **Data** *is assessed and registered into an Enterprise Data Dictionary (EDD)*
2. **Information** *is characterized/cataloged into an Information Asset Catalog (IAC)*
3. **Knowledge** *is contextualized and communicated into a Knowledge Ops Portal (KOP)*

MATURATION PROCESS

Collect data and share it with the community. By registering it within an Enterprise Data Dictionary (*EDD*). This process affords a deconfliction of authoritative data source and a common reference to ensure it is visible throughout the organization. It is not the focus of this process to ensure that it is right or wrong. Ultimately, we must be mindful that we are here to report the news not make it. Thus, we must accept it for what it is void of personal perceptions and biases.

Cataloging information by linking its dependencies. The ability to search derives operational implications and thus leverages data as a strategic asset. This informs the cognitive process the creation of an Information Asset Catalog (*IAC*). This provides the means to identify where it is and how to get access to it. Thus, providing the mechanism to support, enhance and execute (*SEE*) ongoing mission requirements.

Communicating knowledge is imperative to elevate awareness. By applying data that informs the cognitive process, we can begin to identify strategic tradeoffs. Through linking authoritative data sources (*ADS)* in the *EDD,* and aligning the application program interfaces (*API*) we are able to illuminate contextual understanding. Through real-time autonomous updates, elevated awareness provides real-time inputs to illuminate options and opportunities.

Analytical Information illustrates adaptions through contextual understanding of causality in direct forbearance upon consequence. Strategic choices are made given the cost benefit considerations of how prescriptive influences introduced into the environment predicated upon predictable interactions derived probabilistic determinations. By ascertaining relational influence and their resulting effects the interdependencies produce an operational assessment.

The dynamic nature feeds the transformative capacity of this interlinked symbiotic environment whose synthesis is to adapt through a maturation process. The evolutionary nature is conducive to an iterative approach to learn and evolve over time. These temporal adaptations are relational given the pedigree (*point of origin*) and providence (*reference point*). The wisdom derived from how these effects influence the environment divulge the implications of what these trends have on the future and their associated implications.

AI Access Answers– validate/paint a picture of knowns

ML Characterize questions –illustrate and explore the environment of unlimited unknowables

ST – E3 Enlighten/Empower/Evolve– Analyze and identify the plethora of option and the multitude of diverse opportunities of unknowns

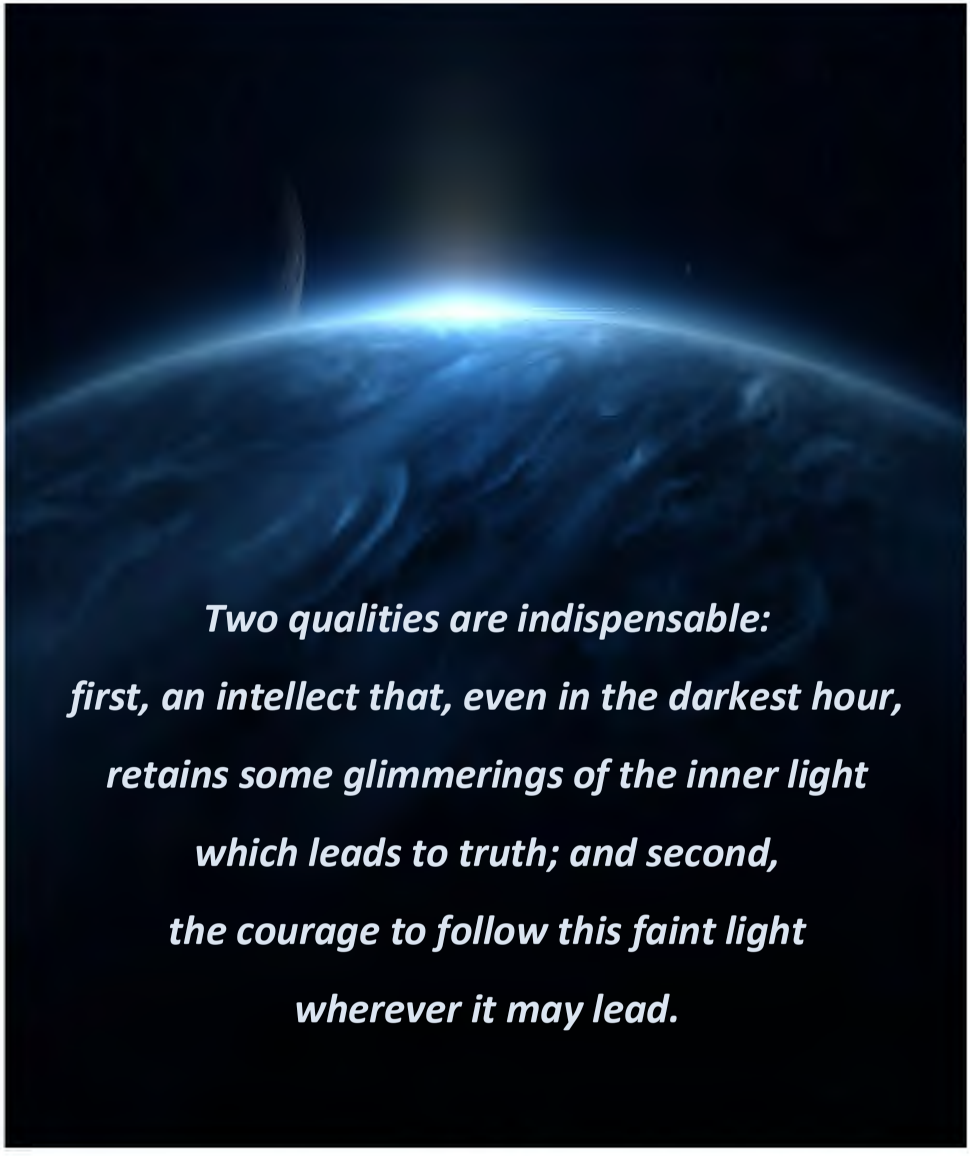
Liken to Edison's experiment, our courageous efforts to solve problem is a three-step process:

- **WHAT**: *is the problem we are trying to solve*
- **HOW**: *is our approach influencing and effecting the environment*
- **WHEN**: *do interdependencies influence ongoing adaptations of the endeavor*
- **WHERE**: *do we explore those options to capitalize on opportunities*
- **WHY**: *impacts of actions taken influence results to be achieved*

SUMMATION

Thus, we would be well advising to take a scientific approach to ensure we are able to create a repeatable process that we can learn, evolve and master. The following structure provides a framework that allow us to think through the challenge, try new options, and test solutions that deliver the results we seek. It is within the structure that we ascribed our approach to Access and Characterize the environment in our effort to Access, Enlighten, Empower, and Evolve - (*ACE*) this dynamic environment. By leveraging data that is Visible, information that is Accessible, and knowledge that is Understandable we can Link it in real-time concurrently measuring its Trustworthiness to unlock the (*VAULT)* of understanding.

So, in conclusion, I would encourage everyone to embark on their journey of exploration to seek knowledge, understand those relationships that influence and effect our environment. For it is your courageous approach to fail forward, that will serve as the light of the world and bring clarity to the murky waters of data lakes and order to the chaos of data warehouse. Clausewitz provides inspiration as he encourages us to be courageous in our journey of exploration free from fear –



TAB 14

V *irtual*

A *ugmented*

M *ulti*

REALITIES

TRANSITIONING to the THIRD DIMENSION

Today's data digital domain is fueled by binary data that is presented in two dimensions. The interpellation needed to transition and apply it to a three-dimensional world is an area that is quickly evolving as the application to create and evolve a visual interface is transforming at the speed of light. With an ever-increasing need to pictorially represent the complexities of today's information environment, recent Virtual, Augmented and Mixed (VAM) Realities provides the initial immolation to interface with and provide humans instantaneous information.

To create seamless connections and instantaneously relay information relative to real-time circumstances requires a dynamic illustration of relational model that identifies the interdependencies associated with engaging in the dynamic digital domain. It is through this direct interface that seamless humans and computers interface provide the catalyst to

work collaboratively in today's volatile, uncertain, complex and ambiguous (VUCA) environment.

VAM Realities is an effort to illustrate those conditions that inform the recipient of the potential causality of their actions relative to the opportunities available to them. Through a proactive engagement of progressive activities, their influence derives resulting effects which enlighten the recipient of the forethought of consequences resulting from actions taken measured against desired results to be achieved. It is through these engagements that users are empowered to proactively shape and evolves the environment in this dynamic interconnected world.

There are many options when it comes to visualization in 3D. Virtual realities allow for a model and simulation of alternative realities whereas augmented realities provide informational context to further inform users. This can be seen in the gaming community with first person games to afford the opportunities to live in an alternative universe/reality typically unavailable under normal circumstances. Typical applications are simulators, training venues, and testing environments to assess and evolve competency. From training to simulations, the VR world offers alternative experiential opportunities to evolve beyond traditional limitation associated with the risk of cost and consequence.

Augmented realities provide context and illustrates conditions as they exist in the current environment. They provide an information overlay to identify additional data in an attempt to inform. Superimposing images in real time from IOT sensors provides a mechanism to elevate situational awareness (SA) and provide context. This is operational tool is one of the quickest evolving areas projecting over $60B in industry by 2020. Coupled with evolving decision support tools is an impactful business intelligence analysis mechanism. From identification on travel applications to warnings in heads up display in today's modern cars, AR is

the means to provide rich context of current conditions. The growing application has provided a multitude of opportunities to train, test, and tutor employees to establish standards the meet expectations.

Through a mix of these two capabilities, organizations can capitalize on the creativity of innovative design, manage value chains, and leverage the cognitive capacity to optimize competencies. It is through the convergence of reality and the virtual worlds that the ability to conceptualize concepts unencumbered by traditional boundaries allows the imagination to explore the art of the possible within the science of the probable. This unbounded environment allows for a creative journey to explore new ideas.

These new information delivery tools we are now able to seamless integrates humans and machines into a world previously only thought to be available in Sci-Fi movies. We can see this in the application of VR as it assists in the creation of ships for the US Navy. Through the application of AR we are able to ensure they are in compliance with standards and specifications. Whether in the VR walkthrough of a new ship with subject matter experts, or familiarization with process assembly to ensure team collaboration in each activity of construction, virtual realities have proven a valuable took in the design and assembly of the vessel.

This new visualization tool, removes the fear of failure and offers opportunities to try. It illustrates the complexity of bring a multitude of efforts together to facilitate searching for solutions as opposed to merely finding a fix to current problems. By bridging physical realities with virtual augmentation these technologies offer the means to illustrate concepts, illuminate circumstances and invest in the creativity that has thereto before gone untapped.

Aircraft design aided by VR allows for a conglomerate to work collaboratively in the development of new an evolving integration of state of the art technological capabilities. The application of this technology has been insightful to illustrate the dynamics of flight. Virtual wind tunnels allow for the incremental testing of performance during the design, development and deployment phases to better understand the implications and impediment of their design. VR affords the means to try and test ideas throughout all phases of development.

Training simulators offer increased opportunities to fly at significant reduction to cost in both equipment lifecycle and risk of potential mistakes. Aircraft simulators have long been a standing way to teach, train and sustain competencies required to establish proficiency and maintain qualification. Industry has already reduced training by over 35% and increased productivity and accuracy through the use and application of this technology. With an iterative feedback look to inform trainees and quality assurance measures for opportunities to improve VR provides real-time assessments assures product productions are on mark.

Assessment of qualification and competencies to assure success has also provided the means to identify those characteristics that serve to succeed and potentially fail in unexplored environments. Most people are unaware if they are susceptible to fear of heights which could impede their ability to function. The Air Force is leveraging VR to ascertain if linesmen are able to scale a telephone pole and if pilots are able to operate parachutes free from distraction of a fear of heights.

Augmented reality is serving to ensure quality control is maintained and ongoing assessments are established to ensure fully functional capabilities that serve to sustain the vessel. Maintaining and sustaining, complex interdependent system is a growing challenge, Augmented Reality (AR) offers insights as to the relationships and dependencies upon which components contribute to the functionality of the system. Illustrating the baseline against the current operational environment offers an insight to more effectively monitor, maintain, and manage the system throughout the sustainment process.

Mixed realities offer a collaboration between humans and machines to support, enhance, and execute (SEE) the mission to fruition. By elevating situational awareness and ensure that procedures and process are followed, effective, efficient and safe operations ensure appropriate actions are taken to achieve mission success. From notifications to bringing the 2-dimentional world of imagination to life, mixed realities offer the opportunity to elaborate and illustrate 3-dimentional concepts on traditional venues like books, magazines and even newspapers. From system notification to real time assessments to decision support, mixed realities offer a means to provide seamless interface between humans and machines. Whether through notification, assessments, or analytics, the opportunity to leverage these new technologies affords a unique opportunity to think, try and test without traditional impediments to the creative process.

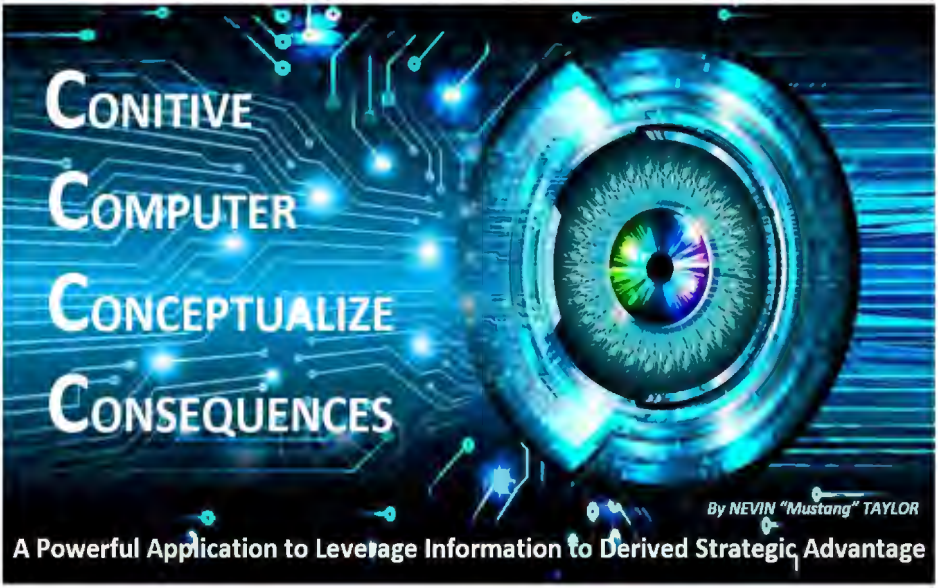
Whether exploring Mar working with the rover, designing the future, or learning to fly, the new technologies have offered unlimited realities to be the order of the day. Recent advances in technology have offered a multitude of capabilities. As we begin to realize the limitless potential of our own imagination, VAM Realities offer the opportunity to embark on a journey of exploration of unending possibilities. Given the ever-increasing demand signal it is only a matter of time that the halo suites of the Sci-Fi bring tomorrows to life.

Tomorrow is here today. With an ever increasing need for instantaneous information unencumbered by traditional platforms, VAM Realities afford necessary visualization of data to get instantaneous results. Through an interactive human machine interaction, the symbiotic relationship affords a collaborative feedback loop to learn and evolve in today's highly interdependent environment. Whether for SA or safety, the need to link and synch operations has never been more crucial in today's digital domain.

Given the transformation nature of this new technology, companies should establish a VR strategy and implementation plan. This exciting medium to visualize the vast amounts of data has proven itself in operational effectiveness and fiduciary efficiency to provide a competitive advantage that cannot be overlooked. Through the properly application of this innovative technology, the means to transform the organization is only surpassed by its creative application to create new realities today.

TAB 15

Cognitive
Computer
Conceptualize
Consequences



Putting the Pieces Together to Make Informed Decisions

With the ever-increasing need for efficiency in our more-for-less world, the ability to leverage and maximize capabilities is a necessary mission imperative. Now more than ever, this demands a formative ability to understand the consequences of potential decisions through assessments that model and ascertain potential outcomes before they are enacted. By modeling activities to determine operational effectiveness and managerial efficiencies, the ability to formulate adaptive planning and prioritized program is imperative to actualize the strategic objectives to be served.

The Cognitive Computer to Conceptualize Consequences is a long way from the days of peanut butter spreading small budget cuts and waiting for the impacts to become clear. The tool permits a responsible, prioritized reduction in capabilities with enlightened awareness of the operational picture and facilitates proactive decisions by highlighting potential trade space; the result is improved expectation management. This ability to adapt to a changing economic climate and supports emphasis on Information as a vital strategic asset to apply past actions (prescriptive modeling) against present performance (predictive modeling) to ascertain future propensity (potential modeling) to explore options to capitalize upon opportunities.

In the past, emphasis was placed on applying resource to maximize efficiencies at the expense of effectiveness. Resources leveraged to provide fast, good or cheap capabilities; when any two are optimized, the third becomes the tradeoff. In other words, to get a quality product quickly, you should expect significant cost. By depicting operational implication to outcomes (*effects*) and processes (*operations*), we are able to prioritize against organizational goals to fulfill the objective that support their goals (*strategy*). These relationships can be visualized to illustrate the implications of the element of time and integrate it into the computational formula.

The necessity to assess prioritized planning along with efficient programing in full consideration with past conditions, present circumstance, and future conditions affords the opportunity to prepare and, in some case, create the future we seek. C4 collates data in a manner that quickly validates its veracity and illuminate's relationships that were previously "unknown unknowns". But asking the right question can often be far more beneficial than answers without context; even valid data may not improve understanding of how your actions will affect the environment unless they are seen in relationship to the whole.

The tool's most valuable role is in raising the user's awareness from the micro to the macro perspective, allowing decision makers to understand the larger impact of tactical financial decisions on meeting strategic objectives. Ultimately, it affords us the opportunity to understand not just what to do, but why we should do it. By providing enhanced transparency, the ability to increase clarity management expectations as it identifies those influences that effective consequences in the future. Through a pictorial assessment that informs available strategic trade space, decision is made proactively vice in reaction to current conditions.

To remain relevant in a dynamic world, we must focus on the objective and not become distracted by obsolete requirements. This top down holistic perspective ensures focus on organizational goals as opposed to a myopic distraction upon bottom up requirements. By exposing the cause-and-effect relationship between a decision and their outcomes prior to enacting upon them affords the means to optimize effectiveness and efficiently leverage resource to maximize productivity. With great visibility offered by C4, the power to evolve and transform fully informed by potential causality and resulting consequence of a relational data analysis. Ultimately, this capability improves our ability to understand the environment and turn limitations into opportunities through creative application of the cognitive capacity offered through this innovative conceptual capability. In the words of Winston Churchill . . .

"Now that we are out of money, we must begin to think."

TAB 16

UNLEASE THE POWER OF INFORMATION

UNLEASHING THE POWER Of INFORMATION

By: NEVIN TAYLOR

"The real target in war is the mind of the enemy commander, not the bodies of his troops. If we operate against his troops it is fundamentally for the effect that action will produce on the mind and will of the commander; indeed, the trend of warfare and the development of new weapons – aircraft and tanks – promise to give us increased and more direct opportunities of striking at this psychological target. "

--Captain Sir Basil H. Liddell Hart, 1944 (Quotes, n.d.)

"The world has become increasingly interlinked through and as a result of technological means. To date, technology's role has been of supporting and enabling function. As such, technology has become interwoven into all aspects of operational and tactical level of engagement. Advantageous as it appears, this growing reliance upon technology creates its own inherent vulnerability." (CITD, 2013)

"Technology's unique collaborative capabilities afford the opportunity to discover and explore the art of the possible in greater breadth and depth than ever before. For through collaborative fully synchronized systems, the resulting synergy is at the core of gaining and maintaining current and future asymmetric advantage within the information environment. Ultimately, the predictive capacity to identify second and third order of effects is a testament to the integrated system's ability to correlate causality." (CITD, 2013)

“The following will an endeavor to transform paradigms, to proactively leverage technology, in a way that matures and heightens understanding. By integrating multiple frames of reference, leaders will mature their situational awareness and thus elevate their capacity to make informed decisions. Through this innovative new approach, technology will be utilized as a catalyst to Collaboration in order to facilitate organizing data into information that can be Correlated and fused in a manner that allows for it to be effectively Communicated (Collaborate-Coordinate-Communicate; C3).” (CITD, 2013)

“Traditionally technology has been utilized in a supporting capacity at the operational level which the synchronization of tactical objectives through Command and Control (C2) networks. This reactive approach precludes fully utilizing technology's full capabilities. Through proactive engagements leveraging technology’s catalytic capacity, the opportunity to drive a collaborative partnership at the strategic level that explores the art of the possible within the science of the probable presents itself.” (CITD, 2013)

“Hence, by considering the ends, ways and means and correlating them against second and third order of effects, current and future risk will be assessed against the causality of one’s actions. For through the application of this new paradigm the asymmetric advantage that information holds will be harvested to leverage opportunities. It is through this unified endeavor, that a collaborative strategic focus will empower the fulfillment of organizational objectives.” (CITD, 2013)

This paper will explore how current technologies are leveraged to determine and mitigate internal as well external risk. It will present the reactive nature of current technological paradigms and explore the transformational process necessary to utilize technology's collaborative capacity. Additionally, it will propose a revolutionary change in mindset of leveraging Information Superiority (IS) in order to provide the necessary control to have the freedom of action upon which to dominate that environment. Ultimately, Information Dominance (ID) effects the cognitive level of human interaction. Proper application of ID within the information environment must leverage technology in a way that unleashes the power of information to inform the decisionary process in a way that surpasses current understanding.

"We are drowning in information, while starving for wisdom. The world henceforth will be run by synthesizers, people able to put together the right information at the right time, think critically about it, and make important choices wisely."

-- E.O. Wilson *(Wilson, n.d.)*

Exploring the value of information and ascertaining how best to leverage and protect it, we must first define it and establish a common framework as to how to look at it. Once we are able to establish the basic building blocks of what ingredients formulate information, how it is developed, matured, validated, assessed and operationalized harvesting power contained within will bear effective application through the decisionary process. By first examining what information is, understand the environment in which it exists, we will begin to understand how best to leverage it. Then and only then will we begin to understand why information is important.

This paper will define information, provide the framework for the environment within in which it exists and then show the operational value contained within it. Therefore, starting with a more traditional outline of defining the what, evolve to the how we will bring the reader to the why. As we continue to endeavor to define the cyber domain we must understand how to look at the value of information, ascertain the purpose it serves in order to best understand how to leverage its capacity. (CIO, 2007) Ultimately, understanding why we need information provides us the opportunity to know how best leverage it. Simon Sinek in his book, Start With Why, enlightens us that we should provide information from a proactive top down approach in a manner that inspires action.

Information is defined as "a collection of facts or data… knowledge acquired through experience or study" (Online, n.d.) Therefore by organizing data in a useful manner as to be easily accessed the value of information begins to evolve to actionable knowledge. It is at this point that the inherent stored value of organized data is leveraged and operationalized to enlighten us as to the opportunity to garner strategic advantage. As we explore industry standards for what information is, National Institute of Standards and Technology (NIST) 800-33

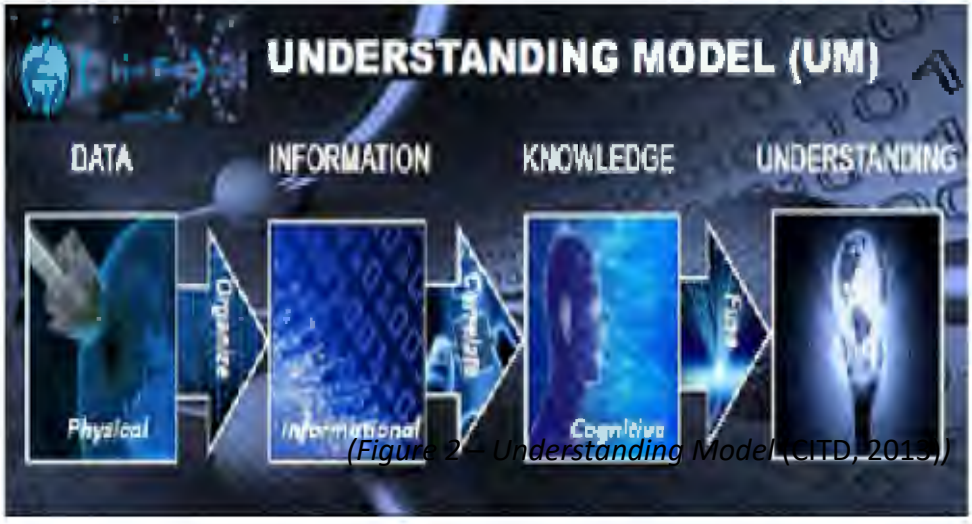
(Stoneburner, 2001) , Federal Information and Information System (FIIS) 199 (PUB, 2004), Joint Publication 3-13 (Staff, 2012) and NIST Special Publication 800-53 Revision 3 provides the recommended security controls for federal information systems and organizations (Technology, 2009). It is from these standards, guidelines and framework that we learn that information must be Confidential, have Integrity, and be Accessible (CIA) to be of any strategic value. As we begin to correlate the impact of the ingredients that ascribe its worth, the last two measures of veracity and timeliness directly determines its inherent impact to the decisionary process. For it is the first ingredient which requiring information to be secure that determines its strategic value as outlined in figure 1 below. For in the end analysis without accurate and timely information the overall result of decisions based upon flawed data can only yield bad results given the old advantage Garbage-In-Garbage-Out (GIGO).

(Figure 1 – Strategic Value of Information (CITD, 2013)*)*

With continued endeavors to understand cyber and the manmade domain of technology, there are continual endeavors to propagate its capacity. Given the cross-cutting nature of cyber and the interlinked world environment, DoD finds itself increasingly reliant upon the resulting

interdependencies of information's supporting supported relationship to synchronize efforts through Command and Control (C2) endeavors. The catalytic capacity to leverage information to capitalize upon the synergy derived from a team focused collaborative endeavor, ascribes to the potential value it possesses. However, the inherent over reliance to drive to pure knowledge, precludes the evolutionary capacity to explore the art of the possible while effectively managing expectations within the science of the probable. Thus, the automated nature of technology affords the opportunity to account, organize and assimilate data into information to identify the breadth of possibilities in this dynamic every-changing environment.

The effects of information reveal themselves as we understand the evolution of the cognitive process. Throughout, cognition is shaped by how data is organized into information and thus correlated into knowledge which in turn awakens us to the significance of how the transitions shape and mature our view of the world as illustrated in figure 2 below. It is through the ability to understand the 2nd and 3rd order of actions taken against desired results to be achieved does enlightened understanding become apparent as ascribed by the contextual framework offered in Figure 2 below. Thus, the importance of information as the centerpiece to the cognitive process becomes clear.



(Figure 2 – Understanding Model (CITD, 2013.))

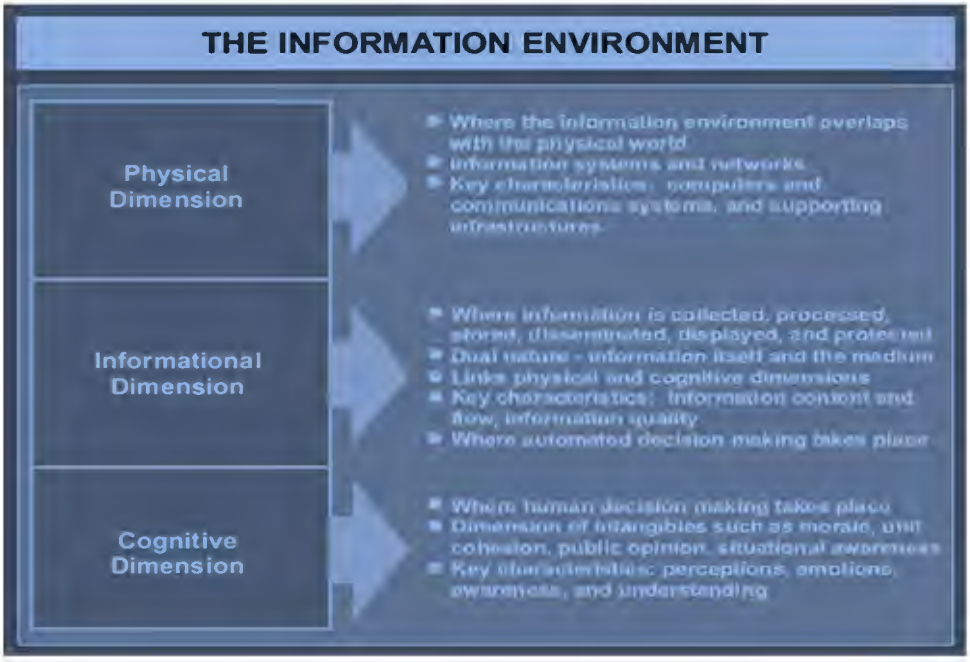
With increased efforts to evolve Situational Awareness (SA) to better understand and adapt to the changing world around us, Sun Tzu's sage advice to victory on the battle field rings true "now the enemy and know yourself, you need not fear the result of a hundred battles. If you know yourself but not the enemy, for every victory gained you will also suffer a defeat. If you know neither the enemy nor yourself, you will succumb in every battle." (Hart, 1910) Today's high-tech ability to organize, correlate and fuse information with an ever-greater enlightened prospect for the operational commanders affords the adaptation to the military environment at the speed of light. Thus, ETTA provides an excellent framework of the informational environment which is made up of a physical, informational, and cognitive building block that serve to enlighten the operational commander with accurate and timely information upon which to make informed decisions as illustrated below in figure 3. (CITD, 2013) (Staff, 2012)

(Figure 3 The Information Environment ((CITD, 2013)*)*

Today organizations are looking to drive collaboration within this Information Environment enhanced by the synergistic capabilities. It is through the alignment of the capacity of leveraging information that evolves the ability to drive efficiencies through the consolidation of data centers and eventual migration to the Cloud. By leveraging technologies, the result will ensure effectiveness through increased accessibility and resulting resiliency as it lowers cost in a resource constrained environment. As Winston Churchill so eloquently stated;

"Gentlemen, we have run out of money. Now we must think." *(Churchill, n.d.)*

For only through a comprehensive understanding of this environment as outlined in figure 4 and 5 below and the attributes and benefits associated with each phase of the maturation process will we begin to appreciate the interdependent complexities of the challenges that are before us. For once we master this environment and understand why it exist we will be better able to effective transition and evolve to the cognitive level.

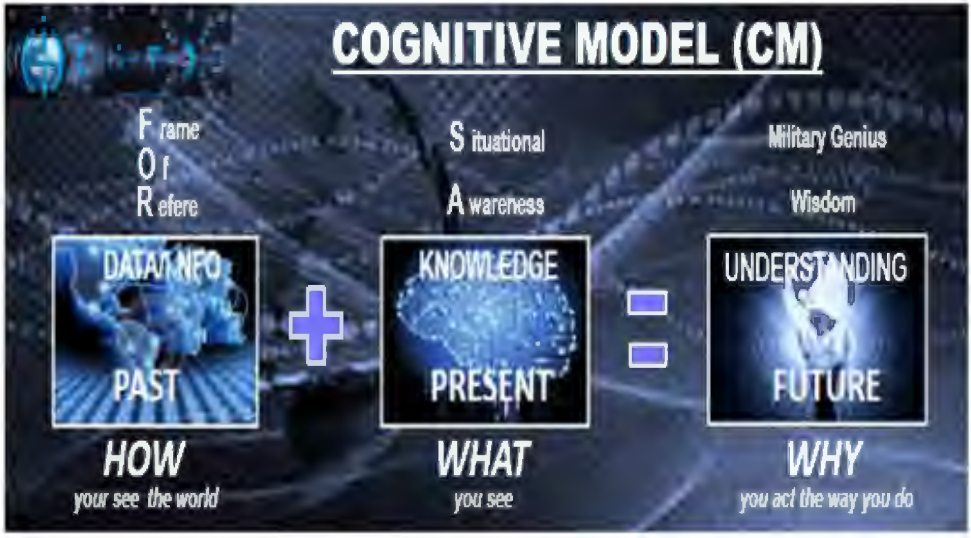


(Figure 4 –Information Environment ((Staff, 2012)

In our more for less world, technologies afford a better means to validate a multitude of sources which establish relationships upon which the maturation process of data becomes knowledge. It is from this Frame Of Reference (FOR) that historical actions inform potential future opportunities. Thus, understanding of how to look at current conditions from informed actions of past performance develop one's FOR. It is this FOR that is the lens upon how to see the world which formulates their Situational Awareness (SA) of what is see given the environment's current state. In the words of Edmund Burke;

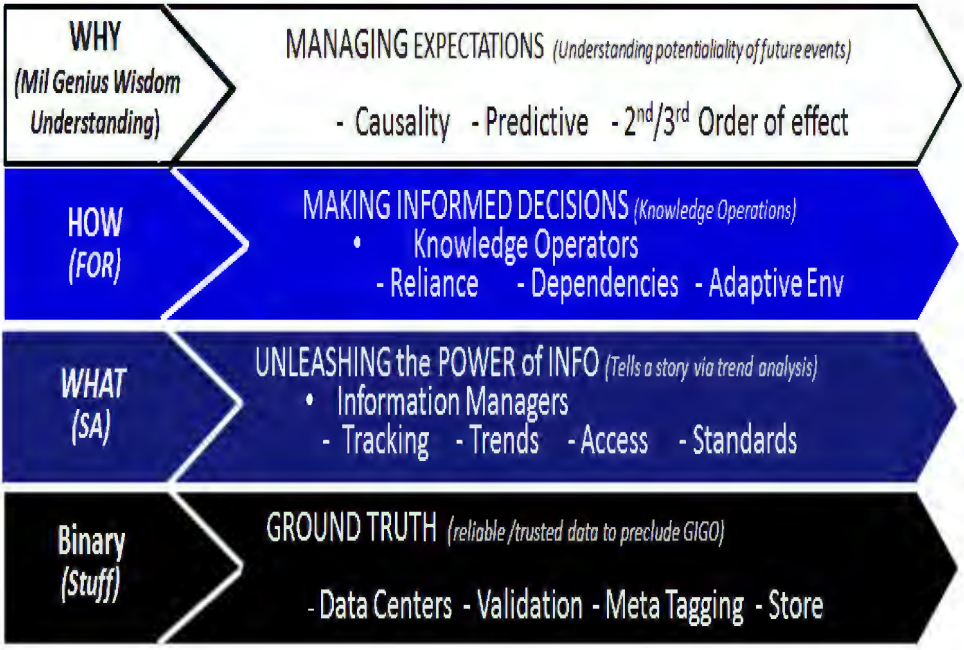
"Those who cannot learn from history are doomed to repeat it."
(Burke, n.d.)

The importance to learn and evolved is at the core of an enlighten species and the necessary adaptations and transformation to gain and maintain a competitive advantage in this quickly evolving and interlinked world environment. For it is this progressive process' reliance upon the reflective competencies that the application of 20/20 hindsight assess the results of actions taken against outcomes for to be achieved. John Boyd clearly understood this in his adaptation model of the OODA Loop. (Coram, 2002) Ultimately one quickly realizes that today's SA becomes tomorrow FOR as illustrate in figure 5 below.



(Figure 5 Cognitive Model ((CITD, 2013)*)*

With these models in place the methodology to operationalize information presents opportunity. For the ingredients that encapsulate how information informs our perspective on the current environment in-turn serves to bring to pass deterministic actions intended to transform it. Therefore, accurate data properly organized into information, paints and enlighten operational picture to afford leaders the opportunity to make informed decisions. Thus, the value of garnering a strategic advantage as outlined in figure 4 below ensures the steps toward cognition necessary to make informed decisions. Therefore, by effectively managing expectations through enlightened understanding the maturation of cognitive capacity is attuned to what Clausewitz described in his book On War as; military genius. (Howard, 1989)



(Figure 6 – Cognitive Process (CITD, 2013)

Overall, information superiority and information dominance are the operational cornerstones to provide benefits of leveraging information to derive strategic advantage. It is within these parameters that Herbert Simon's conceptualized the concepts of bounded rationality. He foresees that actions should be taken despite ambiguous information in an attempt

to produce rational decisions in a Volatile, Uncertain, Complex, and Ambiguous (VUCA) environment. For the heuristic opportunity to consider the myriad of plausible limitless options should not become a paralysis that stagnates the organization's ability to progress within this volatile ever-changing environment. (Simon, 1984) (Gerras, 2010)

INFORMATION SOUPERIORITY

"The mind has no firewall. **' --Timothy L. Thomas, *Parameters,* Spring 1998** (Burke, n.d.)

There is a growing desire to acquire information superiority within the information age as we prepare to evolve to the age of knowledge. The information age is a period in history upon which the technological tools of computers and networks were applied to garner strategic advantage to the acquisition and use of data during its organization into viable information. As such, Information Superiority's focus is on the physical attributes of the information environment as illustrated in figure 7 above. It is the overarching ability to control the access and processing of data at rest and during transit along with the opportunity to deny one's adversaries the same which is at the heart of the strategic advantage afforded by obtaining IS within the cyber domain. Thus, by exceling in greater proportion than our adversary and integrating capabilities in a way to become self-synchronizing the benefits from a Net-Centric approach to leveraging technologies offers

(Fig 7–Info Superiority Environment (CITD, 2013)

Ultimately by utilizing technology's competitive advantage for a better flow of information, the opportune benefit of gaining and maintaining information superiority affords strategic advantages in warfare. Current efforts for information superiority are defined as "the capability to collect, process, and disseminate uninterrupted flow of information while exploiting or denying an adversary's ability to do the same." (Winters, 1997) Information Superiority (IS) simply put is to have a preponderance of data, control of access and more efficient processing than your adversary. Hence the three functions of IS are support, C2, and engagement in offensive/defensive application. To that end, Information Superiority (IS) simply put is to have a preponderance of data, control of access and more efficient processing than your adversary. Hence the three functions of IS are support, C2, and engagement in offensive/defensive application.

To accomplish IS, the organization must possess the ability to deploy technology in order to "plans, coordinates, integrates, synchronizes and conducts activities. (Command, 2009) By proper alignment of the tools of their trade cyber operators are able to control their environments to ensure data at rest, in transition and during processing is protected. Within the tradecraft of information superiority there is a plethora of technological tools to control the physical aspects of the information environment. From firewalls to control access, intrusion detection to monitor activities, backups to provide resiliency, disconnects to mitigate risk, encryption to ensure privacy and redundant systems to provide for resiliency with a focus upon ensuring the control of and protection of US data. Thus, the ever-increasing reliance of these networks and the data resident on them is the target of would be attackers which presents an ever clear and present danger. To managing the increased risk due to this reliance, technology is leveraged to track and account for the vast amount of data in the information environment there. These systems which store, disseminate, aggregate and protect this vast interlinked globally network have become critical to the organization's ability to optimize operations. (Barwinczak, 1998)

The world is plagued with hackers endeavoring to marginalize DoD's ability to Command, Control, and Communicate with the Computer Systems (C4). (Barwinczak, 1998) The operational necessity to operate without impunity and deny others the freedom of action to do the same affords the strategic advantage of informed forethought provided by the power of information. Thus, steps must be taken to gain and maintain information superiority to preclude ongoing endeavors to access through brute force, limit access through denial of service attacks or manipulate and hijack data via virus. (Jr. C. A., 1998)

The increased necessity to ensure secure networks is highlighted given the ever increase threat and ongoing attacks directed to disrupt, access and manipulate data. With continued effort to understand the level of vulnerability to existing networks, "the shared risk nature of this problem requires integrated, comprehensive and consistent defense wide information assurance practices." (Jr. C. A., 1998) With increased emphasis and reliance on information physical infrastructure for SCADA, telecommunication, finance institutions, transportation, and emergency services, the Presidential Commission on Critical Infrastructure Protection acknowledges the criticality of information for the whole of government and the role that gaining and maintaining information superiority serves to fulfill US vital national interest. (Marsh, 1997)

INFORMATION DOMINANCE

"The key is always to tell the truth, and never promise something we cannot deliver. Once we have credibility, then we have an effective message that will win over propaganda and stories told by other factions."

--310th PSYOP Company, Bamian, Afghanistan. (Burke, n.d.)

Information Dominance (ID) exist to harvest the information within the information environment in an effort to correlated it into knowledge so that the senior leader possesses the ability to influence and effects the cognitive level of decisions. For it is the ability leverage the results of the Knowledge Managers endeavors to correlate information into enlightened

knowledge which drives understanding that the resulting influence to relationships shape the perspectives and actions that transform the environment. Ultimately, ID requires proactive transformational leaders with the vision and the inspiration to operate at the cognitive level of the information environment. For it is the mission of ID to enlighten one's FOR and elevate their SA in order to influence perspective, perceptions and paradigms (3P) and thus effect long term actions on the world stage.

(Fig 9–Info Dominance Environment (CITD, 2013)*)*

By understanding the ingredients of information and the dynamic environment in which it lives, we have the opportunity to effect and influence it. The world is rapidly evolving and the adaptive information environment that support it is exceedingly dynamic. One would be well suited to take Steven Covey's approach of to "Understand in order to be Understood" into account. (Covey, 1989) For the ancient principles of Sun Tzu should be considered as they endeavor to keep pace and adapt as with the "water shapes its course according to the nature of the ground over which it flows; the soldier works out his victory in relation to the foe whom he is facing." (Hart, 1910)

Technology offers the opportunity to keep pace with the continual adaptive nature of this challenging environment as we endeavor to assess the veracity of data, apply security to ensure its confidentiality and manage the vast networks which afford accessibility. Through proper adaptive planning the opportunity to apply technology to fulfill operational objectives presents themselves. (Santacroce, 2009) Hence through mature FORs and enlightened SA fully developed Courses Of Action (COAs) can be developed that offer options to the operational commander which fulfill their strategic intent. It is through the balanced application of technology with full consideration of the environment and inherent risk within it the strategic advantage that informed decisions that fulfill organizational objectives can be made.

Information Dominance is focused upon the cognitive level which looks at the motivation why actions are taken in an effort to influence the recipient in such a way as they will affect the environment in a manner commensurate with our combined objectives. There are three ways to create a cause to action in someone; coercion, manipulative or influential. The first, coercion, provides the most immediately results but is only as effective as long as the level of threat to the recipient is sustained and does not exceed the value they place on the actions they wish to achieve. The next, manipulative, yields less immediate results but has more long-term effect until the recipient becomes aware, then the loss of trust precludes future opportunities. Influence requires the most effort investing to build a relationship of confidence which often require less immediacy and more time to garner long term results. However, it is within the sphere of influence that long term relationship of trust upon which future collaborative endeavors can produce mutually beneficial results for all parties involved. It is within this are that the author recommends investing to establish long term relationship upon which to build nation.

INFORMATION SUPERIORITY	INFORMATION DOMINANCE
STATIC IN NATURE	DYNAMIC IN NATURE
PASSISVE	PROACTIVE
SPECIFIC	COMPREHENSIVE

It is important to note that information superiority and information dominance are not differing degrees of one another. The table to the right ascribes the contrast as to these two capabilities and infers the competitive advantage and focus of each. As illustrated in Figure 10 to the left, information superiority is about resolving problems and mitigating threats. Information dominance on the other hand *(Figure 10–IS/ID* (Winters, 1997) endeavors to provide solutions by leveraging opportunities and transforming the environment to meet current and future objectives. It is the proactive nature of information dominance which requires a transformation leader with vision to harness the power of information. For the benefits to be derived, is the strategic advantage to transform the environment to what you want it to be. The results of the transformational leader's ability to master ID within the information environment will afford the opportunity in the words of Winston Churchill to ensure;

"History will be kind to me for I intend to write it."

(Churchill, n.d.)

SUMMATION

"There are but two powers in the world, the sword and the mind. In the long run the sword is always beaten by the mind."

--Napoleon Bonaparte (Burke, n.d.)

In summation, information operations is reliant on the information environment. It is within this environment that the organizations must gain and maintain information superiority. Once information superiority is accomplished the opportunity to influence an effect the environment and those in it at the cognitive level are only limited by our vision and imagination. For those with the capacity to learn from the past in order to envision the future and unleash the power of information are afforded the opportunity to leverage knowledge with the clarity of understand to make wise decisions. Patton said it best;

"A man must know his destiny… if he does not recognize it, then he is lost. By this I mean, once, twice, or at the very most, three times, fate will reach out and tap a man on the shoulder… if he has the imagination, he will turn around and fate will point out to him what fork in the road he should take, if he has the guts, he will take it." *(Patton, n.d.)*

Now is the time to drive forward and take up the mantel of knowledge. By mastering the maturation of knowledge and understanding, the application of transformational capabilities of information dominance affords the opportunity to fulfill those goals that bring to fruition the vision of those opportunities that are available in the future. Ultimately, this future belongs to those courageous transformational leadership with the vision and tenacity to ***Carpe diem.***

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COALESCE

TAB 17

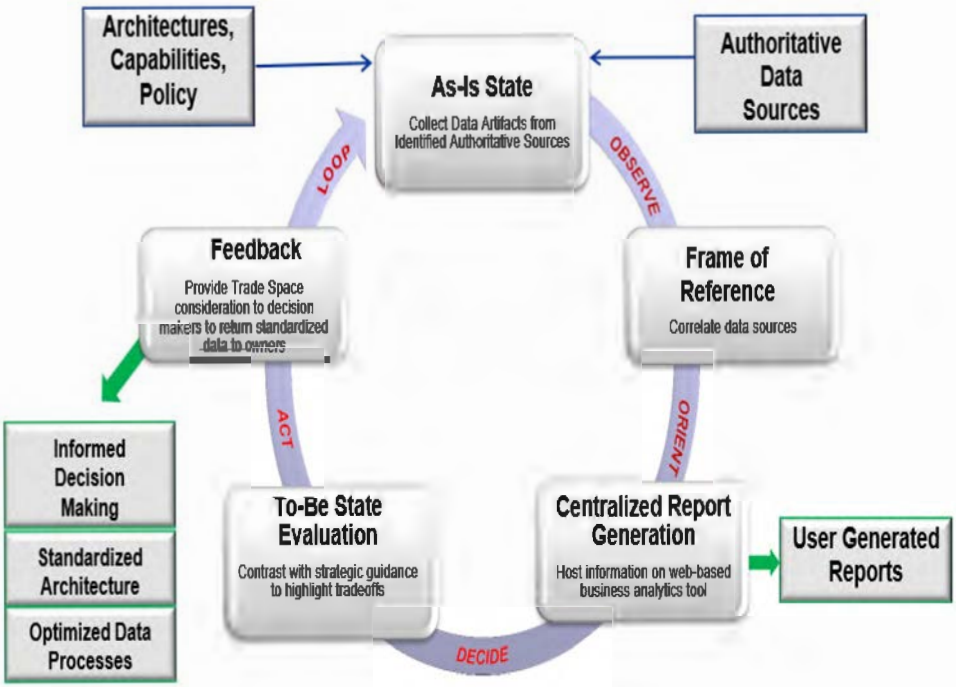
Decision Support Tool

Given an ever-increasing competitive dependency on information, the necessity for timely access to facts, awareness of relationships, and contextual understanding of dependencies has created the necessity for real time assessments of this dynamic environment. This has driven a need to bridge the gap between increasing capabilities and decreasing resources by leveraging technology and analytic tools to decipher complexities and interdependencies associated with today's programs. The methodology and tool suite to derive a fast and thorough analysis is essential if decision makers are to be provided timely information to support, enhance and execute mission capabilities effectively in today's Volatile, Uncertain, Complex and Ambiguous (*VUCA*) environment.

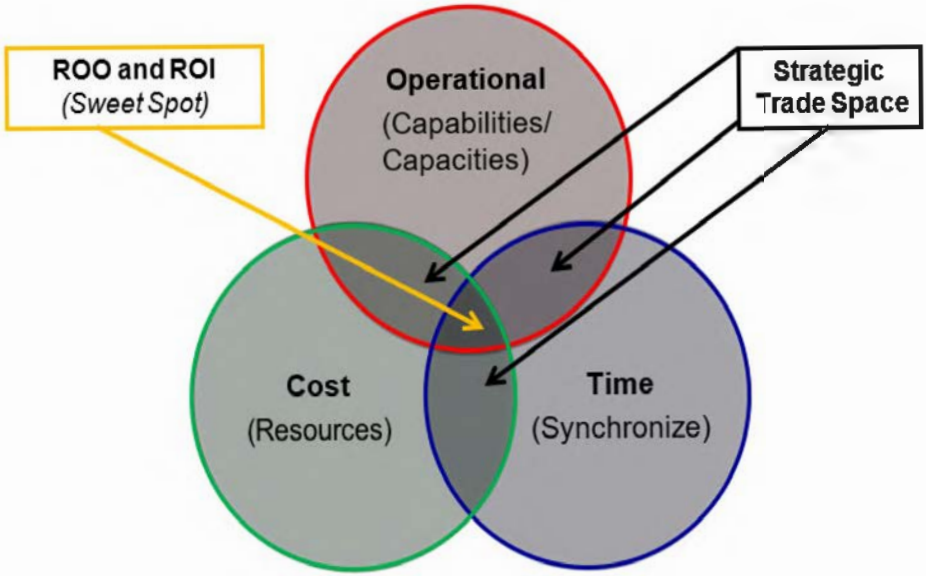
- **Why is a *DST* necessary?**
  - *To make more-informed decisions*
  - *Show the relationships between capabilities, capacity, resources and time*
  - *Illustrates past, present and future trend*
- **How do we move beyond spending the majority of our time on data input and validation to empirical assessments?**
  - *Focus on analysis and trending*
  - *Leverage processes and standards to ascertain data veracity and information dependencies*
  - *Develop business analytics to assess cost benefits analysis to mission effectiveness/efficiencies and reliability/resiliency*
- **How do we make/get *DST* to be the primary integration tool?**
  - *Illustrate causality and potential operational consequences of programmatic decisions*
  - *Identify value proposition of current investments and highlight opportunities for realignment*
  - *Coordination with Subject Matter Experts (SMEs) to correlate and understand results achieved from decisions made*
- **What benefits will *DST* provide?**
  - *Provide contextual knowledge to decision makers to inform wise decisions*
  - *Optimize effective return on operation (ROO) and efficient return on investment (ROI)*
  - *Compares "As-is" state with the "To-Be" state to illustrate those options that illuminate opportunities to fulfill operational objectives*

The Decision Support Tool is a capability to inform decision makers of the relative facts that inform strategic tradeoffs so they can prioritize actions that effectively leverage resource to optimize the potential to derive capabilities in sufficient capacity to meet mission objectives. This highly tailorable authoritative suite of enterprise tools enables the integration across the enterprise. It draws on authoritative sources for its repository of data to dynamically visualize credible programmatic and operational data interdependencies and relationships.

The tool aids in the process of leveraging capabilities in full consideration of current causality as it relates to the consequence of interdependencies. Though a thorough analysis it identifies those options for success. Through measurable metrics it provides quantifiable assessments which illustrate the propensity of risk modeled against what if scenarios to ascertain operational courses of action that identify potential second and third order effects of actions taken measured against desired results to be achieve.



By establishing and applying an enterprise data architecture leveraging authoritative data sources, the complexities are unraveled revealing undesirable redundancies. This affords the opportunity to establish the veracity of data and identify the interdependencies of information to assess the potential value proposition essential to properly align resources against mission imperatives. At its core, the *DST* associates all Program Elements (*PE*) in the organization's portfolio to essential resources to effectively align them to assess Return on Operations (*ROO/effectiveness*) measured against a Return on Investment (*ROI/efficiencies*). This provides the organization relational dependencies necessary to inform the organization's planning and programing processes. The result is the illumination of the complexities of current effort to store, transport, and apply information in a way to provide timely analysis to identify horizontal integration across service core functions, platforms, systems and programs.



Since its inception, the *DST* has a continuum of methodologies, tools and data sets to validate, manage, and Access, Characterize, Enlighten, Empower, and Evolve *(ACE*) program elements critical to the successful engagement of operation imperatives. With the ability to aggregate information and provide a visual representation easily digested by users, *DST* illustrates those capabilities must be applied and the associated capacity essential to fulfill the ascribed operational objectives. This affords the opportunity to assess those options to capitalize on opportunities and their strategic tradeoffs as they present themselves.

The reduction of over 80 percent of time spent on data gathering and research affords more time for exploration to assess course of action (*COA*) analysis and decision options. The result is a more robust solution derived from a better understanding of the capabilities and components necessary to optimize both *ROO* and *ROI*. Once completed, an analysis can occur identifying the interdependencies, investments, risks, and consequences of enemy threat on our logistical assets in theater. Following these activities, detailed recommendations can be established, providing the insight necessary to justify future operations and investment decisions.

This Decision Support Tool facilitates informed decision to manage reaction/expectations to explore causality in an effort the proactively manage potential consequences. By illustrating the interdependencies, combined with the threat and vulnerabilities of each we can now illustrate the critical nodes, assess the quantitative impact of disruption, and the cost of sustainment and disruption in a quantifiable measure for future investment decisions. This process shows the cascading effects of alternatives and long-term cost in both sustainment and operational engagements.

- **Why do we need DST?**
  - *Mitigate unintended consequences*
  - *Strategic tradeoff between capabilities/resources/ time*
  - *Predictive capacity innate in past/present/future trends*

- **How do we move beyond spending the majority of our time on data input/validation?**
  - *Register authoritative data sources (ADS) to establish a common name convention and referential definition*
  - *Catalog Information to establish structure and ascertain intrinsic relation dependencies*
  - *Establish a contextual knowledge base to assess and query ADS to make relative determinations*

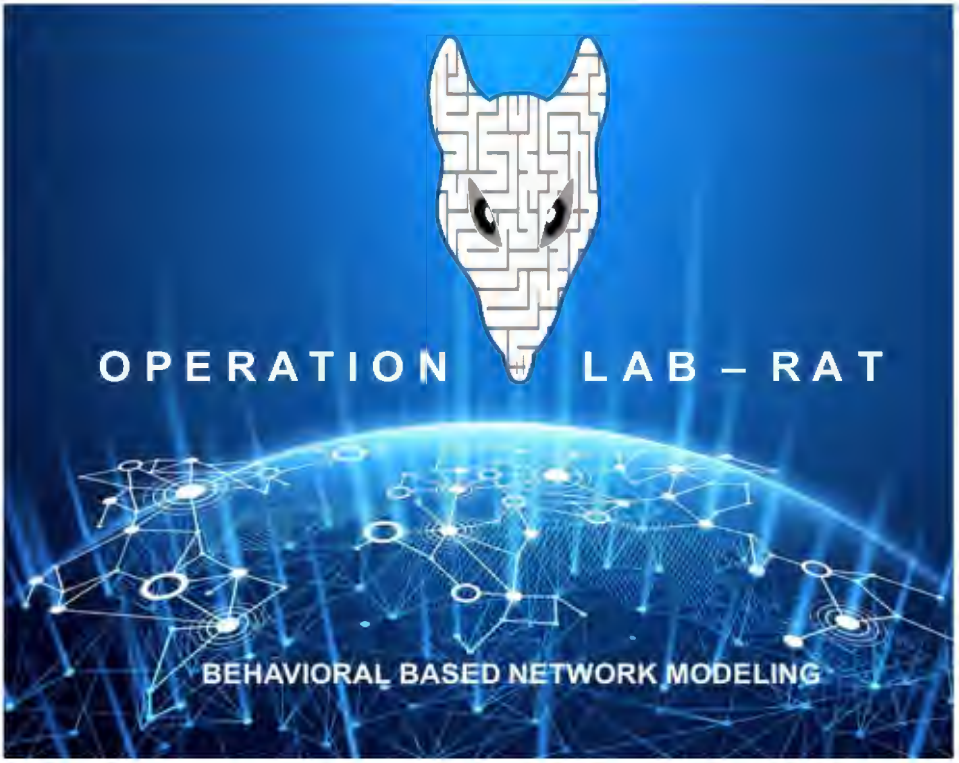
- **What value does *DST* provide as an integration tool?**
  - *Affords opportunity to mitigate potential operational consequences of programmaticdecisions*
  - *Ensures that investments deliver mission value*
  - *Illustrates return on past investments from actions taken measured against results to be achieved*

- **What benefits will *DST* provide for our organization?**
    - *Elevates awareness to inform understanding that shows potential strategic tradespace*
    - *Offers opportunity to capitalize on strategic choices in today's resource constrained environment*
    - *Provides actionable data that informs knowledge to evolve understanding to make wise decisions*

The *DST* evolves an ever-expanding dynamic knowledge base that illustrates current relationships to *ACE* those actions essential to obtain the organization's strategic imperatives. It provides the necessary facts and outlines their associated dependencies to provide an enlightened course of action that leverage enterprise authoritative data sources in a way that empowers organizational decision-making. The shared view of programmatic reality informs planning, programming and budget execution to realize envisioned capabilities that serve those operational objectives that achieve the ascribe goals which assure mission success.

TAB 18

OPERATION LAB RAT



Characterizing the Digital Domain

(Operation Lab Rat – By Mustang and the TFSS BBNM Team)

To effectively manage risk in today's digital domain requires an accurate assessment of our circumstances. By effectively characterizing the environment to elevate our awareness, it is essential that a clear picture be portrayed to illustrate the risk that exist from a persistent threat in this highly contested environment. As one becomes enlightened as to the impact on their future, they become empowered with those options and opportunities to manage this risk in a proactive approach given an unprecedented number of unidentifiable adversaries. Operational Lab Rat is an effort to identify and quality this risk and the resulting consequence it has to current operations.

Whether measuring humans or machines, historic assessments of their actions can serve to identify and measure these endeavors from identification, motivation, or even tactics, techniques and procedures. By characterizing the digital domain, the opportunity to assess risk, manage expectation, and ascertain consequence affords the opportunity to manage this risk measured against an actual and opportunity cost/benefit assessments. Given the increased dependence of the information environment to inform the cognitive process, the dependence and reliance upon the digital domain effects every aspect of our everyday life. This increased reliance requires innovative capabilities to determine the probability of a threat and assess its potential to place current and future operations at risk. By providing a holistic view of the information environment, we can better assess the effects of security, monitoring, provisioning, utilization management, and allocation to support mission sustainment.

Through an advanced approach to conceptual modeling, we can provide current state and trending derived from past actions to determine the predictive and potential future state. Analysis from vector relational data modeling, can now produce insightful analytical visualizations of the strategic trade space. The impending consequences of actions taken measured against desired results to be achieved can be assess and measured as a result of these models that simulate the causality and consequences of actions taken measured against results to be achieved. The resulting synthesis of this process offers an opportunity to identify the interrelation dependencies which enlightens the recipient as to the motivation given an assessment of their actions.

Their behavior can be modeled and analyzed to reveal the intent driven by objectives. Through continuous monitoring the system can derive a multitude of additional benefits as it characterized the digital domain and associates activities causality through prescriptive modeling and consequence derived from a new options and opportunities model that identifies potential. The result is a system that serves to:

- Allow ***intrusion detection capabilities to trigger*** appropriate network management assessment to determine risk while managing traffic
- Include a configurable Vector-Relational Data Model (VRDM) of behavior that ***integrates attack behavior, action policy, and deterrence/deception***
- Represent a ***flexible, open architecture*** to integrate network traffic analysis capabilities
- Provide a ***reference architecture description and prototype implementation*** that includes configurable and adaptable architecture to structure the enterprise
- Define ***models as exemplars*** to synchronize and define other definitions of behavior, and other sensing or control capabilities to elevate situational awareness

By implementing autonomous monitoring in order to elevate understanding of those actions which produce impacts, from varied actors. We can quickly identify malicious, lazy, and uninformed activities to characterize and conceptualize intent. Behavior-based modeling can identify their motivations and even illustrate their plausible objectives. This capability offers cyber subject matter experts the means to examine the environment to develop a means to identify, monitor, and measure persistent and evolving cyber threats.

By establishing a framework, the models can correlate components via adaptive and integrative machine learning. Through ongoing assessments, analysis can reveal their tactics, techniques and procedures (*TTPs*), which is critical to accurately making real time assessments. The elevate SA and derive increased understanding as to how they operate and evolve over time can provide keen insights of the best approach toward managing and, in some cases, mitigating risk. The resulting heightened SA affords the opportunity to develop a deeper understanding modeled against the aforementioned framework upon which to establish the means to adapt, reconfigure, evolve and overcome persistent threats in today's Volatile, Uncertain, Complex and Ambiguous (VUCA) environment.

Cyber-attacks are on the rise as are the resulting imposed costs associated with these malicious cyber actors. The criticality to maintain an advantage in this operational environment has proven to be a perplexing challenge. Organizations are routinely exposed to grave risks in cyberspace, such as insider threats, lone wolves and belligerent nation-states. A number of recent, high-profile incidents have demonstrated the challenges associated with effectively monitoring, recognizing, influencing and/or assessing threats and ascertaining risks impose upon this critical infrastructure. Most importantly is the impact these activities can have on the data contained within it, which is critical to the ability to inform and influence decisions in today's technologically interconnected world.

The cyber domain is a complex and constantly evolving system that has emerged as one of the critical components upon which organizations depend for mission success. The increasing dependence on digital networks for communication, coordination, and collaboration increases the necessity to implement, integrate state of the art system with sufficient oversight to monitor and manage risk in this pervasive environment. Not the least of which is the role that personnel perform who run these systems play as they endeavor to ensure peak performance as they diligently engage to minimize impact in their ongoing efforts to mitigate this pervasive threat. By continuously seeking to improve our ability to leverage and defend our networks, and the information systems they support, we must be mindful of our reliance upon these systems and the criticality they serve in the continuance of our ability to derive current and future strategic advantage.

Current technologies and techniques lack sufficient adaptability to defend this VUCA environment which contain our most sensitive and valuable information. Antiquated systems depend on a collection of limited, point solutions that undergo constant evolution and adaptation, and are continually under fire by increasingly sophisticated adversaries. This situation is exacerbated by:

- **Continual emergence of new transformational technological capabilities**
- **Adversary access to, and exploitation of technologies as quickly as they become available**
- **Managing sophisticated system that assure reliable safeguards to leverage data at rest, in transit and during all phases of application**

While technology continues to evolve rapidly, the gap between software developers' ability to create information management systems capable of handling the amount and diversity of continuously expanding information is increasing exponentially. The developmental frameworks and approaches available today were never intended to grow, manage, and secure critical information systems relied upon with increasing dependencies to communicate via an evolutionary and ubiquitously connected infrastructure. This coupled with the growing mass and complexity is itself a microcosm of the larger, global problem. Despite spending hundreds of millions of dollars on network infrastructure and even more on information management, organizations are scrambling to effectively manage information to support operations. By establishing frameworks to analyze their performance, they will become enlightened at the level of risk in which they are operating.

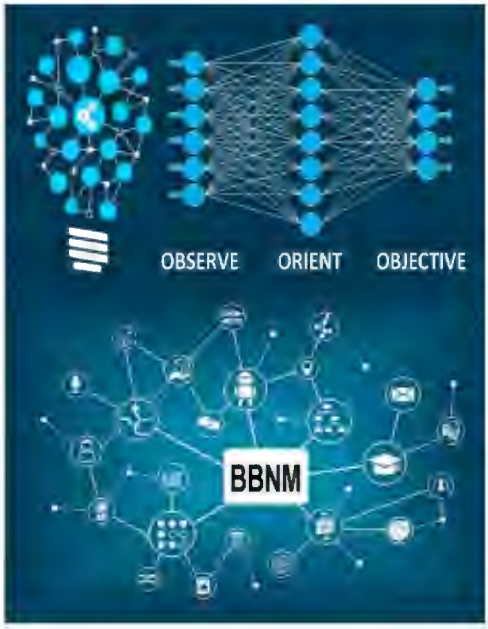
Through monitoring the massive amounts of anomalous data across multiple types of data logs, they be able to measure system integrity, provide mission assurance while attempting to manage and mitigate risks imposed by a multitude of malicious actors. The current reactive posture and the time needed to preserve a massively unmanageable infrastructure which is continually evolving beyond most organization's ability to transform, presents a clear and present danger which is beyond their ability to assess. By adapting an iterative approach to leverage a best of breed in an effort to adapt and overcome adversary's threat affords the means to develop and assess the impact to operations over time. The critical ingredient essential to establishing a proactive approach to managing this environment is the ability to quantifiable measure and characterize offensive actions over time.

Mayfield's Paradox illustrates that it is more expensive to defend as opposed to offend, given the low barrier to entry. He further points out that additional security becomes unrealistically expensive as to does the impact on risk of adding additional users given the convergence of a multitude of security concerns. Therefore, one would be well advising to be mindful of the disruptive approach of those that would do us harm. Through a consistent and conscious network management approach, organizations will be able to capitalize on the adaptive nature of the information environment. For it is this holistic engagement which will quantify and qualify the evolve nature of this domain given the unpredictability generated by the confluence of its human dimension.

By monitoring and managing this environment through measure that matter, metrics will provide enlightened understanding as to available options that empower organizations to avail themselves of opportunities. It is through the application of these venues that they will be able to adapt and overcome if not evolve beyond the influence of malicious actors. By leveraging behavioral based network monitoring (*BBNM*) temporal trends can illustrate behaviors that influence and effect the environment that illuminate through employing self-learning algorithms both the identity and the motivation of their adversaries.

Through advancements in conceptual modeling, the ability to evolve to a modular system-of-systems based approach that categorizes actions of actors in this diverse and rapidly evolving environment provides a means to adapt and overcome threats. This will offer the ability to characterize, assess and shape the digital environment in a way that affords a means to manage risk through a framework that ascertains the impending impact of threats on the information environment.

A well architected framework affords a repeatable consistent approach to assess the environments. Creating point of origin (*FOR-frame of reference*) upon which to reference and correlate activities over time (*SA-Situational Awareness*) affords the opportunity to analyze, model, and test activities (*causality*) against future outcomes (*consequences*).



- ***Objective:***
Demonstrate an operational proof-of-concept to create a simple traffic model that can perform simple adaptation, either autonomously or semi-autonomously
- ***Scenario:***
Simulate interactions among Actors (hackers and good users) and Targets (web pages) and categorize Behavior so we can classify good and bad actors in the future
- ***Strategy:***
Leverage data from an Apache Web Server to infer (based on policy) threat levels of user requests and respond accordingly

BBNM measures human-machine interaction to identify compliance and out of scope actions given established standards and governance. By identifying abnormalities, the opportunity to apply to established conceptual model offers the means to determine both the impact and objectives to be served by the perpetrator. Through a comparative analysis of current actions, measured in a mirrored network, the means to model

adaptions through in-depth determination from on-the-loop and in-the-loop analysts provides comparative understanding to see the proverbial forest through the trees respectively. It is through these simulations that offer thorough analysis of the network to determine and identify causality in order to assess potential consequence.

This system operates at many levels from observables (*such as data logs*) with input triggers upon which to model and simulate operational implications of behavior to actions (*unobservable*). The model automates analyses, inferences, and decision making relative to the performance (*including threat posture*) of observed interactions within the network. The model adapts and evolves autonomously in an iterative approach to include and incorporate additional data through a maturation process which evolves information through semi-autonomous inculcations. It then provides notification to the operator at the point that the system transforms beyond an established framework. Based on the model's assessment, and selected responses, it can send alerts or reconfigure network appliances to cease a given behavior in an effort to manage and mitigate risk.

While normal traffic and activities are processed automatically, unknown and abnormal activities can be addressed quickly, with either human-in-the-loop or human-on-the-loop intervention (predetermined in the model configuration).

- **BBNM's conceptual model produces simulation to enhance understanding by providing:**
  - **Context***: actions and their impact (causality and consequence)*
  - **Continuity***: behaviors associated to evolve understood over time*
  - **Characterize***: interpretation of actions to assess potential impact*

- **The BBNM operational simulation is designed to evaluate observed Behavior to:**
  - *Infer the intent and motivation of a diverse set of actors*
  - *Adapt autonomously to unknown Behavior (where intent can be inferred)*
  - *Respond automatically to observed Behavior (of known and unknown intent)*

BBNM is designed to improve cyber team effectiveness by facilitating a conceptual and contextual understanding of behavior through threat-based response to inform autonomous and semi-autonomous systems. Lab Rat is an unsupervised machine learning system which establishes its own origins and references to ascertain an unbiased perspective without undue influence of supervised frameworks that create cognitive bias through distorts preconceived paradigms. Network traffic artifacts are aligned against a comparative analysis to determine evidence of activity by components that are applied to a conceptual modeling to ascertain causality and assess potential consequence of threats imposing potential risk to the enterprise.

Tightly coupled relationship between user and IP address, are correlated to user location and then associated to relational interdependency upon which the actor interacts. By treating network traffic artifacts in this way, BBNM is assessed through Lab Rat, which offers greater possibilities to comprehend and responding to the motivation behind actions. Through this process the means to monitor and measure efforts provide the possibility to deliberate overriding objectives of the actor.

The distinction mentioned here is anything but trivial, since the existence of a conceptual framework for understanding behavior is often critical to effectively managing the motivation of actors that cannot be attributed to pre-existing circumstance. Therefore, the model requires time to establish references and their relationships upon which to build neuronets that illustrate interdependencies to illuminate intentions. Liken to the establishment of a relational database, the system provides greater clarity as the complexities of this environment correlated to a comprehensive picture that continually evolves and matures over time.

The BBNM approach bundles a set of physical components (*e.g., routers*) and a set of software components (*e.g., firewalls*) within a conceptual model. The components of which are represented as instances of concepts (*i.e., "conceptual components"*) that represent their behavior. Components of concepts (*such as a router and a firewall*) are combined with other concepts—potentially the "*Actor*" mentioned above—to create a comprehensive model that represents a simulation of the entire network, including all associated activity and users.

Artifacts of actor behaviors are aligned against contextual correlation to provide insights within the conceptual framework. Measures are compare to determine resulting causality and consequence of the network's static state, compared to its transit condition. This adaptation informs how influences are associated with and mapped to the operational characteristics of those devices. As the evolution in a close system evolves due to injection from the open system, the causality and resulting consequence are measured to assess actor behavior.

The BBNM model is a system-of-systems that A.C.E. sensors and actuators to inform pre-defined actions to manage and mitigate threats. It then establishes a conceptual model in three stages:

Stage 1- ACCESS: In near real time, BBNM COLLECTs and "triage" aggregated sensor information to established criteria:

- *"known good," for which no action will be taken*
- *"known bad," threats that trigger alerts*
- *"unknown," or traffic that has not yet been evaluated*

Unknown traffic information stimulates the BBNM model which analyzes it in real time to infer intent and suggest a response

Stage 2 – CHARACTERIZE: Unknown traffic received from Stage 1 is analyzed. Incoming behavior is compared to desired (policy compliant) behavior by applying the frames of reference to elevate and evolve situational awareness. When an evaluation can be made, it is translated into additional criteria. This requires a highly adaptive and fluid system conceptually inform the adaptive nature of the network through real time analysis to inform the relationship and dependencies of the volatile, uncertain, complex and ambiguous (VUCA) environment.

Stage 3- E3 (Enlighten/Empower/Evolve):

By analyzing collected data to correlate information contextualize knowledge is applied to inform understanding. The relational data aggregated in Stage 2 is analyzed to determine the influence and impact of actions taken measured against results to be achieved. The result is a decision analysis model that identifies causality and assesses potential consequence in a dynamic ever-changing and continually evolving environment.

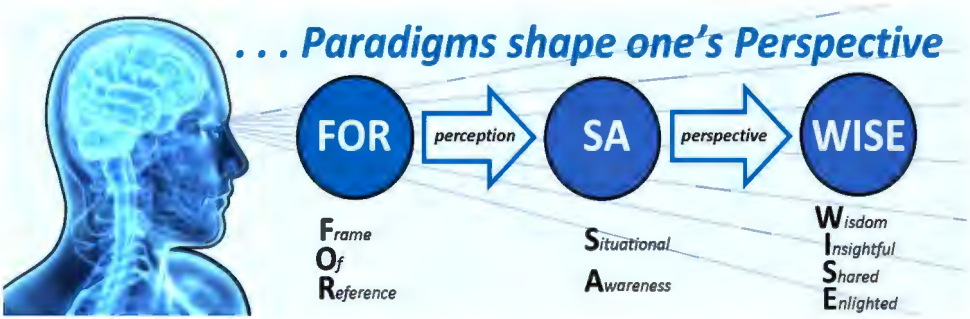
Traditional conceptual model is defined as "a non-software specific description of the computer simulation model (*that will be, is or has been developed*), describing the objectives, inputs, outputs, content, assumptions and simplifications of the model." It is at this stage that distinctions, differentials and determinations are established. The key to good conceptual modeling is to get the level of simplification correct, that is, to abstract at the right level. Contemporary conceptual modeling is separate from the computer model. Moreover, the conceptual model is not specific to the software with which it is developed, and it forms the foundation for computer code development. In contrast, the computer model *is* software specific and represents the conceptual model in a specific computer code. [1] (Robinson, 2010)

Translating the conceptual model into software is time-consuming, typically imprecise and often difficult to change once completed. By deploying a vector relational data model (*VRDM*) the well-defined semantics enable a rendering of the ascribed concepts, objects, and their respective relationships to be visualized. The VRDM-based conceptual model can illustrate dimensional aspects of the relationships and thus characterize the dependencies within this dynamic system. By identifying the degree and direction of movement, and applying weighted measures against them over time, the characteristics of each object can be determined throughout the dynamic environment. Ultimately, the dimensions elucidate the implicit meanings indicated by the available data.

Through an implementation of a System-of-Systems (*SoS*) approach, the data exchange mechanism is expressed as data in one system which often has different structures—not just a different format—in other dependent systems. Hence, SoS are usually best described conceptually. They can be best defined as conceptual model that establish the dependencies and limitations in system interactions. They afford the opportunity to make complex detailed simulations from ambiguous assumptions about real world events. Thus, the importance of unsupervised machine learning (*ML*) systems to validate and establish fact-based simulations preclude cognitive bias which unnecessarily influences paradigms and perceptions.

It is through this continuum of validation that the system adopts a trust but verify perspective is applied. This ensures that through the re-examination of the data/facts and by reassessing the relationships/dependencies which validate and identify those instances preclude missing details that may later prove to be important. Because VRDM-based conceptual models are not translated into code, one can implement a small subset of the model and then observe and correct or extend it to produce a perfectly correct model during the initial and ongoing iterations given the conceptual nature and complexity nature of today's evolving systems.

Executable conceptual modeling of complex systems, such as BBNM, involves assessing the implications of a multitude of numerous domains simultaneously. As continual assessments are made, to evolve situational awareness (*SA*), through system monitoring, measures are taken to assess and identify direct causality of derivative relationships. This develops an appreciation of the implications and complexities of multiple level abstractions by focusing on one actor in a domain and relating to other conceptual components from across a multitude of diverse dimensional domains. The properties inherent between the interactions contribute to instance as it pertains to interrelation dependency that occur during progressive time slices. The temporal analysis provides adaptive correlations that inform intent as well as motivation of the actor and in certain circumstances can reveal their overarching objectives.



To prototype and test this capability and develop quantifiable measures upon which to characterize this environment "Operation Lab Rat," was designed to demonstrate a basic information model application (a straightforward traffic model) capable of performing a simple adaptation, either autonomously or semi-autonomously. Through an applied scenario which simulated relationships between actors (hackers and good users) targets were identified (web pages) and the need to categorize behavior classifying good and bad actors in the future was tested. A limited environment was scoped to afford relational assessments in an effort to infer potential threat levels of user activities in relationship to causality and consequence. Lab Rat learned about network threat entities by observing behavior both good and bad. As more data was accumulated and the neuronet matured, it developed the ability to recognize a threat entity on first interaction based on a well-defined FOR and an elevated SA of its environment.

An initial model of a basic web server that provides an analysis engine, referred to as Lab Rat, was applied in a simple network instance to gauge its ability to perform these simple adaptations. Lab Rat's conceptual model consisted of diverse connections and varied components upon which to identify and assess the resulting relationships. Rather than being programmed, the relationships were configured via unsupervised learning to analyze and associate them from system inference.

The BBNM modeling in Lab Rat depends on identifying patterns in the data that conceptualize the component interactions and adaptations that show the relationships and formulated dependencies amongst those components. Assessing the behavior of actors and characterizing its causality, intuitively obvious deductions can be made. For instance, once

it is known that a user has done a port scan on a site, the user is known to elevate suspicion to cause more investigation as to their actions. As they continue to act in the environment, their actions reveal the nature of their activities. Their behavior informs the model of the intent as they reveal their motivations derived from past and present activities. The system determines from their behavior if they pose a potential threat given their motivation and deterministic intentions.

The framework is further matured to present a conceptual model of behavior to represent critical distinction from existing rule-based approaches to assess actor's associated behavior. An assessment of the level of hostilities and the resulting propensity for success and probable impact imposed by this this threat informs the system to determine if human intervention is necessary. The value of this effort increases over time as the neuronet expands and further develops relational context-based deterministic:

- **Collected data is validated and introduced into the system**
- **Correlated relational dependencies illustrate causality**
- **Contextual analysts illuminate potential consequence**
- **Conceptual TTPs inform adversary's motivation and intent**

Alternatively, an environment in which metarules remain static will quickly become obsolete. Because VRDM-based models are defined using domain-relevant vocabulary, network analysts can also tailor and refine the metarules to manage automatic threat responses more effectively. Network traffic instantiated as instances of behavior which stimulates the model to approximate, adapt, and apprise as necessary. New information adds/updates the state of a component which inform the perspective

which dynamically changes as the status of those components become enlightened (*SA*), trigger become empowered, and continual reassessments of higher-level actions evolve. An update provided by the feedback loops allow the system to respond to new information using both current and historical data without the need to recode. Where appropriate, model decisions and adaptations can update rules processed in Stage 1 for faster processing. The same structure can be used to "*train*" the components in Stage 2.

The model execution process is neither a linear sequence, nor is it directed. Rather, each associated object is derived from the second and third order of effect or causality of action. It is this process that informs causality and resulting consequences. This dynamic environment, therefore, is not governed by predetermined actions, but instead by proactive adaptation. This illustrates the overall potential involved, which stems from the entire pattern of responses and any other results that are needed to take the system to a netcentric state. Not only is this capability easily defined in VRDM, but it also represents a challenge to traditional programming. The model adapts to new Behavior as the data adds or updates instances of entities which cause:

- ***Changes in State (explicit or inferred), such as weights that cause metarules to trigger or stop firing***
- ***Changes in the instances of entities identified by relationships as Targets for execution rules (where relationships are data driven, not programmed)***

The conceptual components in Lab Rat used two threat qualifiers:

- ***LEVEL*** *– a numeric score representing the degree of threat calculated from threat Levels of the related objects or probability*
- ***STATUS*** *– threat, unknown or good are also determined by the status of related objects or potential*

To determine their ultimate threat level and status the two threat measures in Lab Rat are defined as:

- **Threat Status** *(bad or not bad)*
- **Threat Level expressed as a number 0-100**
  - *(0=no known threat / 100=highly threatening)*

Some of the Lab Rat conceptual components had both a Threat Level and a Threat Status (e.g., Behavior), but certain conceptual components had only a Threat Status (e.g., Actor).

As data accumulates, the model updates the components' associated parameters and checks the related metarules to assess the Threat Status or Threat Level. If a metarule is triggered by data, then the related Threat Status and/or Threat Level is updated as specified. The effected components are notified of changes in state so the model can be populated to inform the basic analytical process to evaluate the presence of a threat. This is followed by reevaluation (*up and down*) of the model's hierarchy, which causes the model to adapt and evolve.

Lab Rat's conceptual components are:

- **Actor**
- **Interaction**
- **Behavior**
- **Session**

Selected components of the conceptual model can be represented in three dimensions. By extension, session would be a collection of those points which is a finite asset in the model as well as a contextual component that is part of the environment. Actor is amongst a set of participating components that are dimensional contributors to two different spaces. Similarly, behavior is an evaluation with a state that migrates from good too bad. This is reflected by the changing threat levels, which is determined from the sessions and their resulting interactions within the environment. These events influence and effect of the model evolves and transforms the system. Lab Rat processes data and manages the network autonomously. If finds condition-based action through semi-autonomous network management and informs and evolves the conceptual model. Through ongoing feedback and training informed by known data, it develops and matures its neuronet. After a parameter changes are made, all the historical data are reinterpreted automatically to ascertain secondary and tertiary consequences.

The Lab Rat model is robust enough to learn to identify threats through observations of bad behavior. Consequently, it matures over time to be able to recognize a threat on the first instance. In one substantiation, the model was able to infer at first sight that a particular actor was bad, even though it had no initial knowledge of the actor or their behavior. Given the conditions of observation and existing circumstances of the event, it is able to model, learn and train itself as to the existence of threats due to the interplay between concepts and circumstances (*FOR*). This allows it to acknowledge behavior and understand in what context (*SA*) it influences the framework (*infrastructure and foundation*). It becomes enlightened and empowered to act within the framework and informs actions to update and evolve to prepare for future iterations. Through this complex model, focused on assessing behavior, it establishes the requisite structure to assess possible inflections point within the system to calculate, assign, and ascribe threat levels appropriately.

The Lab Rat proof of concept is a basic traffic model that assesses, characterizes, and establishes behavior dynamics in order to perform simple adaptation, both autonomously and semi-autonomously. By categorizing behavior in order to classify good and bad actors from historic data in relation to current events. Policy and a risk management framework are applied to processes threat and take actions within specified parameters to manage and mitigate risk within the network. It is through a net centric approach toward operations that the system is able to self-synchronize against a predefined framework to effectively measure threats, monitor risk and adapt and mitigate impact.

The model is an example of digital transaction processing through a core analytic engine applying net centric capabilities to adapt in a dynamic ever-changing environment. It develops tactics, techniques, and procedures (TTPs) through computer learning modeling. Behavior is captured through ubiquity and universality of the approach. Ultimately, the analytic engine ascribes parameter of values to identify target parameters upon which to act upon. The engine approximates weights to deduce meaning through an established framework. Informed by a weighted set of assessments and rules, actions are based on decision modeling frameworks designed to manage and mitigate risk.

The ongoing assessments inform and influence the environment and are measured in an iterative approach to create a feedback loop that updates the system to evolve and adapt to the confluence of new information. Decisions are made using frameworks from which support and comply policy mechanisms are applied to achieve a netcentric approach. The resulting increase in responsive actions afford the opportunity to get within the adversary's decision cycle. The adaptive approach informs the system to continually evolve to overcome pervasive threats in the *VUCA* environment. The result is a proof of concept model which demonstrates the ability to stimulate a network model via observables (*web log*), infer intent and adapt automatically effectively by *A.C.E.ing* the dynamic digital domain.

By optimizing available resources through operationalizing data, the opportunity to managing risk, and leveraging technology to derive competitive advantage in the dynamic digital domain. Rapidly evolving within the information environment, provides a strong foundation to expeditiously elevate understanding. It is this holistic approach that adapts to the unpredictability of humans "in the loop" and affords the means to conceptualize the environment quantitatively from a scientific approach to measure causality in this VUCA environment. Given the unpredictability and unforeseen actions in a complex interdependent environment, it becomes increasing important to capitalize upon the ACE model in order to derive strategic competitive advantage.

Sun Zu advises “Know yourself, know your enemy, and you shall win a hundred battles without loss.” Lab Rat offers insights far beyond traditional network traffic analysis, it identifies through behavior-based modeling a framework that supports operational objectives by analyzing traffic against a behavior model. It then implements effective responses across multiple network. Utilizing VRDM-based conceptual modeling, it implements a flexible and adaptive response. The approach capitalizes on existing network appliances, and among its many essential elements is the ability to make conceptual sense of a multitude of data streams through seamless aggregation.

In sum, the capability offered by Operation Lab Rate provides a unique demonstration of effective BBNM. This point solutions learns from log aggregation, signature matching, and anomaly detection. It utilizes a risk management framework to assess and ascertain threats. It utilizes advance technologies that enable rapid configuration, customization and sharing of behavior analysis information. By deploying multiple enclaves and services across the enterprise, its prolific ability to characterize effects and derive instantaneous updates, serve to provide an adaptive system that measures, monitors, and assess related consequences of actions taken via results to be achieved. This highly adaptive system bolsters predictive analytics to effectively leverage a proactive approach to adapt and overcome even the most persistent and pervasive threat.

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TAB 19

O*peration*

C*hess*

M*atch*

Webster defines Cyber as the act of relating to or involving computers or computer networks. In more specific terms it speaks to our ongoing efforts to leverage technology to effectively manage data in a meaningful way. Whether in manner that we store, make visible or share information through a spider web of networks, ultimately it is within our ability to apply technology in a meaningful way that effectively evolve knowledge to understanding which enlightens our ability to strategically operate in today's volatile, uncertain, complex and ambiguous (*VUCA*) environment.

As we transition out of the industrial age into the information age we are quickly transforming our environments into the age of knowledge effectively transition from a war of attrition to a war of cognition. Today's growing demand for data surpasses our ability to supply in our 24/7 interconnected world. Given the advent of the digital domain just 50 short years ago with ARPANETS use of IP protocols to interconnect our systems, the growing demand for data is currently doubling every 18 months. As such we are reliant upon the manmade domain to leverage our technological tools to store, disseminate and process copious amounts of data. Thus, this paper will address the need to understand:

- ***Information in Operations*** *(IIO) – our ability to communicate and raise awareness*

- ***Information Operations*** *(IO) – the necessary Coordination and Collaboration so that the operational Commander can command and control (C2) military forces/capabilities*

- ***Information Warfare*** *(IW) – analytical assessments to facilitate the cognitive efforts to full those strategic objectives that ensure our vital national interest a*nd the growing need for a cyber-modeling tool to assess, characterize and evolve (ACE) operations in this ever-changing information environment.

Figure I-1. The Information Environment

INFORMATION IN WAR

As the world becomes increasingly interconnected, every aspect of our daily lives is monitored, recorded and assessed by the internet of things. The plethora of operations and the strategic advantage derived from accurate, reliable and timely (*ART*) information is the key to garnering victory in this high-stakes environment. By elevating awareness, the ability to communicate with and coordinate forces effectively to synchronize in a collaborative effort assures mission success. Thus, with and ever-increasing reliance on technology to facilitate enlightened understanding in this *VUCA* environment, we must strive to effectively operationalize data in order to make it visible, accessible, understandable, linked and trustworthy (*VAULT*). It is only through this approach that we will be able to unlock the *VAULT* of understanding.

Given the growing reliance of this capabilities to adjust and adapt at the speed of light, the ability for it to inform and enlighten organizations as to the multitude of options available to capitalize on unlimited opportunities in today's interconnected world will be the key to derive competitive advantage in this dynamic environment. Thus, our ability to support communication, enhance awareness and evolve understanding is greatly enhanced by the application of today's technological tools.

INFORMATION IN OPERATIONS

The requisite information to know from where you came to understand where you are which informs you to were current momentum will carry you is vital to our ability to operate. Thus, we must provide the historical Frame of Reference (FOR) to operationalize the digital domain to enlighten the cognitive process in this ever-changing information environment. The strategic trade space illuminate's opportunities and risk inherent in information warfare.

INFORMATION MANAGEMENT

The ever-growing mass of data and complexity of the relationships attune to a devolved science experiment. Recent examples lend themselves to IBM's Big Blue computer to supplant cognitive abilities in the strategic game of Chess. However, given the complexities and in determinant reactions of human dynamics d not lend themselves to even the best probabilistic modeling. For we cannot always determine behavioral modeling given the irrationality of human interactions in event even a controlled environment.

An interactive process that validates the validity of the veracity of data and in turn characterize throw it is presented in this dynamic environment. Thus, through adaptive modeling we believe that the information environment as it pertains to military operations would be useful in assessing expectations, characterizing the intent and motivation of operation in order to determine the COA necessary to ascertain how best to execute military operations. For this the finality of things those actions today and second and their order of effects. And, the causality of actions results in consequences within this environment and all those reliant upon it both in the cognitive and physical domain.

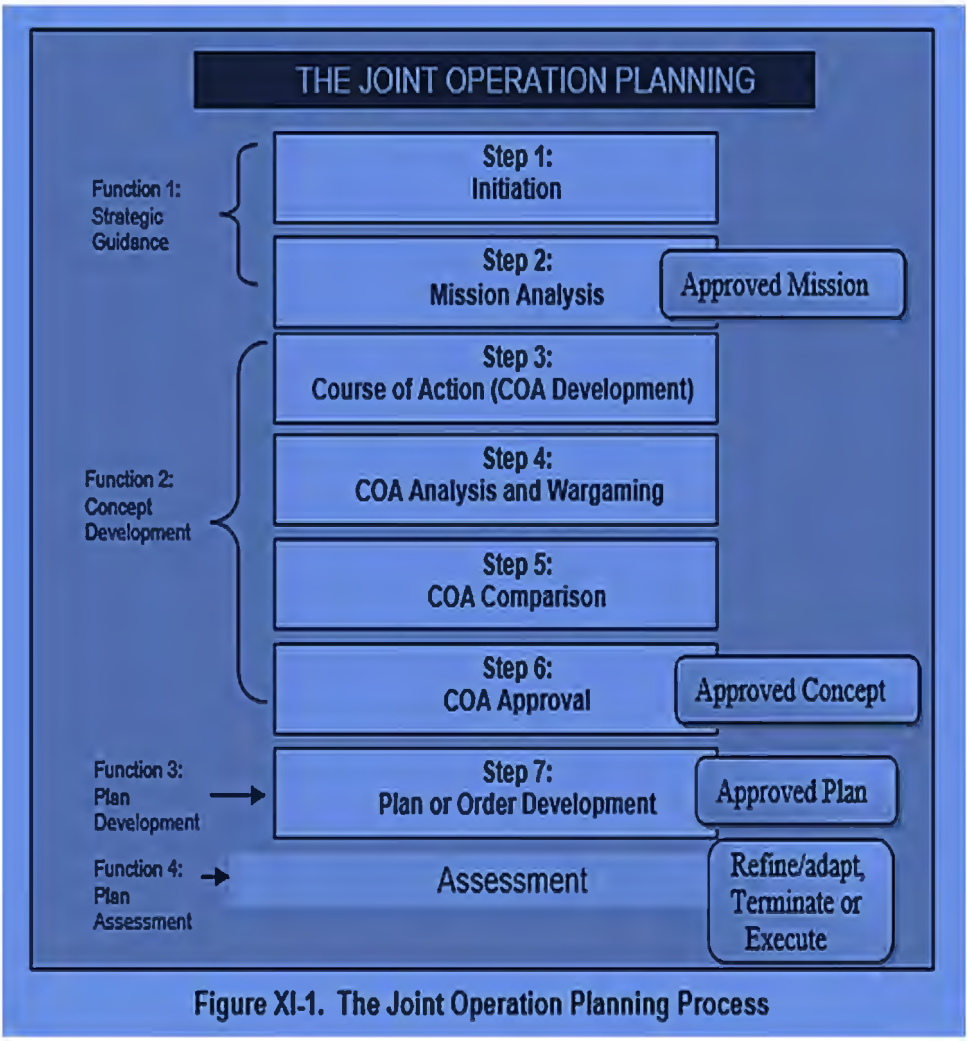


Figure XI-1. The Joint Operation Planning Process

Ultimately, strategic opportunities in military operations are revealed by prudent planning and programing. The National Defense Universities Joint Advance Warfighting School (*JAWS*) offer a sound structure for adaptive planning to overcome the uncertainty presented by the *VUCA* information environment. Thus, we propose a framework for cyber campaign planning which identifies options to manage risk while maintaining a focus upon those opportunities to garner strategic advantage by leveraging flexibility developed through an iterative approach to assess, adapt and act (*A3*) in a manner that provides fluidity of operation in this highly dynamic and constantly evolving domain.

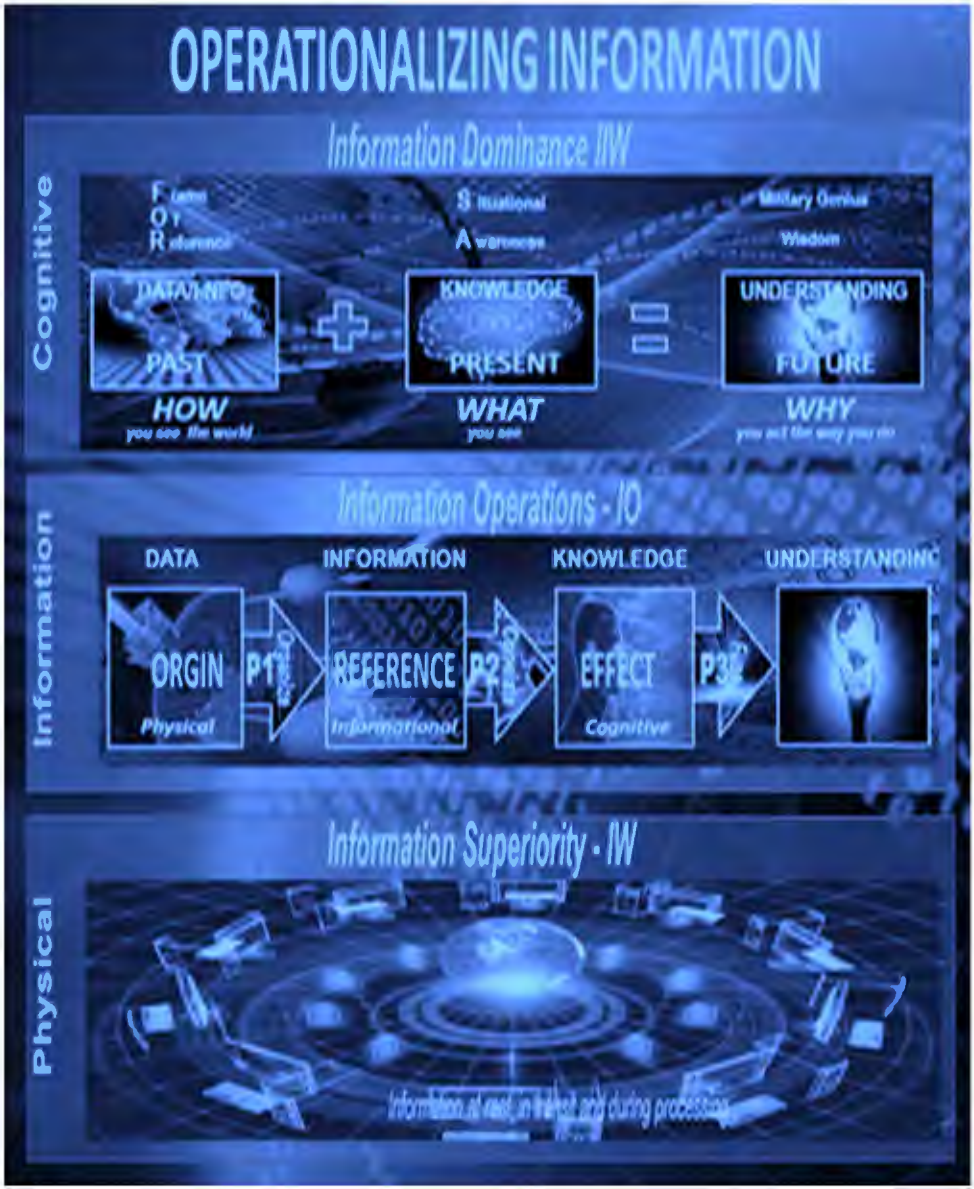
KNOWLEDGE OPERATIONS

To accomplish this the operational commander must have enological systems that identify the veracity of data, reliability of information, dependability of the relationships and finally elevated situational awareness of the environment in which they operate. Given the growing mass and resulting complexity associated with this task, leveraging technological tools to aide in managing the mass and operationalizing the complexity is critical to gain and maintain strategic advantage. The resulting reliance upon these systems creates its own set of inherent vulnerabilities that must be managed.

Notwithstanding, our ability to communicate within this environment is crucial given the extensive efforts to take those security precautions that ensure mission assurance. That said, significant effort must be made to understand the purpose of these systems as to the ability to facilitate the elevation of awareness that informs knowledge to aid in the cognitive process understanding. The resulting cause and effect informs the implications of those strategic tradeoffs within the cognitive process to ensure decision makers are able to maximize their propensity to make wise choices. Thus, the growing need for knowledge operations to assess the environment and provide analytical analysis is vital to understanding the causality and potential consequences of actions taken measured against results to be achieved in this *VUCA* environment.

Today's technological tools afford many opportunities to provide greater capacity to manage information in a meaningful way. The growing desire to establish netcentric systems provides increased timeliness and accuracy derived from autonomous transactions that provide analytical information *which most misconstrue as artificial intelligence*. The increased acceptance and widespread popularity of these new capabilities has elevated our cognitive capacity to increase awareness and proved a common conduit to collectively coordinate and collaborate in order to synchronize operations. With our increased application of these technological systems affords the opportunity to work smarter through a synergistic approach. However, we must be mindful of the quality (*correct…known and complete*) and

resulting dependencies that are derived from this new approach. Additionally, we must be mindful of not only those things that are unknown to us but the propensity of the unknowable in our efforts to paint a holistic picture upon which to evolve our understanding of the VUCA environment.



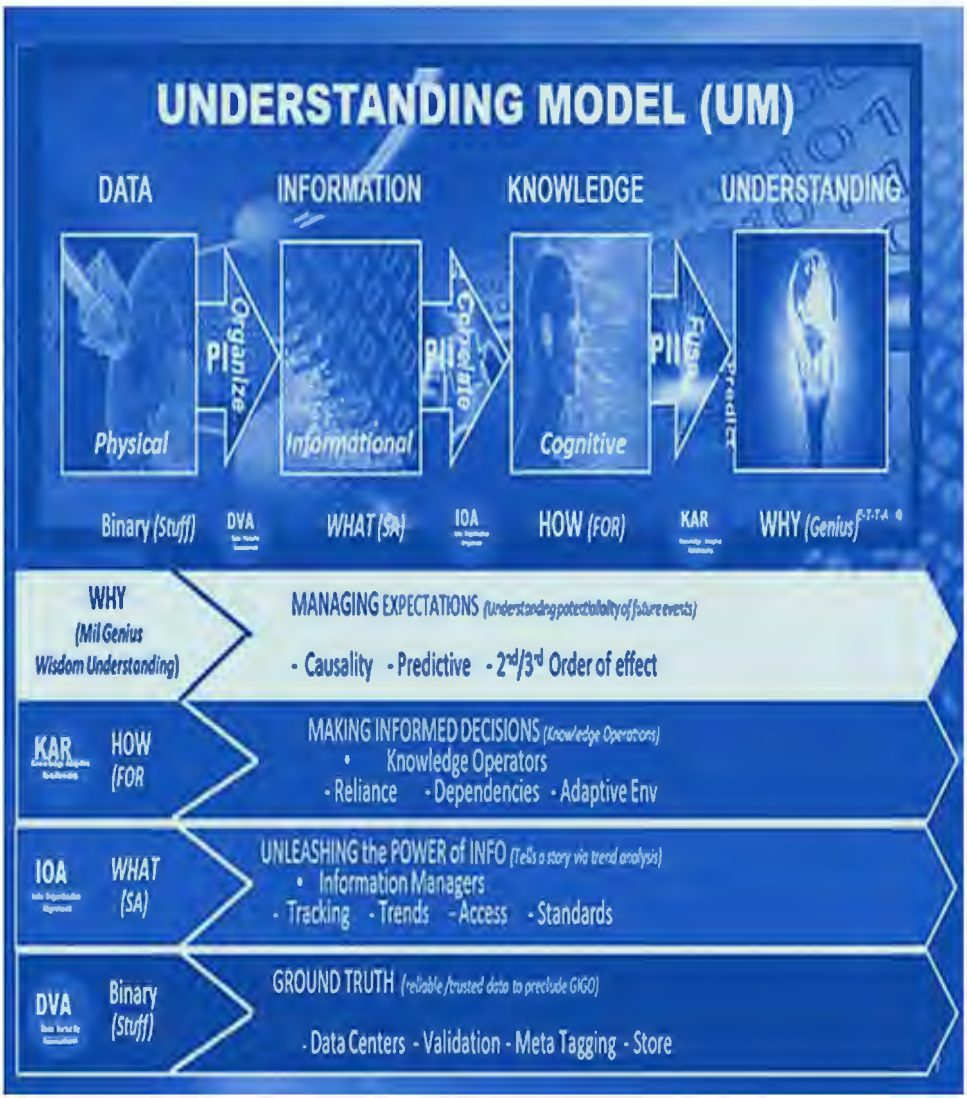
Within this complex interdependent environment, one must be aware of paradigms, and perceptions, to make informed decisions for outcomes that meet expectations. It is through these cognitive endeavors that one becomes aware of the implications and resulting influences through prescriptive modeling, and resulting implications that effects have on the environment. Examining the unpredictability of this evolving domain, we can leverage predictive modeling to identify the probable outcomes given our level of understanding. Thus, it becomes essential that we master this rapidly expanding digital domain to assure the proper application of data that informs knowledge upon which our cognitive capacity struggles to understand the complexity of the second and third order of effects of our influence within this highly dynamic and continually evolving interdependent environment.

With an ever-growing reliance of the digital domain and an unending quest for data, the need to effectively and expeditiously coordinate to establish collaboration and consensus has never been greater. Past Command and Control Centers preclude the essential aggregation of information in a way that elevates situational awareness to understand causalities that influence consequence. Therefore, project "*CHESS Match*" is an effort to addresses the quintessential framework to effectively assess, characterize and enlighten/empower/evolve (*ACE*) operationalization of data in order to support, enhance and execute (*SEE*) mission necessities in a way that meets operational imperatives by leveraging the following understanding model (*UM*).

INFORMATION WARFARE

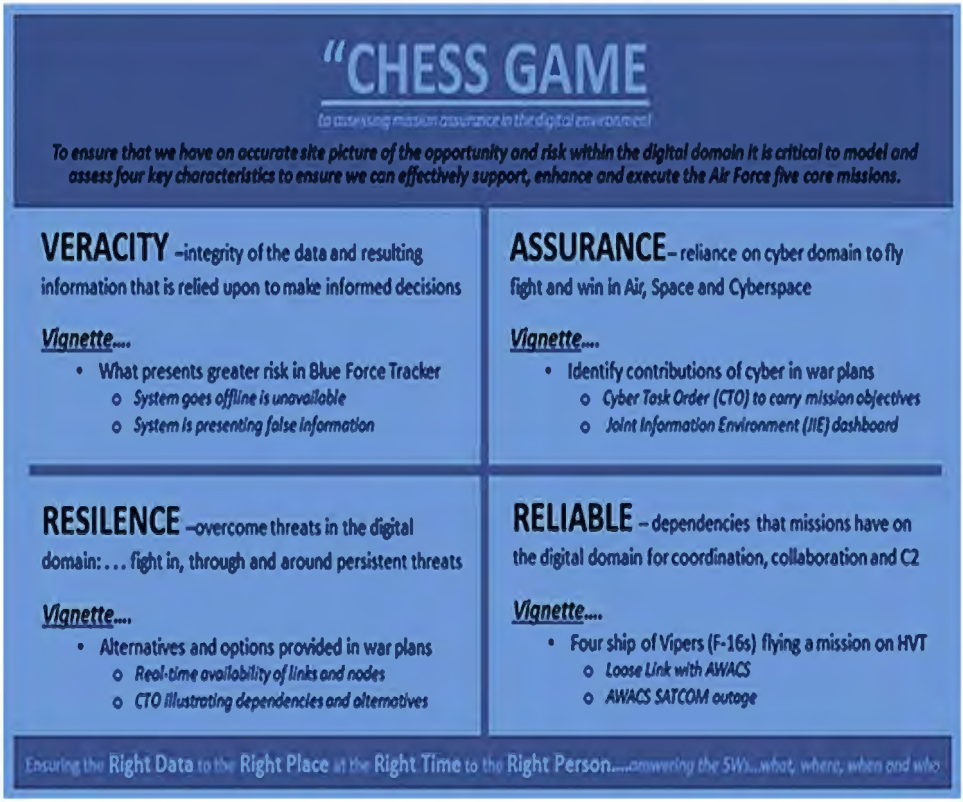
Ultimately, war is a strategic endeavor to leverage resources (*mass*) and the synchronies alignment of capabilities (*maneuver*) to overcome an adversary on the field of battle. Like the game of chess, the diverse capability and capacity of each piece on the board to serve different functions and as such are assigned different point values. Military planners likewise *ACE* tactical endeavors in order to obtain strategic objectives. However, as is the case in military operations, the result of winning the

battle not aligned to strategic objectives all too often provide a short-lived victory at the potential sacrifice to the overarching objective of winning the war. Like chess, we must ensure we take a holistic and strategically focused approach to why we engage in operations liken to capturing the king in order to garners victory on the field of battle. Thus, a holistic approach to operations serves to evolve situational awareness, provide the means to communicate and coordinate activities to ensure a collaborative and synchronized efforts that ensure the ability to make informed decision through a sound cognitive framework.



CHESS Match

Decisions based in fact require trustworthy data at rest, accessibility by providing the means for information in transit and the application to inform knowledge that evolves understanding. Through a structured well-defined process, we are able to mature what we do, how we engage and why actions are necessary to derive operation objectives that provide the essential strategic advantage necessary to fulfill organization goals. By understanding the relationships of information, we are able to assess the probability of future potential to derive success in all our endeavors. The quality of the data and our growing dependencies become a critical factor within the cognitive domain. For the quality of decisions is dependent upon having the correct data within the proper context to make informed decisions in full knowledge of actions taken against desired results to be achieved. Thus, the following is provided to provide a framework upon which to evaluate trustworthiness.



Once we know what we can depend upon we will be able to validate know, understand unknowns, and explore unknowables. Through this process that we are able to identify the veracity, dependencies and gaps of our knowledge. Through sound analytics that ability to access data veracity/quality, correlate information relationships/dependencies, and contextual knowledge that will assure our ability to *ACE* operations. It is thus critical to maintain a clear focus upon these four areas in order to ascertain at what level of confidence we can place in our cognitive process to *SEE* operations in a way that assures mission success.

Ultimately, we must determine at what level of confidence we can have in the veracity of data (*correctness*) and how it is presented (*correlation*) to establish at what level of trust we can place in it. To that end we must measure the return on resource value assessment for (RRAV) which is directly related to the veracity, assurance, reliability and resilience (*VARR*). It is therefore incumbent upon our technological tools provide actionable measures of pertinent information vital for mission assurance that informs the propensity for operational success on the field of battle.

Measuring the aforementioned criteria will reveal the potential for success given current readiness of personnel, equipment, and training. Properly aligned and allocated, resources that are effectively optimized will be brought to bear at a place and time of the Operational Commander's choosing. In the end, "*CHESS Match*" is intended to model and produce real-time cost benefit analysis of resource application providing real time feedback as to utilization and reliance and their ability to SEE available capabilities in sufficient capacity to sustain operations. Through a risk management framework assessed against available options and related opportunities, a cost benefit analysis will reveal potential for mission success in the rapidly evolving and quickly transformative age of knowledge.

TOOLS

This modeling and assessment tool will characterize the effects of the environment to operational imperatives. Real-time assessments will illuminate availability, reliability and dependencies of resources to inform and elevate awareness of opportunities and risk in this highly dynamic domain. This will inform vital efforts to plan, program and garner strategic advantage in this highly fluid environment. Given data is a perishable asset, we must be mindful of the need to monitor it in real time in order to inform, communicate and in turn make the right decision and the right time and place to serve our purpose.

Liken to the strategic approach to the game of chess, point value of winning specific battles does not ensure victory. Chess Match capitalizes upon the strategic principles outlined in the Art of War. Probabilistic computations inform options/opportunities to achieve operational objectives throughout all phases of the adaptive planning process. The strategic implications will inform what actions necessary to synchronize engagements that empower organizations to make informed decisions. It is this process that affords full knowledge and understanding of potential consequences from actions taken measured against results to be achieved in their ongoing efforts to actualize the benefits of wise decisions.

CAPABILITIES

C.H.E.S.S. **C**apabilities-based **H**olistic **E**nterprise **S**imulation **S**ystem

Chess Match was created to assess the growing threats within the digital domain. Whether it be to deny service, unauthorized access to manipulation of data, each can have severe and long-term consequences. The objectives of Chess Match are to assess the potentiality of falling victim to these threats in the past, present and future. It is intended to characterize vulnerability and identify the impact to the organization's ability to operate within this VUCA environment.

The digital domain is a highly dynamic and as such requires a wide array of mechanisms/tools to protect and defend against modern intrusions to assure the ability to command and control (*C2*) in order to communication, coordinate and collaborate (*C3*) in fluidity of this highly dynamic environment. However, the process of assessing the impact from new intrusions and establishing defensive measures is labor intensive and may result in overlaps of capabilities, and unforeseeable second and third order effects.

- ***COMMUNICATE*** *in this Volatile, Uncertain, Complex and Ambiguous (VUCA) environment to ensure data that is visible, accessible, understandable, trustworthy and Interoperable (VAULT)*
- ***COORDINATE*** *opportunities in an evolving information environment to remain informed in this adaptive environment*
- ***COLLABORATION*** *of capabilities integrating current capabilities*

Chess Match will provide a netcentric approach to assess, characterize, enlighten, empower and evolve (*ACE*) this *VUCA* environment in order to gain and maintain a strategic advantage by providing a measurable process to assess it by observing, orienting, and deciding, the best course of action that informs how one must act in an iterative approach that fulfills their objectives.

MODELING

M.A.T.C.H. M*odeling* A*ssessment to* T*est* C*haracterize* H*eal*

Industry has provided several technological tools to better elevate increased awareness and proves a common conduit to *C3*. As we become increasing dependent upon the digital domain, it is critical that we are mindful of the veracity, timeliness and availability of data and the resulting impact it has upon the cognitive process. Thus, the proposed modeling system will illuminate the dependencies and illustrate potential gaps that create unforeseen risk and resulting consequence to the ability to successfully accomplish their mission.

Adversary mission threads (*sequenced events to achieve particular outcomes in relations to: possible, potential, probable, and propensity [4Ps] of attack)* and mission threads need to be defined in these spaces. The thread should include people, processes and equipment (*e.g., communications, computers, capabilities and capacity [4C]*) defined to some level of granularity which can be emulated in a time-based simulation. The prioritized mission threads will be defined by numerous threads within the simulation, to assess the causality of lower priority to the organization. This effort will link the dependencies of mission threads to ascertain the Threat Framework in an effort to provide a means to manage risk in a way that elevates awareness of potential impacts to mission assurance.

The initial driver for the response will identify gaps, illuminate opportunities to evolve operations to overcome risk in and through the digital domain. This environment triggers strategic points to illustrate those actions that must be taken to achieve desired operational objectives. Thus, modeling will establish the effects and resulting impact of multiple/concurrent attacks and those actions necessary to adequately defend *(expectation management)*, along with the potential second/third order effects on other mission threads *(consequence management)* within the information environment. Readiness indicators for each component in the mission thread can be extracted from current sources to inform those influencers that result in effecting operations.

With increased dependencies upon the digital domain the ability to *SEE* mission objectives is highly dependent upon our ability to visualize data and the current state of interoperability to understand the interdependencies that effect collaboration. Chess Match will identify the potential impact from current threat that pose a risk to data manipulation (*veracity*), confidence in what they are seeing (assurance), knowledge of those options (*situational awareness*), necessary actions to overcome threats (*resilience*), and potential impact of denial of service (reliability). To achieve a clear understanding as to the cause and consequences of these actions, it becomes imperative that a holistic and strategically focused approach toward modeling and assessing of those activities is

presented to fully appreciate the imminent implications in in this evolving environment. Thus project "*CHESS MATCH*" will model and produce analyses to help manage risk and capitalize on opportunities to ensure the necessary resiliency is in place to overcome current and persistent threats to operate unencumbered in this VUCA environment. It is therefore an imperative to conduct ongoing automated modeling and associated simulation of scenarios to *ACE* operations.

Through a systematic approach to test and evaluate second/third order effects. The resulting simulation would provide a multi-phase attack scenario-based modeling to ascertain the potential impact of and from possible counter attack scenarios to evaluate the effectiveness of available countermeasures. In time, temporal analysis will illustrate the necessary trends to illuminate the adversary's motivation and intent. It is from these results that we will be able to learn from the interdependencies to identify options and provide opportunities to adapt and overcome the *VUCA* nature of our interlinked world environment. For only through this interaction, will we be afforded awareness of new alternative actions to adapt and overcome obstacles in our ongoing efforts to achieve mission success. Thus, the benefits of autonomous processing provided by *AI* affords the essential frame work to know and understand available options and opportunities derived *ML* to know the Art of the Possible within the self-imposed confines of the Science of the Probable.

MEASURES

The resulting assessments will provide a characterization of the digital domain from which to informed fact-based decisions in fully understanding of their probable and potential cost benefits to the organization. Their understanding of circumstance and the confidence they have on their trustworthiness of data at rest, reliability of access to information in transit, and assurance of applied knowledge that evolves understanding will ultimately illuminate the availability of data, reliability of information and dependency of knowledge. It is this knowledge that will illustrate potential outcomes of the analytical analysis throughout the planning and programing process to assure mission success.

The resulting process will aid in the maturation of operations to provide the necessary flexibility to overcome multiple and concurrent risk in this dynamic environment. Throughout the modeling process the adversary will be simulated to validate knowns, questions unknowns and explore unknowable's through an iterative process of Observation, Orientation, and Decisiveness to ensure those Actions are enacted in a way that affords the opportunity to ACE operations throughout all phases with an intent of learning (*OODA Loop*) and evolving to gain and maintain strategic competitive advantage. The output of the simulation will be an effective and resilient approach to prioritize and synchronize mission threads in a step/counter-step approach to adapt and overcome in this *VUCA* environment. Ultimately, the modeling will illustrate gaps in capabilities, identify current risk inherent in operations, and infer those options and opportunities derived from a cost/benefit assessment that illuminates causality and the resulting consequence of the second/third order effects.

- ***VERACITY*** *quality of data relied upon to make fact-based decisions*

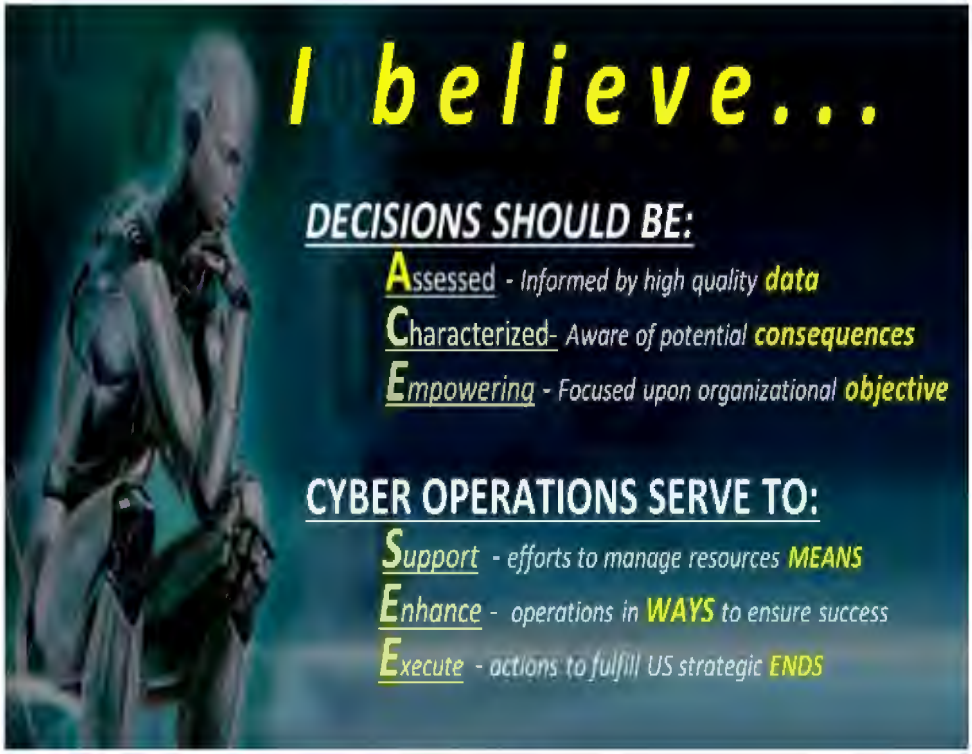
- ***ASSURANCE*** *consistency of measurable actions against outcomes*

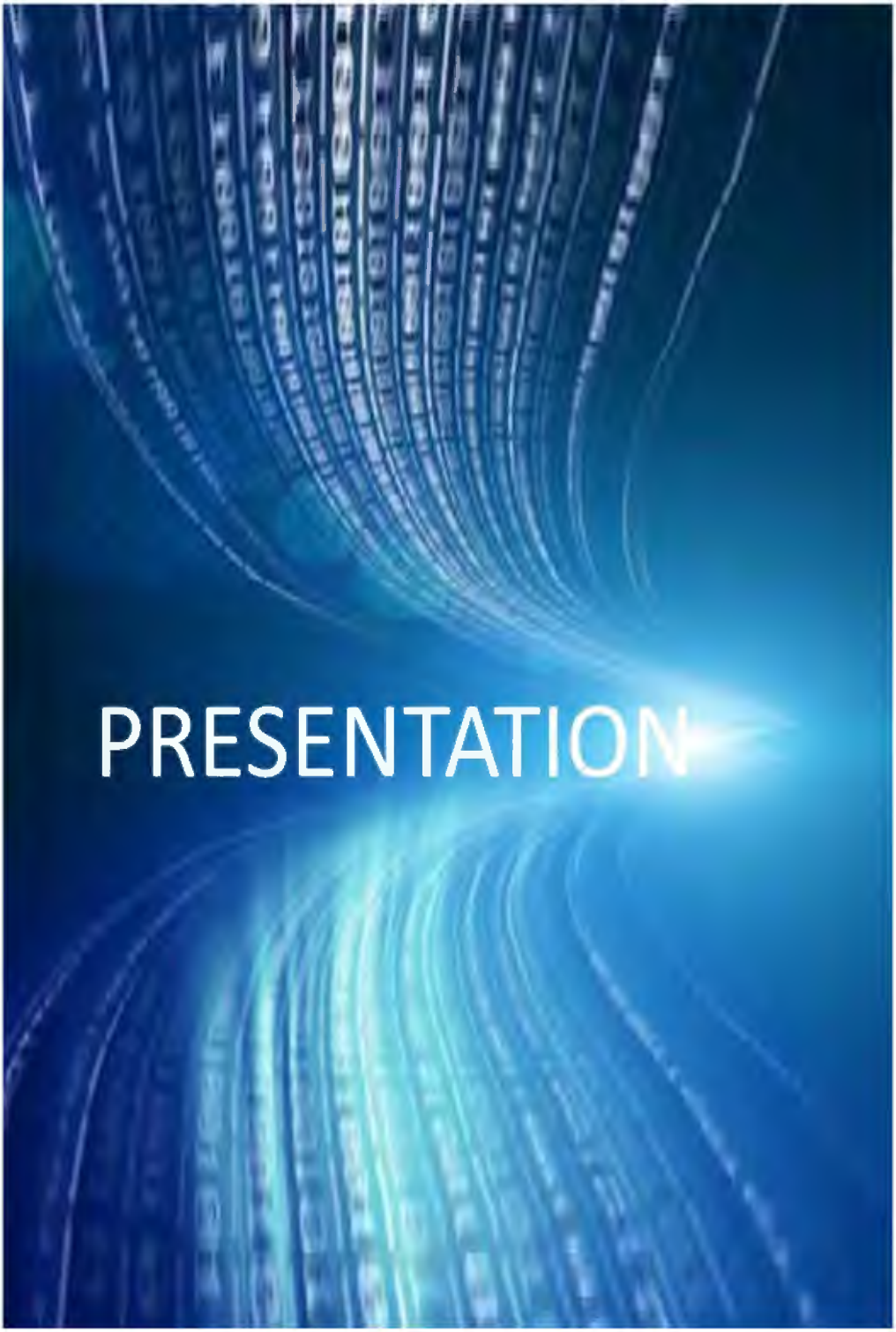
- ***RESILENCE*** *the ability to be adaptive in a pervasive environment*

- ***RELIABILITY*** *ability to provide capabilities in a VUCA environment*

ADVANTAGES

The necessity to operationalize data instead of just manage it speaks to the ability to move beyond just storing it to the criticality of unlocking the *VAULT* to understanding. This "enduring" capability is essential if we are to be able to *SEE* mission threads against potential threats in our ongoing efforts to plan and program in a *VUCA* environment. To these ends, it is critical that we effectively identify and test alternatives to provide sufficient flexibility that affords tertiary courses of action if we are to remain fluid in our approach in this interdependent environment. By exploring the forbearance of opportunities and testing and evaluate their propensity for success, determining readiness and the results of risk management measures, we will derive assurance as to the organization's ability to take appropriate actions that achieve their overarching objectives. Ultimately it is incumbent on leaders to understand both the cost/threats and benefits/opportunities if they are to proceed in a manner that achieves their strategic intent.

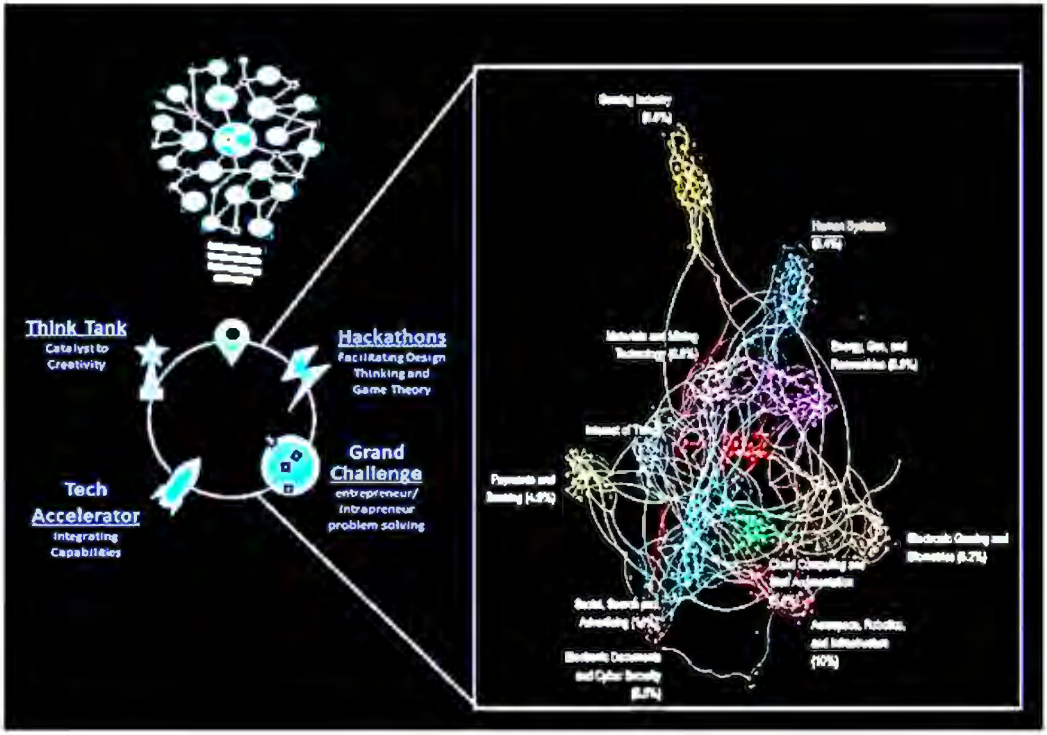


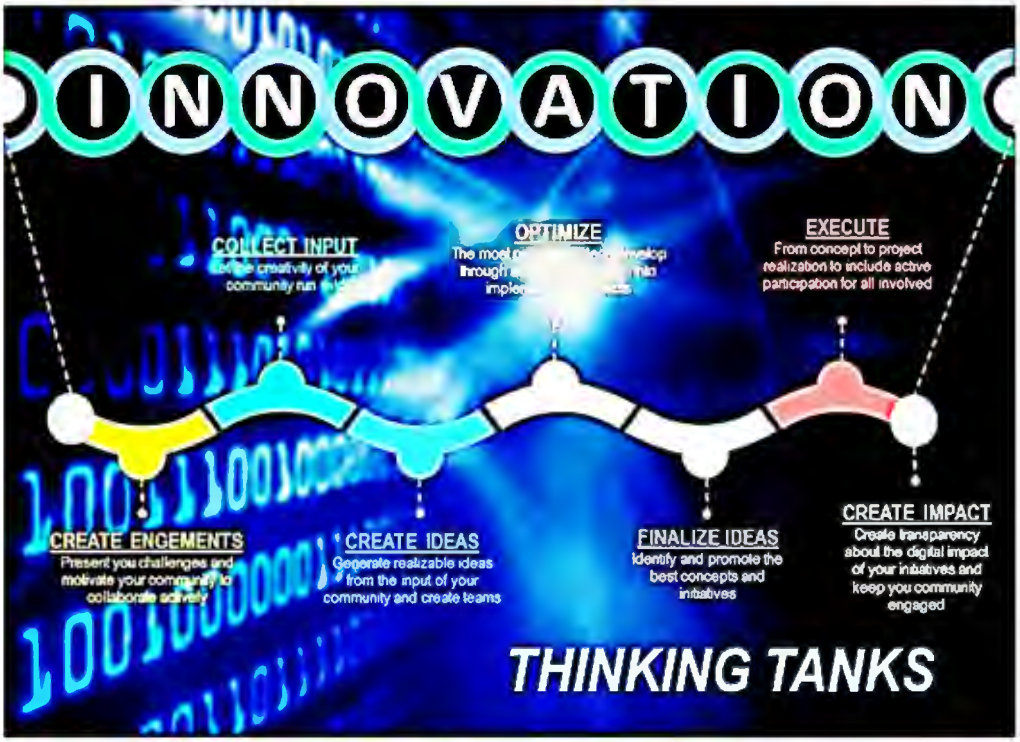

PRESENTATION

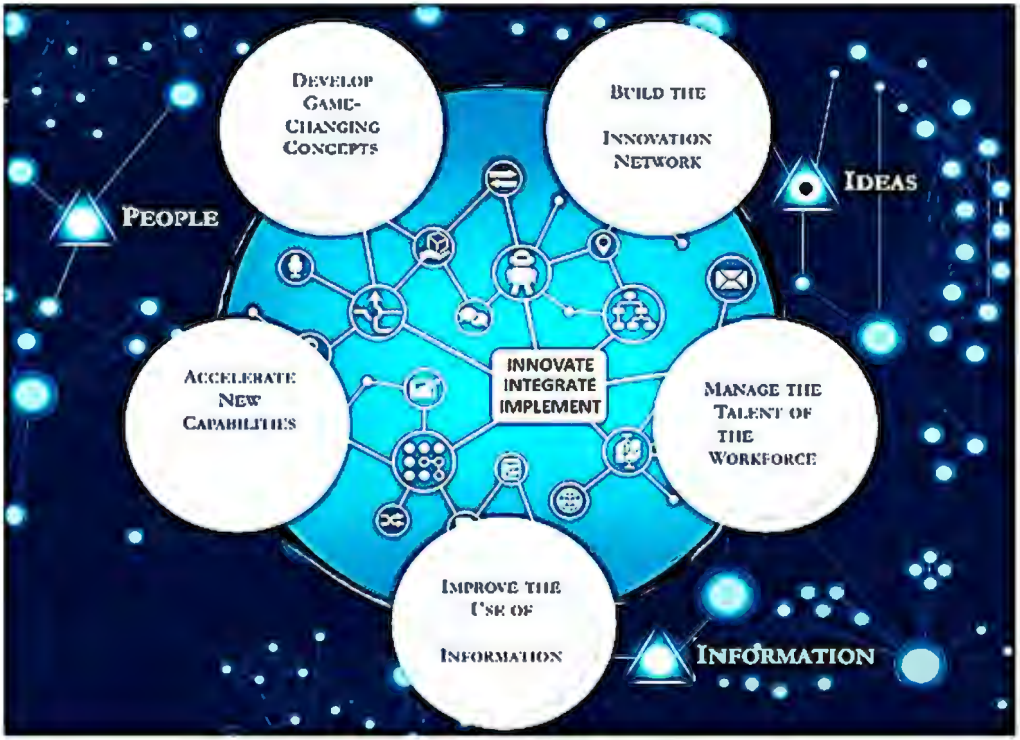
TAB 20

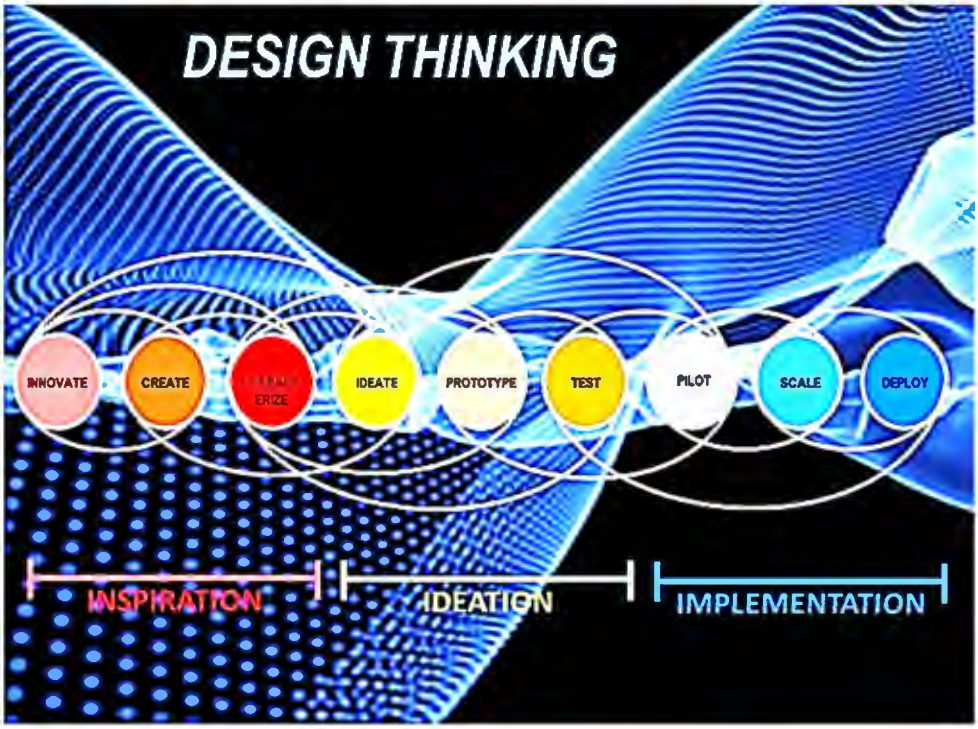
INNOVATION PRESENTATION

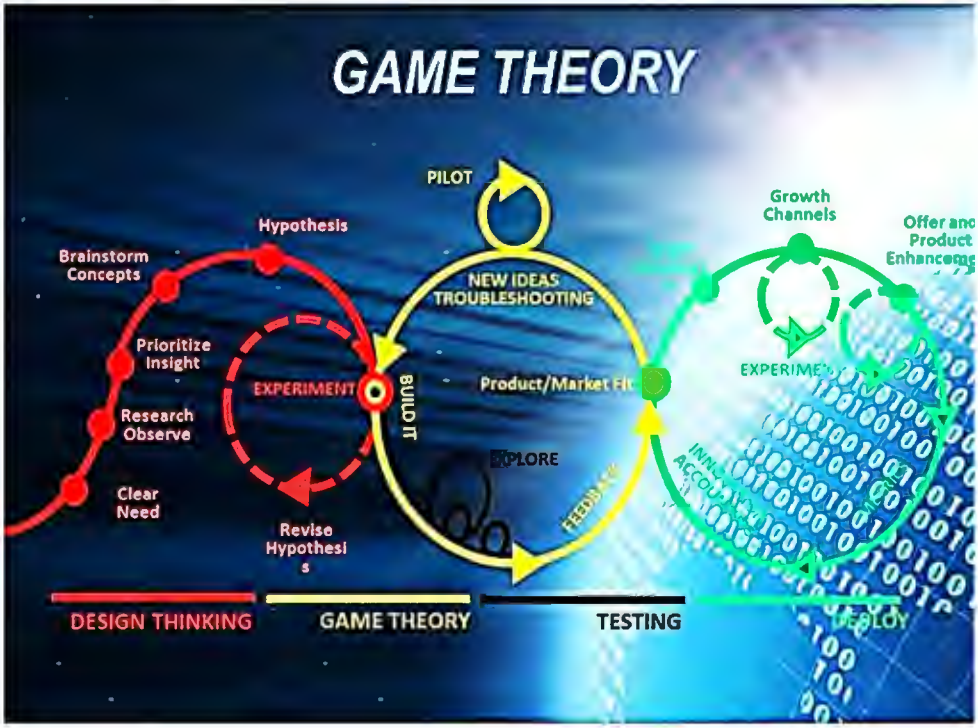

INNOVATION


Think Tank
Catalyst to Creativity
Hackathons
Facilitating Design Thinking and Game Theory
Grand Challenge
entrepreneur/ intrepreneur problem solving
Tech Accelerator
Integrating Capabilities


INNOVATION
COLLECT INPUT
OPTIMIZE
EXECUTE
From concept to project realization to include active participation for all involved
CREATE ENGEMENTS
Present you challenges and motivate your community to collaborate actively
CREATE IDEAS
Gegerate realizable ideas from the input of your community and create teams
FINALIZE IDEAS
Identify and promote the best concepts and initiatives
CREATE IMPACT
Create transparency about the digital impact of your initiatives and keep you community engaged
THINKING TANKS


DEVELOP GAME-CHANGING CONCEPTS
BUILD THE INNOVATION NETWORK
PEOPLE
IDEAS
ACCELERATE NEW CAPABILITIES
INNOVATE INTEGRATE IMPLEMENT
MANAGE THE TALENT OF THE WORKFORCE
IMPROVE THE USE OF INFORMATION
INFORMATION

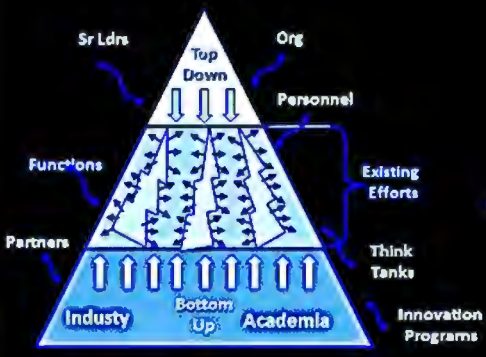

DESIGN THINKING
INNOVATE
CREATE
IDEATE
PROTOTYPE
TEST
PILOT
SCALE
DEPLOY
INSPIRATION
IDEATION
IMPLEMENTATION


GAME THEORY
PILOT
Hypothesis
Brainstorm Concepts
NEW IDEAS TROUBLESHOOTING
Prioritize Insight
EXPERIMENT
BUILD IT
Research Observe
Product/Market Fit
EXPLORE
Clear Need
Revise Hypothesis
Growth Channels
DESIGN THINKING
GAME THEORY
TESTING

TRANSFORMATION

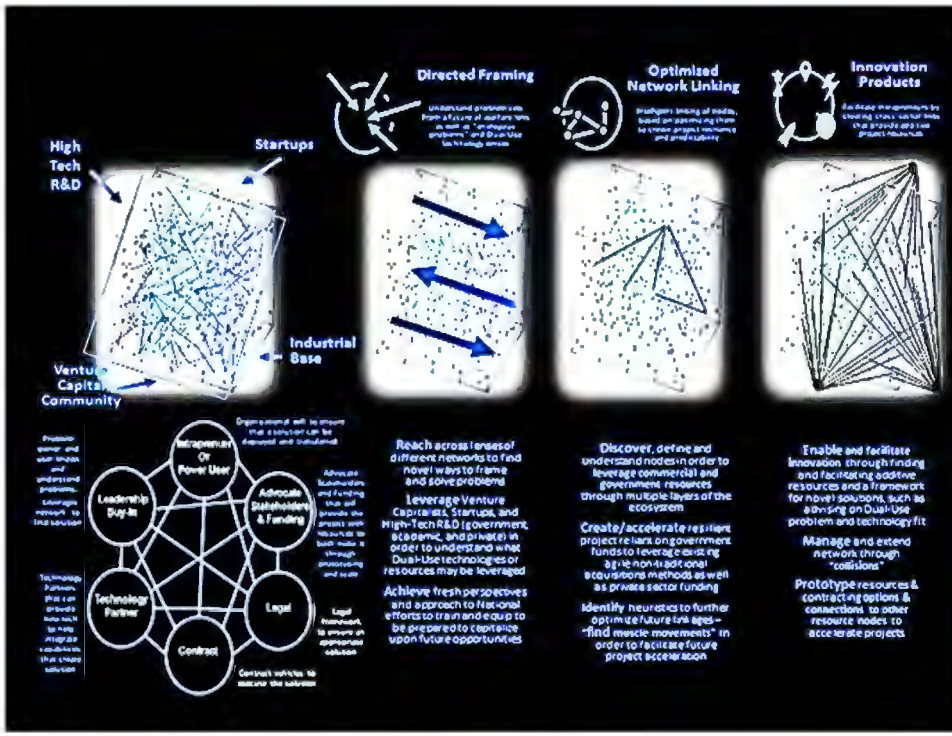
If you want to do this . . — Leadership

. . you also need to address this — Programs/Processes



Synching Stakeholders & Leveraging Quick Wins to Accelerate Innovation

Institute/Reinforce the Multi-faceted Attributes of an Innovative Enterprise



TAB 21

MODERNIZATION PRESENTATION

MODERNIZATION

COORDINATE
COLLABORATE
COMMUNICATE

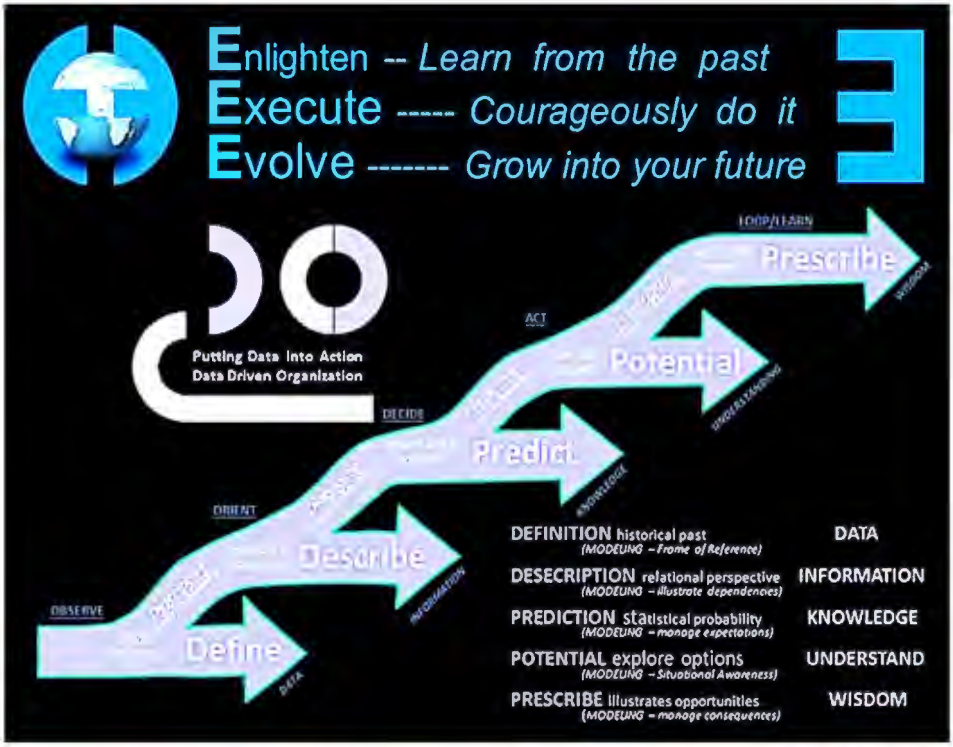
MODERNIZATION

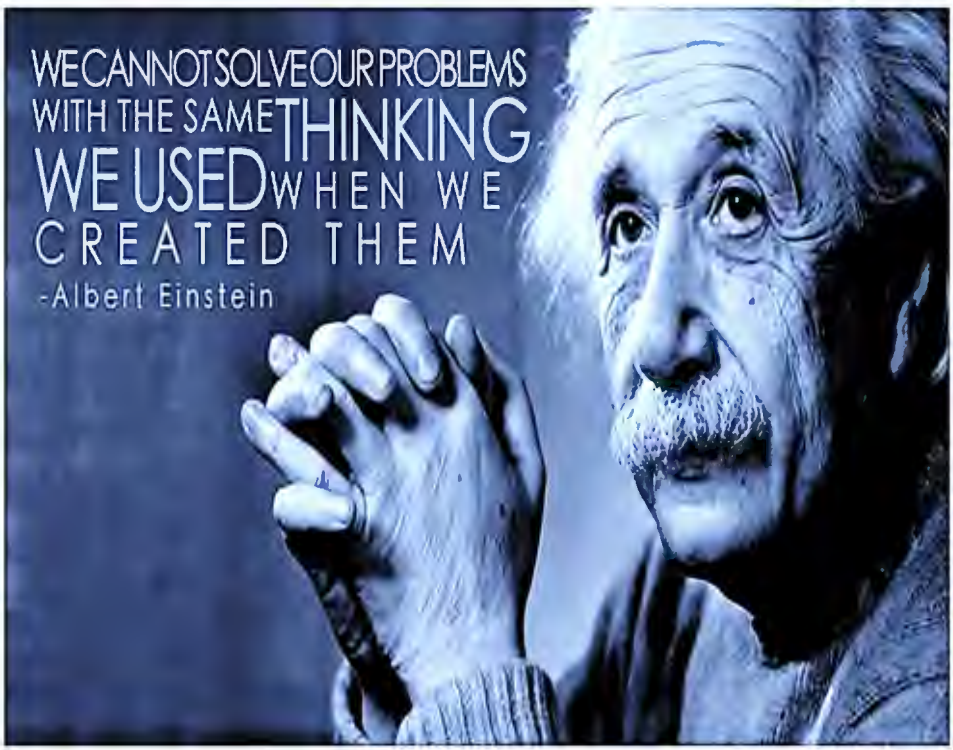
Transformation meets Innovation

GOALS	OBJECTIVES	REQUIREMENTS	TECHNOLOGY

CONNECTIVITY:
• High
  ◦ Resilience
  ◦ Reliability
• Low
  ◦ Latency
	DATA AT REST:
	• DISA/Data Center
	• Cloud
	  ◦ Internal
	  ◦ External
		COMMUNICATIONS:
		• Video telecom
		• Telephone
		• Tweet
		• Text
		• Email
			STORAGE:
			• ENCRYPTE
			• CHARD

SECURE: • Access/Multi-Level • Authenticated • Encrypted	**DATA IN TRANSIT:** • Copper/Fiber • Cellular • SatComm	**DATA:** • Web • Office	**SECURITY:** • SEADE • OS2
FUNCTIONAL: • Remote Access • Synchronized • Available	**DATA IN APPLICATIONS:** • Office Suite • Calendar • Email	**APPLICATIONS:** • Office • GPS • Email	**APPS:** • OFFICE • COMMS • IOT


Enlighten -- Learn from the past
Execute ----- Courageously do it
Evolve ------- Grow into your future
Putting Data into Action
Data Driven Organization
OBSERVE
ORIENT
DECIDE
ACT
LOOP/LEARN
Define
Describe
Predict
Potential
Prescribe
DEFINITION historical past (MODELING – Frame of Reference) DATA
DESECRIPTION relational perspective (MODELING – illustrate dependences) INFORMATION
PREDICTION statistical probability (MODELING – manage expectations) KNOWLEDGE
POTENTIAL explore options (MODELING – Situational Awareness) UNDERSTAND
PRESCRIBE illustrates opportunities (MODELING – manage consequences) WISDOM


WE CANNOT SOLVE OUR PROBLEMS
WITH THE SAME THINKING
WE USED WHEN WE
CREATED THEM
-Albert Einstein

TAB 22

FUTURE OF AI PRESENTATION

THE FUTURE OF

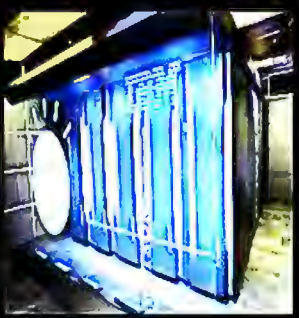
ARTIFICIAL INTELLIGENCE

ANALYTICS ... INFORM

MACHINE LEARNING

to

COGNITIVE DECISIONS



Antikythera Mechanism

Discovered in 1900's, an ancient analog "computer"

- Used to predict the movement of the moon and stars
- Dates back to somewhere between 100-205 BCE

Eighteen gears in an open system establish the interrelationships between desperate data to formulate contextual correlations

WHAT IT IS: DEFINITION *of* AI *and* MACHINE LEARNING

Characteristics:

- **THINK** - *logical reasoning*
- **UNDERSTAND** - *knowledge representation*
- **AWARENESS** - *planning and navigation*
- **COMMUNICATE** - *natural language processing*
- **CONSCIOUS** – *Perception, Perspective and Paradigms*
- **LEARNING** – *Adaptive and Evolving*

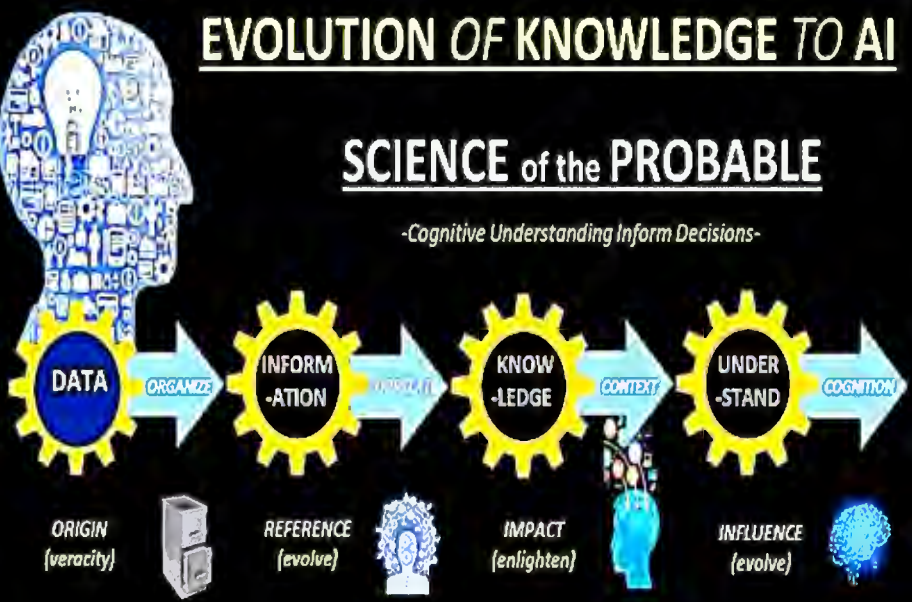
Methods:

- **"Symbolists"** *logical reasoning based on abstract symbols*
- **"Connectionists"** *build structures inspired by the brain*
- **"Evolutionary"** *use methods from previous observation*
- **"Bayesians"** *use probabilistic inference*
- **"Analogizers"** *extropolate from previously seen cases*

EVOLUTION *OF* KNOWLEDGE *TO* AI

SCIENCE of the PROBABLE

-Cognitive Understanding Inform Decisions-



WHAT IT IS: DEFINITION of AI and MACHINE LEARNING

AI defined as a system that:
- *Exhibits behavior requires intelligence*
- *Rationally solving complex problems*

Taxonomy are systems that:
- *Understand relationships* (e.g., cognitive architectures/neural nets)
- *Act like humans* (e.g., pass the Turing test via natural language processing; knowledge representation, automated reasoning, and learning)

Rationality
- *Think like Humans* (e.g., logic solvers, inference, and optimization)
- *Goal directed Acts* (e.g., intelligent software agents embodied goals via perception/planning/reasoning/learning/communicating/decision-making/acting)

Result
- *Knowledge Acquisition* (Context)
- *Reasoning* (Consequence)
- *Consciousness* (Evolving)

https://www.whitehouse.gov/sites/default/files/whitehouse_files/microsites/ostp/NSTC/preparing_for_the_future_of_ai.pdf

What to Expect in the Future for AI

1. **Deeper personalization:**
   - *Adapt to past preference*
   - *Predict future opportunities*
   - *Adjust to inflection*
2. **Neural networks on mobiles:**
   - *Object association*
   - *Speech recognition*
   - *Face detection*
3. **Real-time speech translation:**
   - *103 text languages*
   - *32 speech languages*
4. **Health and fitness:**
   - *Assess and recommend*
   - *Identify and diagnose*

EVOLUTION of AI and the APPLICATION of MACHINE LEARNING

DARPA GRAND CHALLENGE

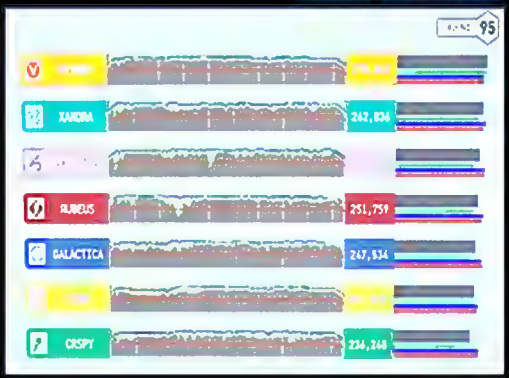
CYBER AUTONOMOUS SYSTEMS

Reasoning/Rational/Resilence

CYBER GRAND_CHALLENGE

Final 2016 Teams:

1. **Mayhem** – Carnegie-Mellon University
2. **Xandra** – TECHx, Gramma Tech & Ithaca
3. **Mechanical Phish** – Shellphish
4. **Rubeus** – Raytheon and Deep Red
5. **Galactica** – CodeJitsu
6. **Jima** - CSDS
7. **Crspy** - disekt



EVOLUTION of AI and the APPLICATION of MACHINE LEARNING

DARPA GRAND CHALLENGE

AUTONOMOUS VEHICLES

- 2004: A 150-mile route with no robot vehicles finishing the route
- 2005: Course w/ 100 sharp turns and three tunnels finished by:
  - *Stanley* 6:54 – *Stanford University*
  - *Sandstorm* 7:05 – *Carnegie Mellon*
  - *Highlander* 7:14 – *Carnegie Mellon*
  - *Kat-5* 7:30 – *Gray Insurance*
  - *TerraMax* 12:51 – *Oshkosh Truck*
- 2007: A 60-mile urban course with traffic lights and other vehicles
  - *Tartan* 4:10 – *Carnegie Mellon*
  - *Standford* 4:20 – *Stanford University*
  - *VictorTango* 4:36 – *Virginia Tech*
  - *MIT* 6:00+ - *MIT*
  - *Ben Franklin* *NRT - University of Pennsylvania*
  - *Cornell* *NRT – Cornell University*
- 2012: Robitics Challenge
- 2013: Fast Adaptable Next-Generation Ground-Vehicle

URBAN CHALLENGE

HUMAN INTELLIGENCE - RATIONALITY

ART of the POSSIBLE

-Paradigms shape one's Perspective -

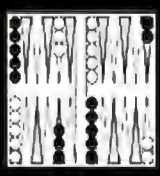
FOR → **SA** → **WISE**

Frame
Of
Reference

Situational
Awareness

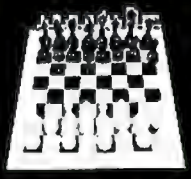
Wisdom
Insightful
Shared
Enlighted

EVOLUTION of AI and the APPLICATION of MACHINE LEARNING

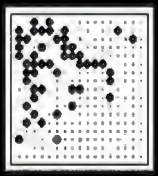


1992 – Backgammon

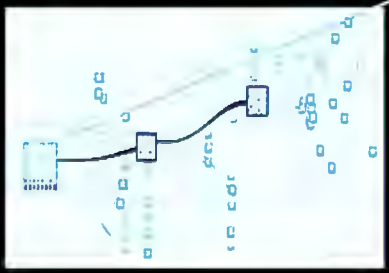
1992 – Drafts



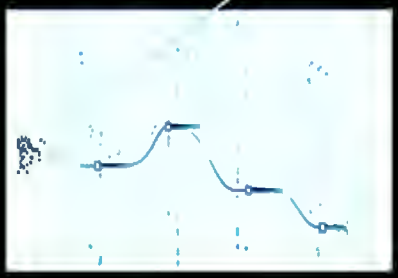
1997 – Deep Blue



2016 – GO



Chess must compute 20 moves for each position



GO must compute 200 moves per position

Goal Directed Extrapolation

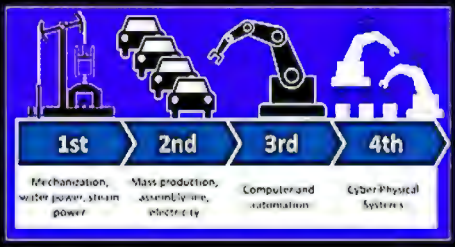
EVOLUTION of AI and the APPLICATION of MACHINE LEARNING

Robotics:

- *Manipulators*
- *Mobile*
- *Humanoid*

Capabilities:

- *Service*
- *Transportation*
- *Delivery*
- *Manufacturing*



What must be done to advance AI

- **MASS**
  - *2.5 quintillion bytes of data is created every day*
  - *Total accumulation of data doubles every two years*
- **COMPLEXITY**
  - *Statistical Algorithms*
  - *70-80% data is unstructured*

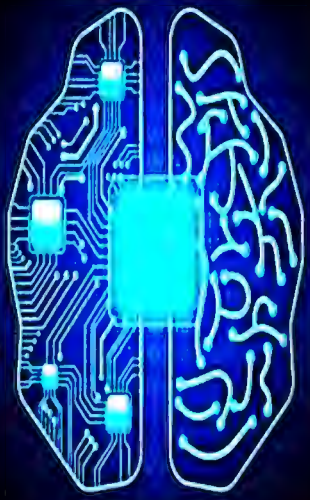
- **CONTEXT**
  - *Understand the structure of the data*
  - *Correlate relationships and dependencies*
- **CAUSALITY**
  - *Iterative approach to identify influences and effects*
  - *Assessment of interdependencies and reliance*

- **CONSEQUENCE**
  - Neural networks correlate complicated patterns
  - Predict and prescribe possible outcomes
- **POTENTIAL**
  - *Temporal analysis to ascertain outcomes*
  - *Predictive and prescriptive analysis*

What to Expect in the Future for AI

Narrow AI specific application areas:

- *language translation*
- *self-driving vehicles*
- *image recognition*
- *playing strategic games*



Foundational General Theory:

- *Articulation of a general mathematical framework*
  - *independent of any particular machine learning method*
  - *provides quantifiable and generalizable measures of learning*
  - *fundamental limits across*
    - *Supervised*
    - *Unsupervised*
    - *reinforcement learning*

Consideration/framework:

- *The type, quality, and relevance of the signals available from the data*
- *The structure, complexity, and observability of the target task/concept space*
- *Task performance metrics as well as the interactions and trade-offs*

Capabilities/performance:

- *Supervised learning from example input/output pairs*
- *Unsupervised learning from only input data*
- *Reinforcement (policy) learning from reward/penalty signals*

Research Area address questions:

- *What are the performance limits of methods/architectures that combine the algorithms from the above categories?*
- *For what classes of problems are these algorithms optimal or near the performance limit?*

ABOUT THE AUTHOR

TAB 23

ABOUT THE AUTHOR

NEVIN "*Mustang*" TAYLOR

Colonel Nevin "Mustang" Taylor is a decorated combat veteran with a distinguished 32-year military career that includes leading one of the nation's largest logistical activities following the initial cessation of hostilities in Iraq. An Air Force Senior Officer with a decade of command time, he has served as the Sr. IMA to the Deputy Under Secretary Policy Integration and Chief of Staff, Military Advisor to both the Under Secretary of Defense Policy and Under Secretary of Defense for Acquisition, Technology and Logistics in the Office of the Secretary of Defense. During his tenure, he has chaired the Strategic Advisory Board for USAF Task Force Cyber, and led the DoD CIO's Enterprise Services and Data Panel Tiger Team Enterprise Search and Catalog.

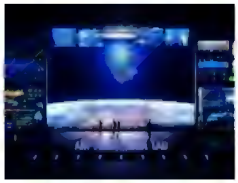
A Harvard University National and International Security and Senior Executive fellow as well as a Cyber Policy credentialed professional he is one of MIT's Big Data and Social Analytics credentialed expert and technology anti-tamper professional. A National Defense University Credentialed Chief Information Officer and lecturer of "The Power of Information." This Georgetown University's Transformational Leadership alumni serves as the State Department's Foreign Service Institute orator lecturing on "Leaders Inspire T.H.E.M." This credentialed Stanford University's Strategic Decisions Management and Oxford University Planning Foresight, Innovation, Knowledge, and Change Management certified professional has served as the White House international visionary on Artificial Intelligence and Machine Learning and national lead for the Camp David Summit on developing a data driven organization.

An innovative leader and seasoned data, cyber, and space professional in corporate, public and military service, he has relocated two Air Wings, built an air base, and oversaw the standup of the first space communications squadron coupled with the nation's only Joint Space Operations Center. He has served as the Deputy Regional Director Liaison Officer Air Force Academy, Honor Guard Commander for President Ronald Reagan at his Presidential Library, Naval Destroyer modernization technologist, Cyber Subject Matter Expert underway onboard the USS Carl Vinson and Deputy Director Warfighter Integration Senior Executive Service bridge.

He is currently the Co-Chair of the United States Data Cabinet and the four working groups; Policy, Governance, Talent, Analytics and the NSTC's Data Science Interagency Working Group. Colonel Taylor also serves on the Air Staff as the Air Force Deputy Chief Data Officer, Deputy Chief Technology Officer for Special Programs, and Cyberspace Strategy and Policy IMA. A published author, he is currently working to support the development of a strategic framework to operationalize a data driven organization. Additionally, he is one of the founders of the Secretary of the Air Force's AFWERX innovative initiative to transform and modernize their ability to Fly, Fight and Win our Nation's Wars.

TAB 24

PAST PROGRAMS


1981 – Developed, coded and tested an educational program on a Texas Instrument TI994A to teach and test students on reading and speaking German

1982 – Programed an Apple Series II basic math curriculum with quizzes, tests, to assess and adapt teaching styles to tutor students from initial math skills culminating in completion of college algebra

1985 – Operationalized TTC-39 from IOC to FOC for combat tactical communications environment

1985 – AF modernization program backward compatible Zenith 100 5MNz Intel 8088 processor transition to a Z-248 12MHz Intel 80C286 processor workforce integrating automation systems

1986 – Developed hydrogen accumulator for Tesla's HHOs brown gas extraction system utilizing an electrolysis catalytic process to produce hydrogen and oxygen on demand from tap water

1988 – Created a Loran-C Khz long range navigation interface to provide autonomous steerage for a 50-foot sail vessel featured on the front page of the Yachting World Magazine

1989 – Initial electromagnetic parking sensors to include eventual Ultrasonic Transducers providing short/long range spatial orientation. Reduced latency evolved an initial autonomous CEED vehicle

1990 – Overseeing split operations of AF technology model installation integrating a digital switch, developing Network Control Center, and operationalizing a Banyan Vines token ring network

1991 – Integrated CPU overdrive from a P54C to doubling performance through application of FPU

1993 – Establish one of five national regional Air Force Data Centers while concurrently modernizing mainframes to a server based operational component of mini computers

1994 – Developed deployable secure communications center leverage Sahara LTE/STU-III/Z184-97

1995 – Preliminary test/implemented a commercial voice mail systems for the USAF Academy

1998 – Designed/deployed a weapons integration server for USS destroyer modernization program

1999 – Deployed on USS Carl Vinson for a C2 technological assessment to integrate capabilities

2001 – Technologist for Nintendo to deploy Dolphin, the next evolution platform/console

2003 – Created the Computer Transportation Assisted Secure Network (*CTASN*) nodal acquisition wireless/cellular interfacing system providing monitoring, navigation and autonomous operations

2004 – Integrated CTASN into Universal Transport's CEED R&D to produce an automatous vehicle

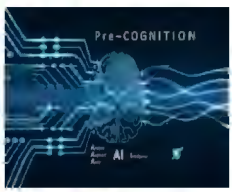
2004 – Transition the US Space Fence from the Navy to the Air Force to detect/track orbital objects

2005 – CONOP development establishing/integrating the Joint Space Operations Center (*JSPOC*)

2006 – Est self-evolving system to provide a common operational user definable space ops picture

2007 – Stood up 614SCC which consolidate operational C2 of Joint Space Forces to evolve Space SA

2007 – Consolidated all space operations into JSPOC under the operational control of USSTRATCOM

2008 – Established a framework for data driven organization to leverage SA to evolve knowledge into understanding to operationalize data as a vital strategic asset for competitive advantage

2009 – Facilitated establishing the Cyber and Space offices for the DoD Policy Undersecretary

2010 – Oversaw establishment of DoD AT&L Asst Secretary of Energy/Installations/Environment

2011 – Director of Staff overseeing redeployment of forces from Iraq culminating combat in Iraq drawing Operations New Dawn culmination of the largest logistical movement in military history

2012 – Created $2.5M Decision Support Tool, to align AF Program Elements to Resource allocation analyzing temporal analytics to optimize effectiveness maximizing efficiencies saving DoD $14B

2013 – Created doctrine to leverage information dominance cyber ops modernization for the POM

2014 – Catalyzed PBR integrating C4 for 35 net centric sys saving $850M in FY and $3.5B over FYDP

2015 – Aided development of a Security Encapsulated Application Data Enclave (*SEADE*) framework

2015 – Est ops ability (*Chess Match*) to assess predictive model, characterize prescriptive modeling against a RMF framework to identify options/opportunity to adapt/overcome threats

2016 – Created an adaptive tool (*OS2*) to leverage a flexible virtual Application Data Center (*VADC*) to realign an Enterprise-Level Security (*ELS*) approach to characterize, protect and assure DoD data

2016 – Stood up White House Data Cabinet in EOB/OSTP to leverage CDO to leverage data ops

2016 – Camp David Data Collaboration Summit Co-Chair; established the National DRM, DMM, and CDORR for the USDC and DSIWG

2016 – White House SME on AI and ML to 50 UK CEOs, Google London, Royal Society, and US Secretary of Small Business

2016 – Ops Lab Rat identifying quantifiable measure/characterization of cyber domain certified by the Air Force Research Laboratory

2016 – Constructed a system to identify Behavior Base Network Modeling (BBNM) to mgt ops risk

2017 – Chartered Sr. Fed. CDOs for NSTC to identify collective data challenges and best practices

2017 – DoD Tiger Team Lead est. Enterprise Search and Catalog framework to operationalize data

2017 – US Data Cabinet Co-Chair and Exec Director/NSTC Data Secretariat/Data Steering Committee

2017 – Established the AF Data Office and AF Data Laboratory to optimize and evolve mission ops

2017 – SG pioneer; stood up AFWERX on bequest of the SECAF, CSAF, VCSAF and A5/8 to drive innovation recognized by the United States Vice President

2017 – National Security Council Cyber SME integrating a whole of government approach to sec ops

2017 – Est innovative prgs: Electric Parameter Wall, JCN cognitive systems, C2abit, CAWS, and MSC


TAB 19

FUTURE PROGRAMS

CONSIDERATIONS	OPTIONS OPPORTUNITIES OUTCOMES	EVOLVE
CAUSALITY	PRESCRIBE PREDICT POTENTIAL	EMPOWER
CONSEQUENCES	DISTINCTIONS DIFFERENCES DIFFERNENTIALS	ENLIGHTEN

ACCESS

THINK – POTENTIAL
TRY – PRODUCTION
TEST – PLATFORMS

CHARACTERIZE

VAM Realities
Virtual/Augmented/Mixed Realities

PSTM
Prototype/Simulate/Test/Model

SIMULATE

TAB 20

FUTURE PUBLICATIONS

TEACH	OBSERVE ORIENT DECIDE ACT LOOP	THINK TRY TEST TRUST	IDEATE INNOVATE INTEGRATE IMPLEMENT	CREATE CULTIVATE CALLABORATE CULMINATE	STRATEGIC OPERATIONS
HELP	OBSERVE ORIENT DECIDE ACT LOOP	HUMBLE HONEST HEAR HONOR	*Who you are?* *Have you engaged?* *What you say?* *Why you said it?*	REAL RELIABE REPOIRE REACT	FACTS RELATIONSHIPS
EMPOWER	OBSERVE ORIENT DECIDE ACT LOOP	ENLIGHTEN EVOLVE ENGAGE ENACT	PURPOSE POTENTIAL PRIOIRITY PROGRAMTICS	OBJECTIVES OPPORTUNITIES OPTIONS OUTCOMES	STRATEGIC OPERATIONS
MENTOR	OBSERVE ORIENT DECIDE ACT LOOP	MEASURE MOMENTUM MOTIVATE MATRICULATE	How are we doing? Where are we going? Why is this important? How do we align it?	ASSOCIATE ADVISE ASSIST ALLOCATE	FACTS RELATIONSHIPS

THIS IS I.T.


Mustang