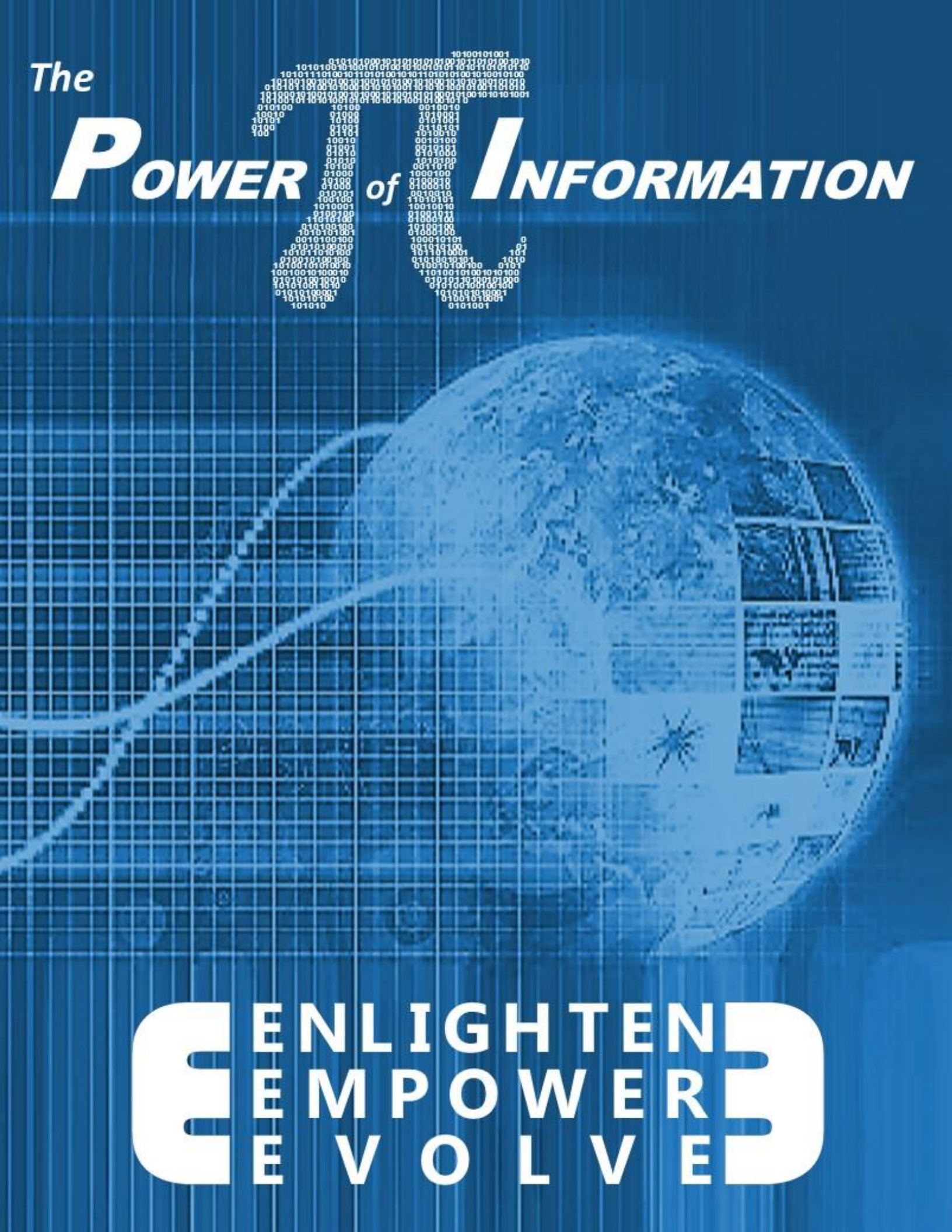
The Power of Information



ENLIGHTEN
EMPOWER
EVOLVE

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OUTLINE

OVERVIEW

TAB 1 – The Answer is the Right Question

Utilize data that is organized into information that contextualizes knowledge to evolve understanding. Too often this is looked at as an endeavor for answers without the wisdom to understand the implication on the future. It's a cognitive endeavor to prepare and transform the environment with the right questions to explore opportunities.

TAB 2 – Evolving Knowledge Into Understanding

Establish the framework upon which to understand how our influence on the environment effects it. It begins to address the consequence of causality which provides the means to be act proactively.

TAB 3 - Knowledge that Surpasses Understanding

A framework to THINK (cognition) and UNDERSTAND (awareness) in a proactive approach to apply analytics that operationalizes data and unleash the power of information in order to actualize the strategic value of data/information/knowledge.

TAB 4 - Age of Knowledge

Assure visible, accessible, understandable linked and trustworthy (VAULT) data at rest, in transit, during application and throughout the application of distributed information storage.

TAB 5 - Taking the Fiction Out of Science Fiction

Encourages a courageous exploration of and application of technology in an effort to encourage a creative approach to transform the nature of our present and our outlook for the future.

TAB 6 – The Future of Technology – Conscious Computers

What is the benefit the CDO offers their organization and why they need them.

TAB 7 - Leadership

A structure to illustrate the three circles and their inherent relationship on producing the requisite Return On Investment (ROI) to provide value to our organizations.

TAB 8 - Cyber Strategy

A speech given to illustrate the purpose, goals, objectives and linkages of the national, DoD, and Air Force cyber strategy in an effort to operationalize it.

TAB 9 - Leaders of Technology – The LOT of T.H.E.M.

Illustrate the functional responsibilities, roles and relationships between the C-does.

TAB 10 - Operationalizing the Power of Information

Operationalizing cyber with a focus upon the purpose of collecting data, operationalizing information to evolve knowledge which informs the cognitive process.

TAB 11 - Technological Catalyst to Perpetual Understanding

Framework to leverage technological tools to structure data, manage information, and illustrate knowledge that harvests its intrinsic value through analytical capabilities to put into context a level of understanding for wise decisions.

TAB 12 - Chief Information Officer

The purpose of and focus upon the CIO and their responsibilities to the organization.

TAB 13 - Operationalizing Cyber

The purpose of, and why we do cyber…its about organizing data into information and correlate it into knowledge that informs understanding to make wise decision.

TAB 14 - Future of Technological Leadership

The distinction between the roles/relationships of the CIO/CTO/CSO/CDO C-codes.

TAB 15 - Data Value Proposition

How to cultivate and harvest the inherent value of data for your organization.

TAB 16 - Data: Strategic Msn Asset D-SAMS / Maturation

Transforming data in a way that informs decision in order to take wise actions.

TAB 17 - Chief Data Officer

Why it is important to develop a Data Driven Organization (2DO)

TAB 1

The Answer is

the Right Question

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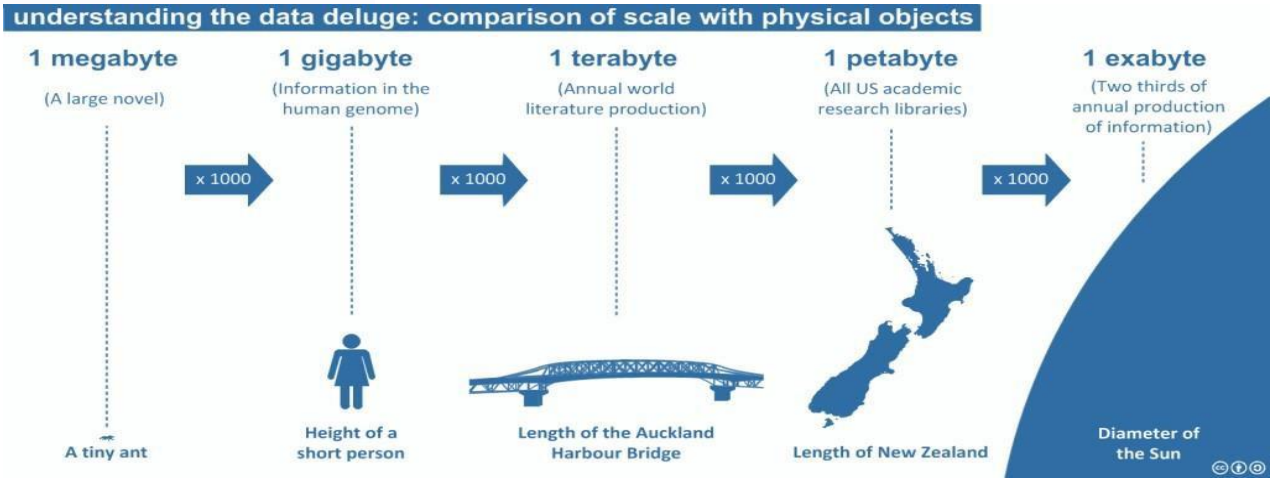
The ***ANSWER*** *is the* ***RIGHT***

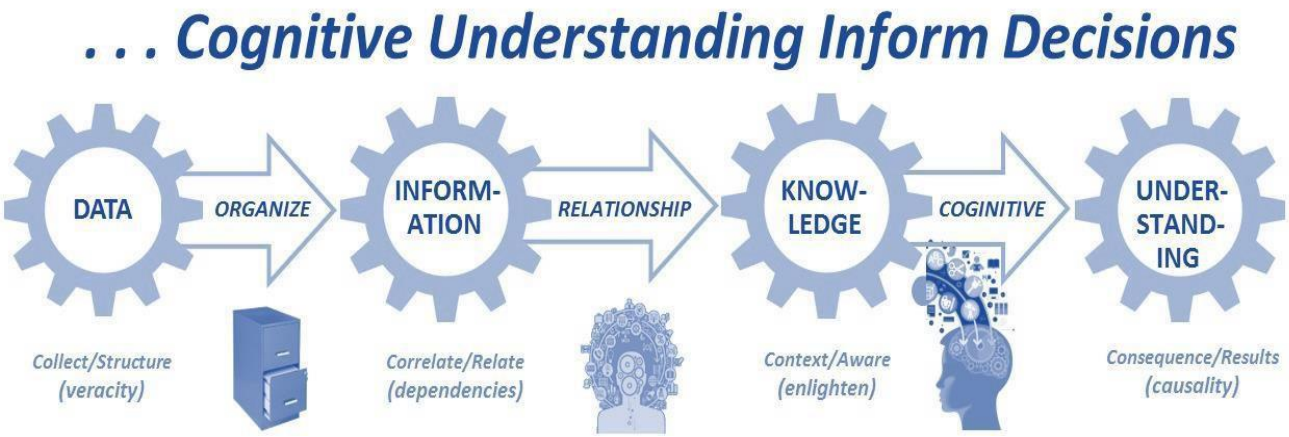
QUESTION

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 18 months, few of us realize that Buckminster Fuller's "Knowledge Doubling Curve" is at the core of that law. Fuller asserted that while knowledge doubles every 12 months, that interval would eventually be compressed into 12-hour intervals. That insatiable thirst for knowledge drives the demand for data, referred to currently as "big data," which now doubles every two years.



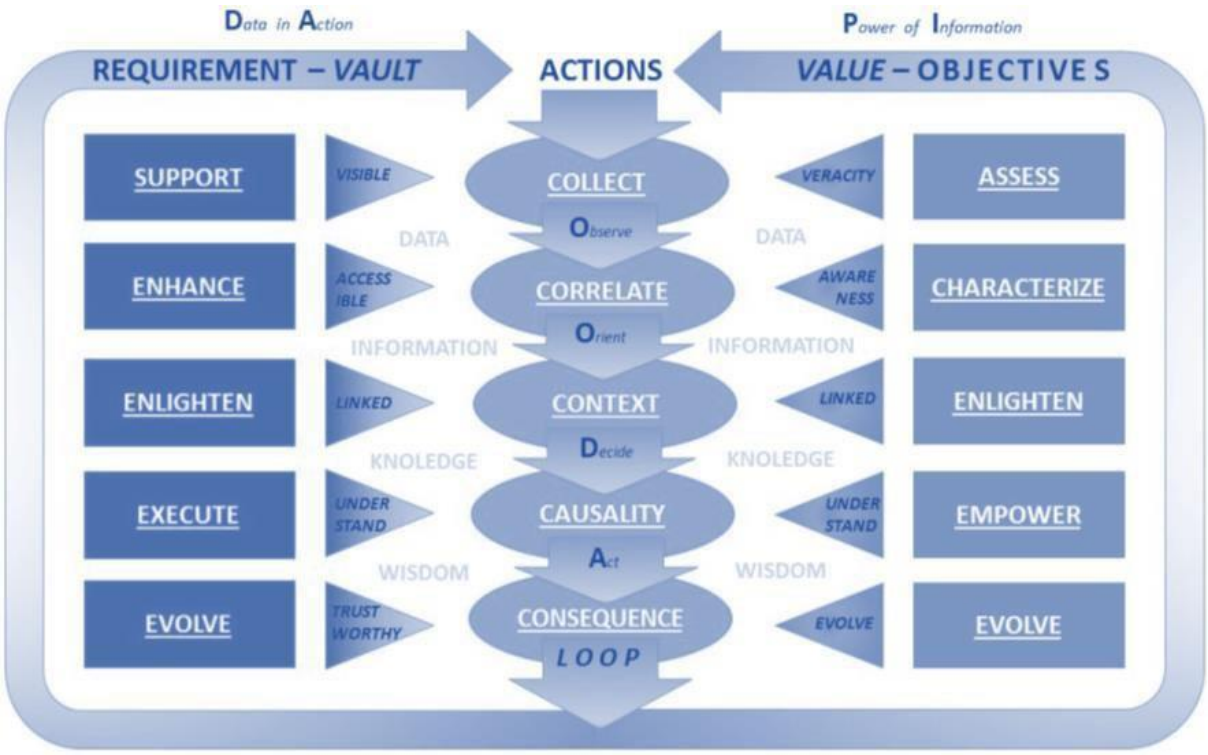
The ability to internalize such copious amounts of information and conceptualize the interdependencies that exist within this complex environment become an effective metric for gauging an individual's ability to derive strategic advantage from their efforts and master their environment. By extension, the ability to compare one's starting point to the intended destination facilitates some appreciation of the vector and character of those elements and some understanding of how they can influence the 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 and 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 of cause and effect will impact the potential and probable effects of actions taken to influence the environment, actions that will certainly effect the overarching outcomes.

In today's globally interlinked environment, the rate at which data is produced (and the interdependencies organic to that 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. By doing so, such 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 (as illustrated below).

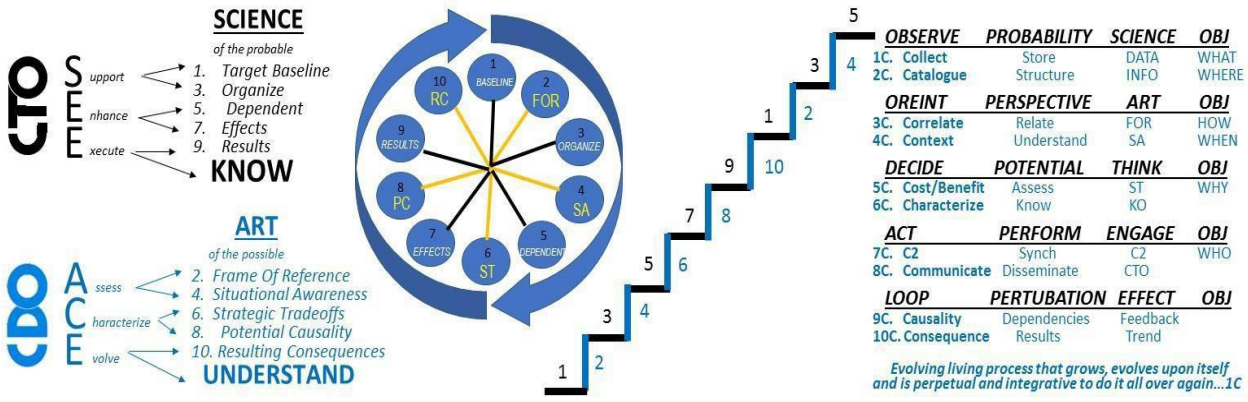


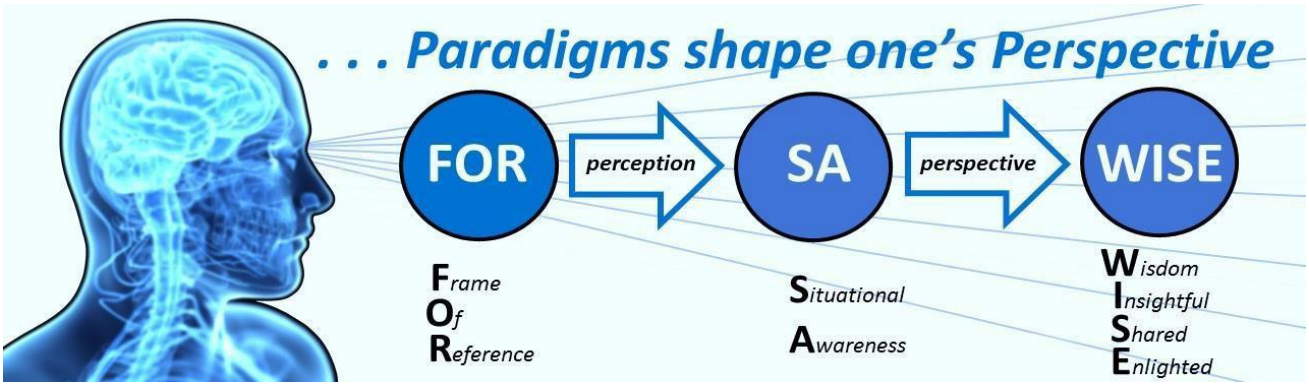
Structuring and transforming this increasing mass of complex data into information is vital, as it will provide the clarity needed to make informed desertions. To appreciate the value of big data and use it to our advantage, it must first be organized and structured. This can only be accomplished via strong DRM practices implemented by Data Stewards (DS) and Information Managers (IM), which will ensure the data is fit for its intended purpose. Considering the growing dependence on the depth and breadth of data's strategic value, data hubs are essential in identifying where the data is, how it can be accessed and ensuring that it is Visible, Accessible, Understandable, Linked and Trustworthy (VAULT). The criticality of a supremely capable data services unit within the organization will ensure that effective business intelligence is available to determine the credibility, confidence and trustworthiness the organization can reasonably expect of its data.

Our alignment of data assets with the foregoing imperatives, identification of potential interoperability conflicts and establishment of the basis for effective and cross-organizational discussions will combine to ensure that data services units meet the overarching organizational goals 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 the VALUE of data by assessing its *V*eracity (quality), assessing our reliance on *A*ccess to that data, improving its resilience by creating a network of *L*inkages and expanding our situational awareness to enhance and expand our *U*nderstanding and ability to *E*volve in this VUCA environment.



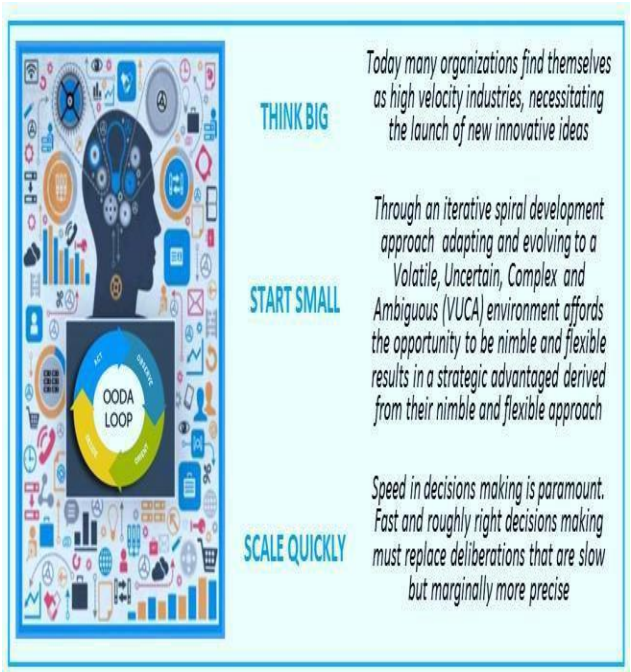
This iterative, five-step VAULT process of putting data into action and unleashing the power of information (VALUE) is a progressive approach to establishing a Data-Driven Organization (2DO). Thus, the 5Ps and 5Cs of Collecting data to accomplish Prescriptive modeling, correlating its Structure with information that illustrates its Probabilistic qualities for accurately identifying its Contextual Potential will disclose the Consequences of the actions we take to Predict the best course of action. By taking an interactive approach, we can Collect, Catalog, Correlate, Contextualize, conduct Cost/Benefit analyses, Characterize, advance C2, Communicate and determine Causality and Consequences (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) (outlined in my work on evolving knowledge into understanding, available at http://www.dtic.mil/dtic/tr/fulltext/u2/a530070.pdf).





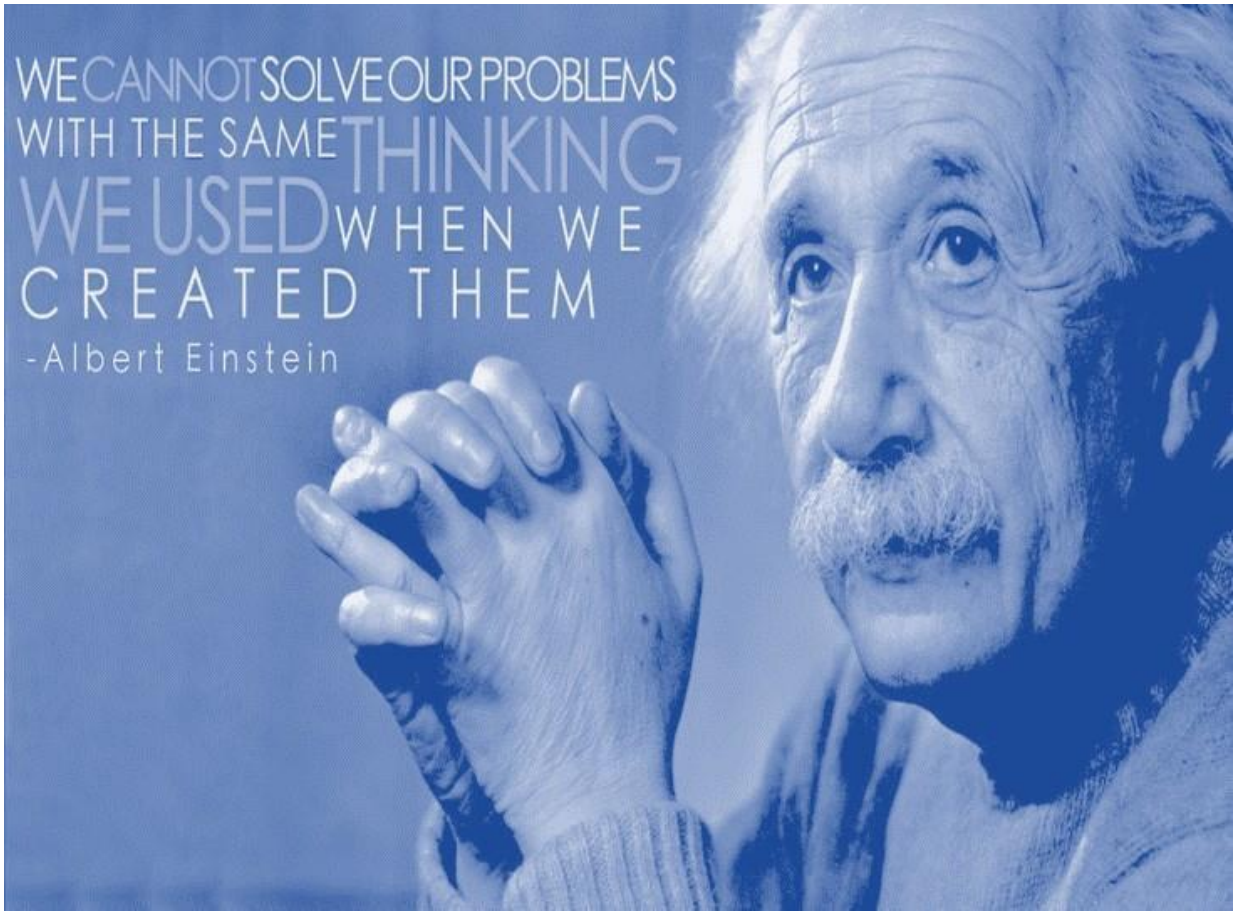
In our effort to make good decisions, we must be willing to utilize a cognitive approach that will enhance our understanding and allow us to embrace failure courageously in order to learn. These qualities are fundamental to the skyrocketing interest in Artificial Learning and Machine Learning. While today's focus on analytics centers on answering questions, that focus could be refined to help us better understand our circumstances vis-à-vis 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 OODA Loop framework in our efforts to Access, Characterize and Evolve the strategic advantage we could gain by applying all aspects of the information available to us. Moreover, it is critical that we harvest the inherent VALUE of information by Accessing (the veracity), Characterizing (our awareness) and Empowering (evolving toward) (ACE) our understanding of today's interlinked information environment.

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, evolve and learn thanks to determined analytical analysis and coherent ML processes.



In today's highly competitive environment, organizations rely on big data to mitigate risk. Unfortunately, the result is a risk adverse environment that does not tolerate bad decisions. Though we should consider failure as just another opportunity to learn, wetypically do not choose to learn from our mistakes—which forces us to repeat them. 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. Further, the growing mass and complexity of data in today's information environment compounds this situation.

Currently, data professionals help enable sound decisions by consulting the 20/20 hindsight of our FOR. In short, such actions imbue our SA with current knowledge so that we can ascertain informed options and opportunities in the future state. These actions allow us to replace our 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 we mature, which then can be used to paint a contextual picture of understanding. Ultimately, we must cease our reactionary post-event responses and use a far more proactive approach by taking actions that transform our environment to suit our needs. Most importantly, the ability to think, learn, evolve and grow ensures that we can transform our environment in a way that accommodates current and future objectives. We 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 imperative, therefore, that a new approach and perspective be adopted in this rapidly changing environment. In doing so, we must advance and advocate a visionary approach that ensures we can overcome the self-imposed constraints that force us to live in the problem, and instead focus on searching for solutions. This shift will require us to take a proactive stance by centering our efforts and energies on understanding our environment…by asking the right question.



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TAB 2

Evolving Knowledge

Into Understanding

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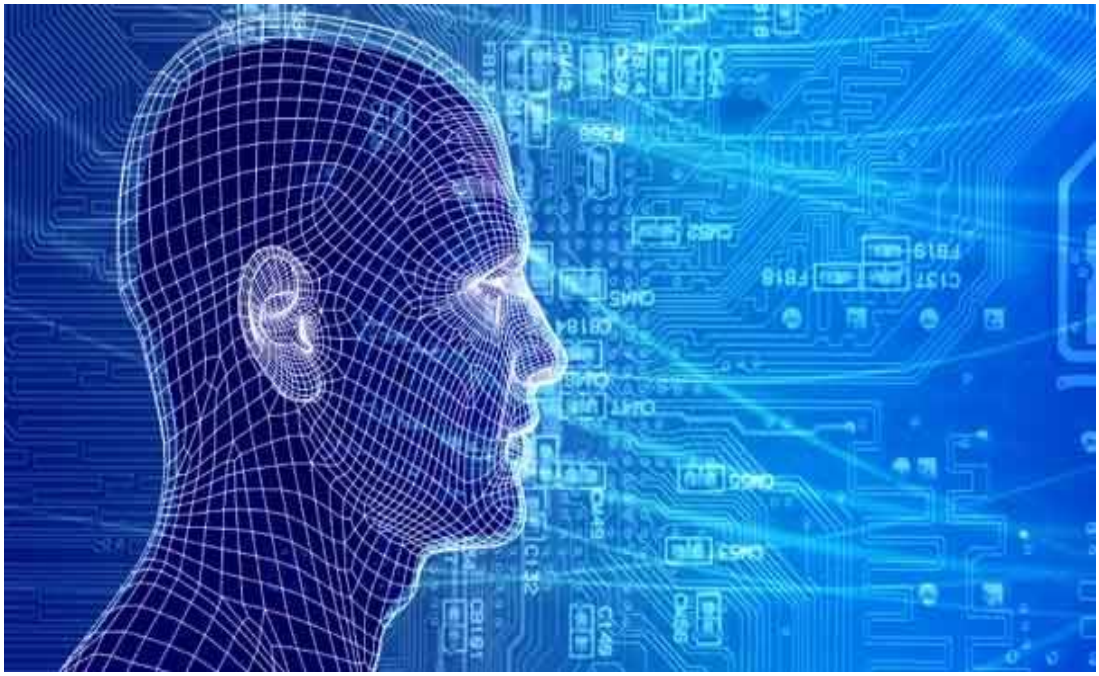
SITUATIONAL AWARENESS



EVOLVING KNOWLEDGE

INTO UNDERSTANDING

A COMPETENCY CRITICAL TO:

MAKE INFORMED DEICISONS

ACKNOWLEDGEMENTS

I would like to extend my gratitude and my sincere appreciation to my thesis advisor Lt Gen(r) Cunningham for his wisdom, inspirational leadership and unyielding support. It is his thoughtful mentoring which has guided me through this process with the strength of courage to instill in me the faith to carry through. Additionally, Dr. Fautua's strategic vision, Dr. Dickson's intellectual fortitude coupled with Dr. Nicula's caring sharp pen has elevated the presentation of my thoughts to what is presented to you today.

I am thankful for the loving understanding of my wife, Stephanie and our three children. Their support and sacrifice has enabled me to take this journey with focused determination. This has been a year of growth and exploration and I am thankful for the opportunities and for the people who have so deeply touched and enriched me along the way.

ABSTRACT

History offers ample evidence that enlightened decisions are at the core of military success in warfare. 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 in correlation to their frame of reference derives the antithesis of enlightened decisions. It is through the maturation of knowledge into understanding that strategic leaders cut through the fog and mitigate the resulting friction of war.

The value that Situational Awareness (SA) brings to the fight has long been overlooked and even discounted. In hindsight, failures and shortcomings in military operations are often 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 informed decisions facilitated by heightened awareness and sound cognitive skills.

Understanding what one is aware of and what they are unaware of, or does not understand, is a critical competency if not the cornerstone of informed decisions. It is essential to understand how SA supports U.S. strategic ends, ways and means in fulfilling U.S. national interests. Based on the foregoing, the thesis of this paper is that strategic critical thought elevates knowledge which through heightened situational awareness and a good Frame of Reference (FOR) develops understanding. It is this enlightened understanding that permits the effective employment of U.S. instruments of national power.

CONTENTS

FIGURES

GLOSSARY

CCIR - Commander's Critical Information Requirements

COA - Course of Action

COP - Common Operational Picture

DIME - Diplomatic, Information, Military, Economic

EOT – Elements Of Thourght

FOR - Frame of Reference

IM -Information Management

JIPOE - Joint Intelligence Preparation of the Operational Environment

JFC - Joint Force Commander

NETOPS - Network Operations

OODA - Observe, Orient, Decide, Act

PME – Professional Military Education

RAND - Research and Development

SA - Situational Awareness

UDOP - User Definable Operational Picture

US - United States

USSR - Union of Soviet Socialist Republics

UM – Understanding Model

VUCA - Volatile, Uncertain, Complex, Ambiguous

INTRODUCTION

Everything in strategy is very simple, but that does not mean that everything is very easy.[1]
Clausewitz

All too often, leaders have failed to learn from the lessons offered by history. Hindsight shows clearly the results of previous actions and the impact of decisions that have been made with less than full awareness. Now and in the future, it is increasingly important that we learn from and apply lessons from the past. The future is indeed revealed through a concerted assessment of history which provides a pathway for overcoming the challenges we face in the present. The development of sound strategy, elevated by a heightened awareness of past actions and current circumstances, offers the opportunity to confront emerging threats successfully.

Given the dynamic and interlinked world environment, the necessity to apply all instruments of U.S. national power in a collaborative manner is absolutely critical to success. Concise strategic objectives are essential in developing a strategy that focuses resources and efforts adequately in light of the complexities associated with the cultural, paradoxical and diverse motivations of the current environment. Cognition coupled with heightened awareness which is infused with a good frame of reference (FOR) is essential in developing the necessary understanding to fulfill these strategic objectives.

Within the context of the DIME (diplomatic, information, military and economic), information is typically the least leveraged but potentially the most valuable element of national power. The information revolution and the knowledge age are clearly upon us~~, thus it becomes critical to~~ determine what information is relevant when seeking to fulfill strategic objectives. To assist in this endeavor, technology can be leveraged to provide a timely and accurate means to manage and organize accumulated data from which useful information can be produced. As the demand and necessity for intellectual capital grows, so does our reliance upon the information age since it feeds the rapidly unfolding knowledge age. Strategists must leverage this knowledge, cultivated by awareness, to actualize the asymmetric advantage offered through intellectual enlightenment.

Given that war is an extension of politics by other means, it becomes essential that political as well as military leaders possess and hone the competencies needed to develop awareness. U.S. national interests can be met by acquiring the knowledge that will foster our understanding of the likelihood to leverage resources and capabilities to fulfill those objectives. It is this ability— military genius—that Clausewitz defines as —a very highly developed mental aptitude for a particular occupation.ll[2]

As the complexities of the world continue to compound, so does the military's need to evolve. While the world flattens and the information society grows exponentially, it becomes imperative that a heightened awareness of circumstances is both available and utilized. Indeed, the actions taken today must be committed to with a full understanding of their second and third order effects to preclude unintended consequences. Thus, the fog and resulting friction and misunderstanding caused by cultural, language and intelligence barriers could lead to insurmountable obstacles to progress.

[1] Carl von Clausewitz, On *War*, Michael Howard and Peter Paret eds. and trans. (Princeton: Princeton University Press, 1976), 178.

[2] Ibid, 43.

The globally interconnected world environment has increased the intensity of once simple dilemmas due to the confluence of diverse perspectives, expectations and perceptions. By developing an appreciation for the conditions, cultures and world expectations inherent in an open system, military leaders will be suitably prepared to overcome evolving threats and challenges. Joint Publication 3-0 cautions that —history has shown that cultural awareness cannot be sufficiently developed after a crisis emerges and must be a continuous and proactive element of theater intelligence and engagement strategies.‖[3]

Understanding and agreeing on U.S. objectives and by developing the knowledge necessary to achieve them, speaks to an important aspect of what Clausewitz referred to as *military genius.*[4] It is therefore incumbent upon strategic leaders to establish good SA and an expansive FOR in which to make sound decisions. In order to prepare adequately for the art of the possible, given the affects of the current environment on the open system, it is crucial to leverage the ways and means with which information is accumulated. When properly fused, information elevates awareness and serves as a catalyst to facilitate understanding. Cultivating this knowledge yields an appreciation of the complexities of this interconnected environment.

Research concludes that all too often, the magnitude of a given situation is underestimated due to a lack of awareness. By effectively leveraging this knowledge with heightened SA and a sound FOR, decision makers are afforded the opportunity to mitigate risk in order to fulfill U.S. national interest. Therefore, to tackle the difficult strategic problems that will affect the U.S. now and into the future and to obtain a full understanding of their second and third order affects, SA is essential in preparing strategic leaders to formulate sound strategic decisions that support U.S. national ends.

Within the context of this paper, a Model For Enlightened Understanding Process (UM) will be presented to enable the reader to conceptualize the process upon which informed decisions can be made with a high level of acuity. The paper will walk the reader through the steps of data assimilation in accordance with Bloom's Taxonomy in order to elevate the process of critical thought. It will then outline how information is fused into knowledge through the cognitive process. Finally, the UM will then establish how past SA enveloped into a FOR coupled with current SA develops understanding. It is through the maturation and refinement of understanding which becomes the catalyst for informed decisions.

The will research explores the impact of the cognitive model on perceptions held at all levels and address the associated liability of being uninformed and unaware. By applying cognitive skills to ascertain the effects of actions taken against results achieved, the opportunity exists to assess measures of performance and measures of effectiveness within the closed system. By considering the injected variable and the implications that surround the dynamics of an open system, the propensity to accurately forecast future action will reveal themselves. Thus, by applying heightened awareness to a sound FOR produces a high degree of reliable predictive analysis predicated upon an open-minded approach to the art of the possible.

[3] U.S. Joint Chiefs of Staff, Joint Publication 3-0, Joint Operations (September 10, 2001), VII-10.
[4] Carl von Clausewitz, On *War*, Michael Howard and Peter Paret eds. and trans. (Princeton: Princeton University Press,

1976), 43.

Finally, the method in which this research was conducted explores the foundation upon how information is assessed and defined. The process of developing knowledge through cognition is formulated to mature the reader's appreciation of how to think. Additionally, those issues, perceptions and paradigms that influences how things are viewed, directly impacts their approach to shape the environment. Conscious competence models are presented to provide the reader the opportunity to assess their cognitive level and provide them the criteria upon which to think critically. Finally, the implications and affects of SA are defined and explored to correlate their contributions to the UM presented in figure #1. A real world example illustrates the cost and potential benefits of properly applying SA. For through an effective development of SA and its associated cost benefit analysis as a competency, the ability to leverage SA reveals the benefits it holds in elevating knowledge that develops understanding.

1. *Data is observed, captured and organized into information*
2. *Information is fused in accordance with Bloom's Taxonomy through critical thinking into knowledge*
3. *Knowledge correlated against one's FOR and current SA is developed into understanding which is the basis upon which informed and enlightened decisions are made*

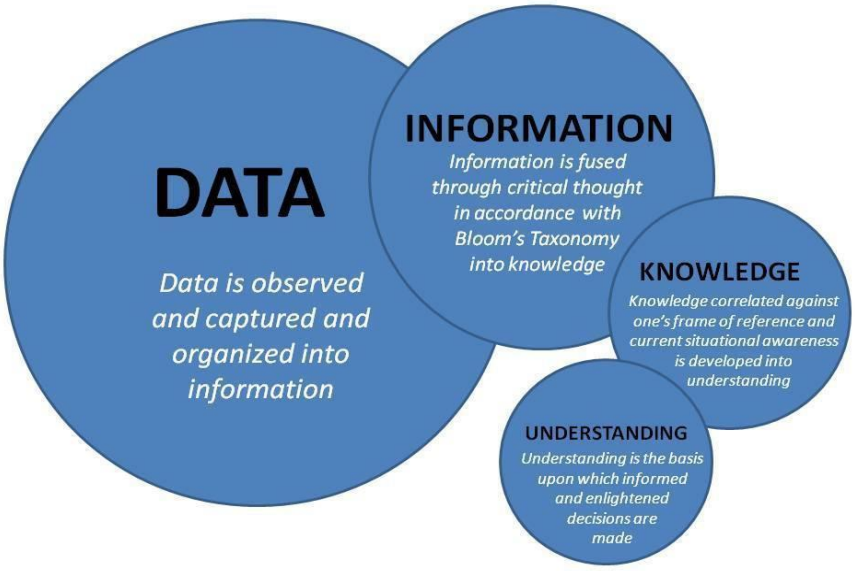


Figure #1 (Author's Representation of an Understanding Model -UM)

CHAPTER 1

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 glimmering of the inner light which leads to truth; and second, the courage to follow this faint light wherever it may lead. [5] *Clausewitz*

The *Strategic Leadership Primer* published by the Army War College observes that strategic leaders —must create and maintain absorptive and adaptive capacity in addition to obtaining managerial wisdom.‖ [6] To prepare for ingestion, data must first be organized into information. The information then must be correlated and fused into knowledge that drives understanding. The value offered by strategic leaders is their ability to assimilate understanding sufficiently in an adaptive capacity to effect change that shapes the environment to the desired end state.

It is important to understand that the information, which is so critical to the decisionary process, is derived from data. Data as defined by Webster's Dictionary is —information output by a sensing device or organ that includes both useful and irrelevant or redundant information and must be processed to be meaningful.‖[7] Through the proper organization and validation of data, one is able to present reliable information. Information as defined by Webster's is —a signal or character which represents data.‖[8T]Through a learned layered approach outlined by Bloom's Taxonomy the cognitive process begins to develop this information into knowledge. Webster's defines this knowledge as —the fact or condition of knowing something with familiarity gained through experience or association.‖ [9] The experience related to circumstances shapes how one interprets and uses information.

COGNITIVE ENLIGHTENMENT

The first goal of awakened consciousness is to develop one's cognitive enlightenment. Cognition is defined as —the mental process of knowing, including aspects such as awareness, perception, reasoning and judgment.‖[10] Bloom's Taxonomy presents a framework upon which to examine and facilitate an understanding of the cognitive process. It consists of the following six levels necessary to elevate levels of intellectual acuity.

1. ***"Knowledge*** – The capacity to recall or recognize pertinent learned information associated with terminology and facts.
2. ***Comprehension*** – Obtaining a level of understanding through oral, written, or symbolic representation to translate, interpret, or extrapolate upon a level of knowledge that demonstrates the assimilation of the presented concept. It allows one to grasp the meaning of information.
3. ***Application*** – The capability derived from the fully matured understanding of a concept.
4. ***Analysis*** – One's ability to break down information and correlate its relevance and implications to its derivative of intent.
5. ***Synthesis*** – Formulating and organizing the individual parts of information such that it collectively imparts a newly matured meaning.
6. ***Evaluation*** – The action based on judgment influenced by cultural norms, academic teaching and personal biases.‖[11]

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5 Carl von Clausewitz, On *War*, Michael Howard & Peter Paret eds. and trans. (Princeton: Princeton University Press, 1976), 558.

6 United States War College, *Strategic Leadership Primer*, 2004, http://www.carlisle.army.mil/USAWC/dclm/slp2ndEd.pdf (Accessed March 12, 2009).

7 *Webster's Collegiate Dictionary*, 11th ed., s.v. —data,‖ http://www.merriam-webster.com/dictionary/data (accessed November 21, 2008).

8 Ibid, s.v. -information,‖ http://www.merriam-webster.com/dictionary/information (accessed November 21, 2008).

9 *Webster's Collegiate Dictionary*, 11th ed., s.v. —data,‖ http://www.merriam-webster.com/dictionary/data (accessed November 21, 2008).

10 Benjamin S. Bloom, *Taxonomy of Educational Objectives* (Cognitive Domain), Longman, New York, 1956, 18.

11 Ibid., 184.

Within this cognitive domain, knowledge and comprehension enables 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 resulting perspective gained that represents the crux of the cognitive process.

LEVERAGING INFORMATION

Current and historical facts must be assessed against pertinent assumptions so that perceived inferences can be determined in order to appreciate the scope and implications of the problem. The conditions that feed a problem that clearly define the potential and relevant variables surrounding it are essential to its resolution. Thus, the teachings of Karl Weick, an American organizational theorist, encourage leaders to explore the properties of improvisation and enlightenment.[12] It is through improvisation that the benefits of experience and knowledge can become apparent. Questions can be raised throughout the enlightenment process which clarifies the elements of thought (EOT) as they relate to the three-step concept offered by Haridimos Tsourkas, a professor of Organization Studies at the Warwick Business School.

- **Step 1:** Individual A externalizes a portion of their tacit knowledge in the symbolic form of information that can be shared with others. Individuals B & C do likewise.
- **Step 2:** Individuals A, B and C engage in the exchange of their externalized information elements, or combine it to form new elements (theories, models, or reflected understandings).
- **Step 3:** Each individual then internalizes the new information elements, thereby modifying or adding to their own existing tacit knowledge structure.[13]

FRAME OF REFERENCE

As information is amassed and correlated, it builds upon itself to elevate the relational effect. The results of lived experiences establish perspectives and perceptions that become elements of one's frame of reference (FOR). It is important to note, that we have all developed a FOR with which we filter, assess, relate and understand information that is presented. Outside influences and an individual's breadth of observed and learned experiences shape their internal perspective and the manner in which they see the problem. It is important to assess the validity of this information and the context in which it is presented since the foundation upon how one establishes the framework they will use to make decisions must be both solid and reliable. Therefore, by assessing the validity and applicability of the acquired experiences of others, one can quickly establish an extensive and diversified depth of experience that consists of a layered framework for successful decisions.

As noted in the Fontana Dictionary of Modern Thought, a Frame of Reference is defined as —the context, viewpoint, or set of presuppositions or of evaluative criteria within which a person's perception and thinking seem always to occur and which constrains selectively the course and outcome of these activities"[14] In the process of framing the solution to a problem, an appropriate FOR is critical to fully understanding and defining an accurate awareness of cultural perceptions, paradigms and expectations. One's FOR is therefore related directly to past SA

[12] Karl Weick, Gretchen Spreitzer and Thomas Cummings, *Leadership as the Legitimating of Doubt*, 2001, 91-102.

[13] Tsoukas, H., *Do We Really Understand Tacit Knowledge?* 14 June 2002, 6.

relative to actual courses of events. Given technological means to acquire, organize, correlate and assess information from a prescriptive perspective, the validity of action taken against results achieved becomes a key determinant to achieving future objectives. By documenting, observing and validating the quality of past SA, the benefit of heightened awareness becomes actualized. However, the prevailing motivation and the effects derived from their intention will seldom if ever be fully revealed.

ELEMENTS OF THOUGHT

It is from this FOR that information is filtered by the taxonomy of one's perceptions and biases. With this in mind, one can begin to appreciate the value of relationships inherent with the associated information in order to synthesize knowledge into understanding. The resulting synthesis provides unique and innovative perspectives on capabilities upon which one evaluates information to formulate it into knowledge. The six areas addressed previously in Bloom's Taxonomy provide thestructure on which we are able to formulate and elevate information into knowledge. For as one assess the issues and acquires information, in order to interpret the implications and the consequence of actions taken against results achieved, they must be able to adequately interpret their understanding based upon their point of view or FOR.[16]

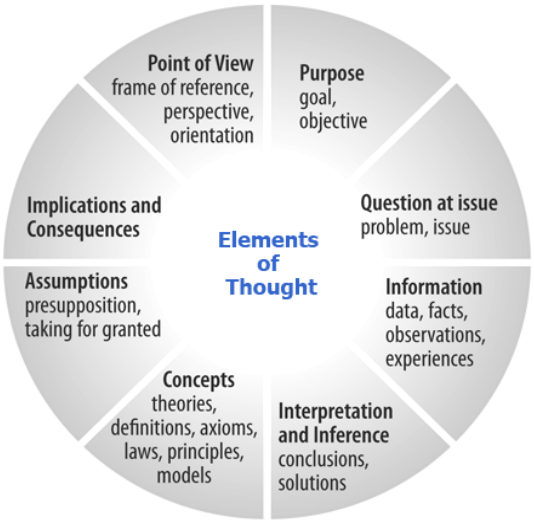

Figure #2: Elements of Thought (EOT)[15]

It is important to note that our experiences, expectations and perceptions influence the manner by which we become aware. Once data is organized into information that is ultimately correlated and fused into knowledge that drives understanding, the strategic leader becomes an empowered decision maker. A cross-correlation assessment is necessary to develop a single operational picture and it is from the resulting shared awareness that trends are identified from lessons learned, thus permitting deterministic actions to be derived from cognitive awareness. However, caution must be taken to preclude the introduction of inferences and assumptions that can cloud and distort one's point of view. Therefore, consideration of these biases, perceptions, viewpoints and motivations in sharing the information will establish the validity and resulting credibility of these shared experiences. Once these experiences are applied to the decision-making process, discretion must be employed to preclude becoming overly reliant on misleading or biased information that can distort the FOR being used. Thus by reflecting on the validity of one's SA one can determine the context in which the information was interpreted and applied.

[14] Alan Bullock, *Fontana Dictionary of Modern Thought,* 1988.

[15] Foundation Critical Thought, 2007,http://www.criticalthinking.org/CTmodel/CTModel1.cfm#,(Accessed April 3, 2009)

[20] Richard Paul and Linda Elder, *Critical Thinking: Tools for Taking Charge of Your Learning & Your Life* (2nd Edition), (Prentice Hall, 2001).

HOW AND WHAT TO THINK ABOUT

The level of awareness achieved directly affects the quality of the decision being made. Timely and accurate assessment of information provides the basis for sound decisions and ultimately results in cognitive enlightenment. In order to learn and evolve from previous experiences, it is essential to assess and analyze problems. Hence an astute and consciously aware individual possesses the ability to reflect on the outcomes of an opportunity as well as the range of options available to mold and shape the environment. The following questions have been developed and presented by Richard Paul and Linda Elder, as a means to identify the issues involved and in-turn, formulate one's initial thoughts:

Elder's disciplines of how to think and guide toward a strategic end state:

- What precise question are we trying to answer?
- Is that the best question to ask in this situation?
- Is there a more important question we should be addressing?
- Does this question capture the real issue we are facing?
- Is there a question we should answer before we attempt to answer this question?
- What information do we need to answer the question?
- What conclusions seem justified in light of the facts?
- What is our point of view?
- Do we need to consider another?
- Is there another way to look at the question?
- What are some related questions we need to consider?
- What type of question is this: an economic, a political, a legal question, etc.? [17]

Within the context of examining the implications related to these questions, the parameters, scope and intent regarding the problem set is established. By framing the problem in order to clarify the focus being applied to the objectives, the cognitive process correlates the assessment from the questions asked.
Ultimately, the propensity to acquire knowledge relative to the situation at hand affords the opportunity to elevate SA in order to develop useful understanding.

[20] Richard Paul and Linda Elder, *Critical Thinking: Tools for Taking Charge of Your Learning & Your Life* (2nd Edition), (Prentice Hall, 2001).

CHAPTER 2

"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. Thinks in terms of systems/linkages (effects) and is an expert learner." [18]

Peter Pace - CJCS Vision for Joint Officer Development

CRITICAL THINKER

An adept critical thinker raises vital questions and problems based on the relevant information that has been gathered and assessed. The individual then interprets and organizes it to a given level of maturity, at which point it is tested against relevant criteria and standards. By using an open-minded perspective and employing alternative systems of thought, the individual validates assumptions and identify practical consequences. Finally, the critical thinker disseminates his or her findings to others in a dialectic manner to determine solutions to complex problems before assimilating the resulting antithesis into the general knowledge base.[19]

"A well cultivated critical thinker:

- *Raises vital questions and problems and formulates them clearly precisely gathers and assesses relevant information using abstract ideas*
- *Interpret the problem effectively comes to well-reasoned conclusions and solutions and then tests them against relevant criteria and standards*
- *Thinks using an open-minded approach within alternative systems of thought, recognizing and assessing as need be their assumptions, implications and practical consequences*
- *Communicates effectively with others in determining solutions to complex problems."* [20]

From analysis, the critical thinker develops a presumption of their unique perspective. Paul and Elder posit this to be —whenever we reason, we must reason within some point of view or frame of reference. Critical thinkers strive to adopt a point of view that is fair to others, even to opposing points of view.‖[21] Hence, critical thinkers must adopt the philosophy that critical thinking is a process of understanding the circumstances with which you are faced and then determining —the lay of the land‖ as situations present themselves. From this, decisions must be made and in the presence of good awareness, informed decisions will ultimately fulfill expectations. Thus, the framework of thinking is related directly to the benefit derived from how information is processed in accordance with the disciplines to derive at a strategic end state as illustrated in figure 3 below. [22]

[18] Pace, Peter, *CJCS Vision for Joint Officer Development* (November, 2005), 4.
[19] Ibid.
[20] Richard Paul and Linda Elder, *Critical Thinking: Tools for Taking Charge of Your Learning & Your Life* (2nd Edition), (Prentice Hall, 2001).

- **"IDENTIFY**: Recognize and clearly define the root problem, situation/question
- **GATHER**: Sort/assemble information
- **EXAMINE**: Analyze pertinent information
- **FORMULATE**: Devise a plan
- **APPLY**: Implement the plan
- **EVALUATE**: Judge the results objectively
- **REFLECT**: Think about thinking[23]

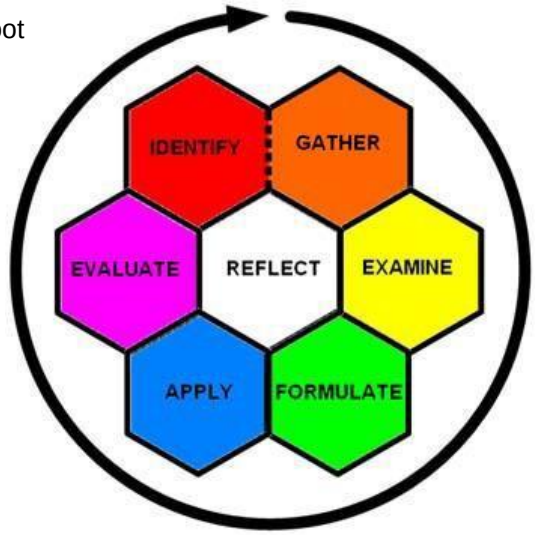

Figure #3: Disciplines for a Strategic Endstate[24]

Elder's model illustrates progressive aspects of critical thinking. First, a clearly defined problem set must be identified. Next, steps must be taken to amass the necessary information to address the issue at hand. Once this information is accumulated, it must be examined so that a plan can be formulated and applied to a course of action that fulfills the objectives. Finally, a means to evaluate the results will reveal whether the objectives were met. Hence the use of a reflective approach toward assessing its effectiveness, relative to accomplishing the task at hand, will enable the process to adapt to changing requirements.

By following Elder's disciplines for a strategic end state, it is necessary to develop a well-defined and scientific approach toward how such potential problems can be resolved. The manner in which the problem is framed and considered, in view of the information available, directly influences how information is processed in order to achieve a given level of understanding.

Ultimately the central issues, as well as the purpose to be achieved, must be clearly understood in order to approach and apply the necessary methods to effectively solve the problem.[25] Therefore, consideration should be given as to how the U.S. should develop its capabilities to confront current and future threats despite the potential of limited capacity. Once the necessity for a well defined and scientific approach toward confronting problems is understood, it then becomes imperative that the information necessary to frame the problem is adequately assembled and assessed.

[21] Richard Paul and Linda Elder, Critical Thinking, Tools for Taking Charge of Your Learning and Your Life (Upper Saddle River, NJ: Prentice Hall, 2001), 98.
[22] Ibid., 70.
[23] Ibid.
[24] Ibid.
[25] Ibid.

The means necessary to drive effectiveness and efficiency requires a clear understanding of their surroundings. To preclude biases or becoming distracted by irrelevant injects, critical thinkers must master not only the process but also the art of thinking. Therefore, it becomes imperative that the information is presented in a timely and useful manner to develop an accurate awareness infused with a corresponding FOR. It is this understanding and the implications associated with the current environment that enables an awareness of how current conditions unfold from past actions.

REASONING

Boal and Hooijberg identify precisely the value of a strategic leader when they observe that —Critical thinking is the use of reasoning to develop sound strategies that increase the probability of a desirable outcome. Critical thinking is thus the description of how to thinking in a manner that is purposeful, reasoned and goal directed.‖[26] Through the process of reasoning, a conceptual synthesis of information formulated through observed experiences defines the purpose, assumptions, implications, points of view, inferences and consequences. By utilizing reliable empirical evidence, one can apply sound reasoning to assimilate a relational affect. Hence the mental model is derived from conclusive assumptions based on a reliable FOR. This mental model affords one the opportunity to apply past performance and reasoning in a rational manner against predeterministic outcomes within a closed system or environment.

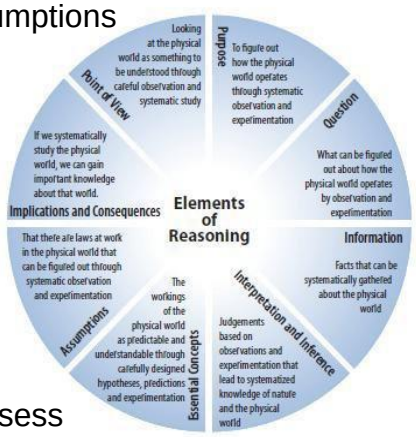

Figure #4: Elements of Reasoning[27]

One must remain aware that the process is susceptible to biased perspectives, or distortion. It is through this cognitive bias which allows two people to arrive at different conclusions despite having the same information. Thus the questions should be considered when following applying the elements of reasoning to assess the effects of these variables within the open system.

"Question: All reasoning is an attempt to figure something out, to settle some QUESTION, to solve some problem

- State the question at hand clearly and precisely
- Express the question in several ways to clarify its
- meaning Break the question into sub-questions
- Distinguish questions that have definitive answers from those that are opinionated or that require multiple viewpoints

Concepts: All reasoning is expressed through and shaped by, CONCEPTS and IDEAS

- Identify key concepts and explain them clearly
- Consider alternative concepts or alternative definitions of
- concepts Make sure you are using concepts with precision

Interpretation and Inference: All reasoning contains INFERENCES or INTERPRETATIONS by which the CONCLUSIONS drawn give meaning to data

- Infer only what the evidence implies
- Check inferences for their consistency with each other
  Identify assumptions that underlie your inferences

Assumptions: All reasoning is based on ASSUMPTIONS

- Clearly identify your assumptions and determine whether they are justifiable
- Consider how your assumptions shape your point of view

Implications: All reasoning leads somewhere or has IMPLICATIONS or CONSEQUENCES

- Trace the implications and consequences that follow from your reasoning
- Search for negative as well as positive implications
- Consider all possible consequences
-

Point Of View: All reasoning is done from some POINT OF

- VIEW. Identify your point of view
- Seek other points of view and identify their strengths and
- weaknesses Strive to be fair-minded in evaluating all points of viewǁ[28]

UNDERSTANDING

Opening one's mind to identifying how to mitigate risk and knowing what is important and what is not is critical to developing awareness. This presents an interesting dilemma, since one does not know what he or she did not know until it is eventually learned. Therefore, it is incumbent upon them to be conscious of their ignorance and the effect it has on their ability to make informed decisions.

Ultimately, the area of conscious incompetence allows one to mitigate liability and examine the opportunity to think strategically. Once individuals are aware of what they know and do not know, their knowledge and associated reliance on pertinent information impacts their ability to make effective and informed decisions. Research conducted by Justin Kruger and David Dunning, from Cornell University, illustrates that incompetent individuals tend to overestimate their own level of skill.[29]

1. Incompetent individuals fail to recognize genuine skills in others.[30]
2. Incompetent individuals fail to recognize the extremity of their adequacy.[31]
3. If they can be trained to improve their own skill level substantially, these individuals can recognize and acknowledge their own previous lack of skill.[32]

CONSCIOUS COMPETENCE

Through examining the conscious competence learning model, we begin to understand how to assess the level at which we are operating and the inherent risk found at that level. Understanding that one does not always understand, affords the opportunity to be receptive to exploring the art of the possible. By adopting an open-minded approach toward issues as they present themselves, the opportunity exists to increase one's awareness and heighten their SA.

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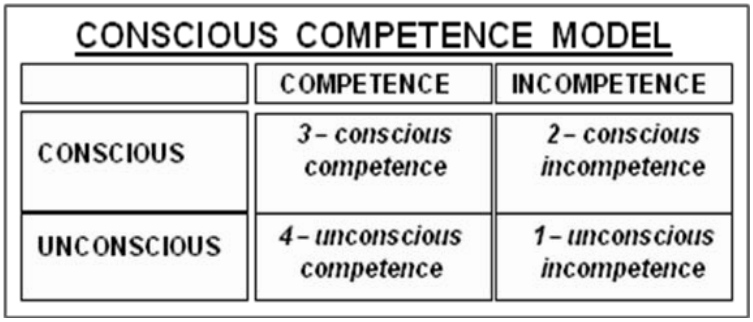
[29] Justin Kruger and David Dunning, —Unskilled and Unaware of it: How Difficulties in Recognizing One's Own Incompetence Lead to Inflated Self-Assessments,ǁ (*Journal of Personality and Social Psychology* 1999), 1121-34.
[30] David Dunning, Kerri Johnson, Joyce Ehrlinger and Justin Kruger, —Why People Fail to Recognize Their Own Incompetence,ǁ (*Current Directions in Psychological Science* 2003) 83 – 87.
[31] Ibid.
[32] Katherine A. Burson, Richard P. Larrick and Joshua Klayman, -Skilled or Unskilled, but Still Unaware of It: How Perceptions of Difficulty Drive Miscalibration in Relative Comparison,ǁ (*Journal of Personality and Social Psychology 2006),* 60 – 77.

To help visualize the conscious competence model, the author presents the following four level quadrant table in Figure #5 to illustrate this concept:



CONSCIOUS COMPETENCE MODEL

	COMPETENCE	INCOMPETENCE
CONSCIOUS	*3 – conscious competence*	*2 – conscious incompetence*
UNCONSCIOUS	*4 – unconscious competence*	*1 – unconscious incompetence*

"1 – Unconscious incompetence

- person is not aware of the existence or relevance of the skill area
- person is not aware that they have a particular deficiency in the area concerned
- person might deny the relevance or usefulness of the new skill
- person must become conscious of their incompetence before development of the new skill or learning can begin

2 – Conscious incompetence

- person becomes aware of the existence and relevance of their skill
- person is therefore aware of their deficiency in this area, ideally by attempting or trying to use the skill
- the person realizes that by improving their skill or ability in this area, their effectiveness will improve
- Ideally, the person has a measure of the extent of their deficiency in the relevant skill as well as a measure of what level of skill is required to achieve their own competence

3 – Conscious competence

- the person achieves —conscious competence‖ in a skill when they can perform it reliably at will
- the person must concentrate and think to perform the skill
- the person performs the skill without assistance
- the person will not reliably perform the skill unless thinking about it—the skill is not yet —second nature‖ or —automatic‖
- the person should be able to demonstrate the skill to another, but is unlikely to be able to teach it well to another person
- the person should ideally continue to practice the new skill and if appropriate, commit to becoming "unconsciously competent" in it

4 – Unconscious competence

- the skill becomes so practiced that it enters the unconscious parts of the mind— it becomes —second nature‖
- common examples are driving, sports activities, typing, manual dexterity tasks, listening and communicating
- it becomes possible for certain skills to be performed while doing something else; for example, knitting while watching television
- the person might now be able to teach others the skill concerned, although after sometime of being unconsciously competent, the person might actually have difficulty explaining exactly how they do the skill which is now largely instinctual‖ "[35]

Roger Kane, *Conscious competence learning model, stages of learning - unconscious incompetence to unconscious competence - and other theories and models for learning and change*, Roger Kane, *Conscious competence learning model, stages of learning - unconscious incompetence to unconscious competence - and other theories and models for learning and change*, http://www.businessballs.com/consciouscompetencelearningmodel.htm#will_taylor_5th_level_conscious_competence, November 2005: (accessed 16 Nov 08).

Moreover their lack of a clear relationship between variables within the environment preclude opportunities to make effective and informed decisions. Since the individual is aware of their condition, they recognize the opportunity to become enlightened through education and experience. Hence, individuals at this level make the best students due to their awareness of their predicament of being uninformed. These decision makers can typically be expected to take concerted action to elevate their understanding and thus potentially mitigate risk. Ultimately, their conscious awareness prevents them from being ineffective or becoming a liability.

At level 3 of the cognitive model, the individual is consciously aware but experiences difficulty in correlating relationships and thus finds difficulty fusing the facts and synthesizing the knowledge into understanding. Thus, it is difficult for them to formulate the implication of information and in-turn they are unable to estimate its effects upon the environment. The results of these limitations make it increasingly more challenging for them to determine or even forecast future dynamics without a well-defined mental model. At this level, the individual is predisposed to eschew a strategic and deterministic approach that fosters an enlightened expectation of future impacts. Here, the decision maker's inability to fuse a multitude of problem sets into a unified approach toward cohesive resolution hinders their ability to act strategically. Thus, the lack of mature cognition and heightened SA prevents these individuals from becoming fully informed which precludes autonomously linked enlightened decision.

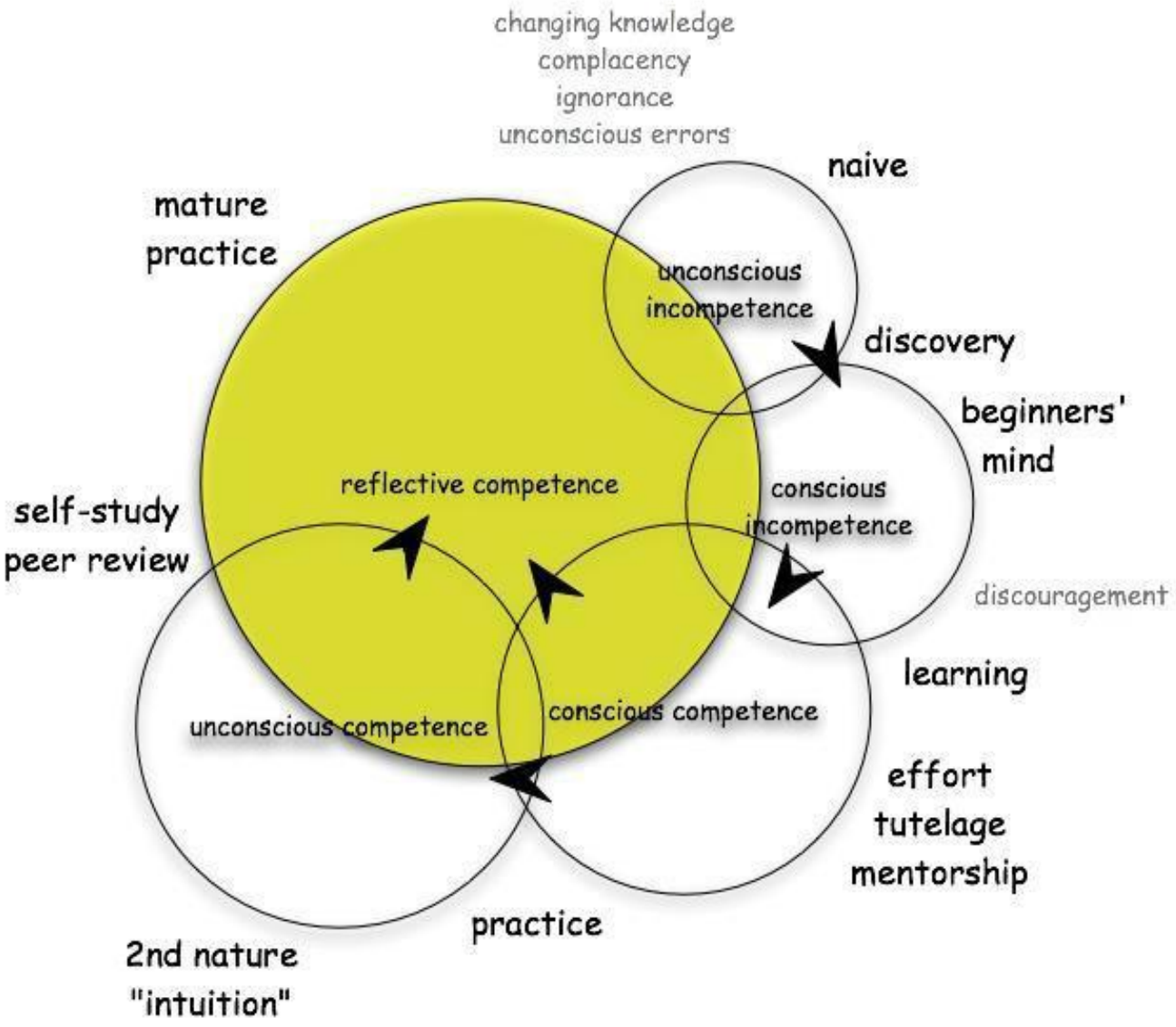
Notably, level 3 is the stage at which teaching, adapting and error detection activities are performed. At this level, the individual is receptive to acknowledging when new information does not fit properly into the model based on their FOR, perceptions, or expectations. Of course, ignoring or forcing the new information to fit could place the entire premise and course of action at risk and send the individual back to sector 1 and quadrant 1 of the SA and cognitive models. Further, it is at these stages that imparting knowledge to others is most beneficial for both students and teachers become aware of their deficiencies in knowledge.

It is through this symbiotic relationship at level 2 and 3 of the cognitive model sharing one's experiences and collaborative understanding which opens their perspective to the realm of options and the art of possibilities. It is through this exchange that teachers and students derive mutually beneficial opportunities exploring answers to previously unexplored questions. Individuals in stage 3 should be chosen to teach those in stage 2 as they expand their knowledge and broaden their FOR in preparation to ascend to stage 4. It is from this symbiotic mutually beneficial relationship between student and teacher that provokes a reflective reassessment of perceptions and is necessary to elevate both individuals to their next level of cognition. [34]

Many have remarked that intuition or military genius exposed by Clausewitz as *coup d'oeil* is depicted in a heightened level of fully conscious competence or Level 4 of our model. Roger Kane spoke of a fifth level at which the individual responded with optimal, instantaneous and instinctive reaction. Some refer to this as being in the —zone.ll[35] At this level, an individual becomes able to achieve self- awareness and make accurate assessments of their abilities based upon an understanding of current conditions. By leveraging opportunities in this adaptive approach, threats can be mitigated and weaknesses overcome.[36] Having an awareness of one's limitations enables an individual to approach the true capacity of their ability. Indeed, it is not what one knows that makes them an asset but the awareness of what they do not know, which precludes them being a liability. Moreover, it is through this awareness that they are able to establish their overall realized value to an organization.

[34] Ibid

To preclude diversionary qualifiers, astute leaders reflect on the perceptions and expectations of others throughout the conscious competence assessment. Further, through a thoughtful, reflective, open-minded and empathetic approach towards issues, the propensity to achieve self-awareness and circumvent egocentric tendencies begins to reveal itself. Indeed, such biases, preconceived notions and paradigms distort or sometimes blind leaders and thus prevent effective critical thought as depicted by the reflective competence model shown if figure 6 below.[37]



(Courtesy of Will Taylor, Chair, Department of Homeopathic Medicine, National College of Natural Medicine, Portland, Oregon, USA, March 2007.)

Figure #6: Reflective Competence[38]

[35] Roger Kane, *Conscious competence learning model, stages of learning - unconscious incompetence to unconscious competence - and other theories and models for learning and change*, http://www.businessballs.com/consciouscompetencelearningmodel.htm#will_taylor_5th_level_conscious_competence, November 2005: (accessed 16 Nov 08).

[36] Headquarters, Department of the Army, *The Army Training and Leader Development Panel Officer Study Report to the Army*, *http://www.army.mil/atld*, 2001, OS-3.

[37] Richard Paul and Linda Elder, Critical *Thinking, Tools for Taking Charge of Your Learning and Your Life*, 234.

COMPETENCY

It is essential to develop the competencies that will ensure efficiency and effectiveness to increase proficiency. Through the application of a well defined and collaborative process, the opportunity exists to achieve collective intellectual cognizance. By examining the elements that drive these competencies, the characteristics of skill, experience and knowledge can identify the need for strategic leadership. James F. Bolt observes that leadership can be taught which he asserts is rooted in a strong foundation of an enlightened decisionary process. He believes that less focus should be placed on reacting to the environment and more given to leaders who, through self reflection, derive the benefits as described in Thales —know thy self‖ in order to effect their environment.[39] Bolt postulates that through self efficacy, the strategic leader can indeed shape the environment to their desired endstate.[40]

Absent any cognitive or correlated biases, assumptions predicated upon perceptions require that inferences be made. The inherent risk is that an ill- defined scope and the resulting variables are not properly correlated. In this case, the deterministic actions taken based on the reliance of skewed information are what Herbert Simon calls "bounded rationality." The results of actions taken amidst ambiguous information causes strategic leaders to arrive at irrational or suboptimal decisions. Within this volatile, uncertain, complex and ambiguous (VUCA) environment, reliance must be placed on strategies that drive a heuristic endeavor to explore the art of the possible. Thus consideration must be given to myriad of plausible solutions in an effort to determine the best fit from a reflective FOR in order to implement appropriate actions from previous successes.

Placing too much reliance on empirical statistics or allowing undue influence from social attribution leaves one susceptible to cognitive bias.[41] Hence, the scope of how information is collected, interpreted and filtered determines the development of perceptions. Therefore the impact of how information is processed affects the formulation of understanding. Elder and Paul have established the following considerations upon which to insure critical thought precludes the pitfalls of close mindedness:

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[38] Ibid.

[39] James F. Bolt, Frances Hesselbein, Marshall Goldsmith and Richard Beckhard, —New Skills for New Leadership Roles,‖ *The Leader of the Future: New Visions, Strategies and Practices for the Next Era*, (San Francisco: Jossey-Bass, 1996), 161 – 173.

[40] Marshall Sashkin, Robert Phillips and James Hunt, —Strategic Leader Competencies,‖ *Strategic Leadership: A Multiorganizational-Level Perspective* (Westport, CT: Quorum Books, 1992), 139 – 160.

[42] ***"Elder presents the following considerations to determine whether you are being closed-minded:***

- Are you unwilling to listen to someone's reasons?
- Are you irritated by the reasons people give you?
- Do you become defensive during a discussion?

Analyze what is going on in your mind to understand the cause of close-mindedness:

- I realize I was being close-minded in this situation because...
- The thinking I was trying to hold onto is . . .
- Thinking that is potentially better is . . .
- This thinking is better because . . .‖ [43]

Within the context of the decision-making process, one can easily become quick to jump at the first available solution without having explored the art of the possible. This commonly accompanies the failure to explore all viable options and thus making it impossible to derive the best solution available. As problems are defined and solutions developed, the risk of logical fallacy can cause unrelated facts to convince one to accept a premise that is not supported. The implications of accepting information that may not be all-inclusive and may even include incorrect assumptions, can serve as the basis for a flawed perspective. The reliance on this perspective is at the heart of the consequences that stem from a lack of awareness.

To preclude biases and prevent distraction, by non-relative injects, critical thinkers must master not only the process but also the art of thinking. Therefore, it becomes imperative that the information is presented in a timely and useful manner in order to leverage a FOR with awareness that develops accurate understanding. The implications associated with the current environment drives an awareness of current conditions which proceeds from past actions. Each occurrence that requires critical thought is stimulated by ambiguity within the environment. Therefore, if the world was indeed only black and white, one's inherent ability to make an immediate decision would preclude the necessity for any form of critical thought. However, given the unpredictability of the human dimension and its affect on the environment, the need to clarify objectives and evaluate relevant circumstances that filters our perceptions becomes evident.

Thus the current environment is plagued with ambiguity, which drives assumptions that are made in accordance with the paradigms and inferences obtained through a FOR. Therefore, the critical thinker must remain aware of these distracters and take steps to overcome them.

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[41] Max H. Bazerman, *Judgment in Managerial Decision Making* (Hoboken, NJ: John Wiley & Sons, 2002), 23.
[42] Ibid.
[43] Richard Paul and Linda Elder, *Critical Thinking: Tools for Taking Charge of Your Learning & Your Life*.

CHAPTER 3 – AWARENESS

If I always appear prepared, it is because before entering upon an undertaking, I have meditated long and have foreseen what may occur. It is not genius that reveals to me suddenly and secretly what I should do in circumstances unexpected by others; it is thought and preparation.[44] *Napoleon Bonaparte*

Situational awareness is defined by Endsley, the author of *Human Capabilities and Limitations in SA*, as ―the perception of the elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future.‖[45] The focus of SA, although still in its infancy, has been employed extensively in the aeronautical, space and intelligence communities. Yet there is no single mutually acceptable definition of SA among the multitude of different variables upon which it is measured.[46] However, it is generally accepted that within the context of awareness lies the ability to develop and maintain a perspective of the big picture. Indeed, this defines the ―operational space‖ within which the environmental factors influence the ability to move, act and fulfill objectives.

INTELLECTUAL COGNITION

SA is generally accepted as the state of intellectual cognition is correlated within the dynamic environment where one operates. Hence, SA results directly from an internalized mental perspective filtered by one's perceptions and FOR. It is the correlation of this cognitive knowledge which feeds SA and validates the resulting outcome of expectations. As illustrated in Joint Publication 6 the use of information is to ―help create situational awareness as the basis for a decision.‖[47] Hence maintaining heightened SA has become increasingly essential in today's competitive world. In ―Situation Awareness Analysis and Measure,‖ authors Kaempf, Wokf and Miller observe that to be successful, a strategist must "recognize the situation provided by the challenge to the decision maker.‖[48]

SA informs and elevates knowledge to a level at which it facilitates and predicates understanding. Upon consideration and assessment of the open system, SA provides an enlightened understanding of the variables within the environment so that sound decisions are made based upon analysis garnered throughout the cognitive process. Hence, elevated understanding facilitates informed decisions while allowing for the potential to forecast deterministic second and third order affects. Therefore, the criticality of actions taken as a result of the information presented requires due diligence to engage with careful analysis and assessments in order to adequately portrays the battle space.

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[44] Quotes by Author, http://www.quotesandpoem.com/quotes/listquotes/author/napoleon-bonaparte, (Accessed 03 May 2009)

[45] Endsley, M. R. and Bostad, C. A. (1993). *Human Capabilities and Limitations in Situation Awareness,* 19/1 – 19/10.

[46] Dennehy, Kathryn and Deighton, Carole D. B., 1997, -Engineering Psychology and Cognitive Ergonomics, no. 1," Transportation Systems; Proceedings of the International Conference, Stratford upon Avon, United Kingdom; 23 – 25 Oct. 1996. 283-290.

[47] U.S. Joint Chiefs of Staff, *Joint Publication 6-0, Joint Communications System* (March 20, 2006), I-2.

[48] Daryl G. Croft, Simon P. Babury, Laurie T. Butler and Dianne C. Berry, *The Role of Awareness in Situational Awareness*, 1993, 82.

Hence by using a well developed mental model along with the benefit of a strong FOR and coupled with acute cognitive skills, the opportunity to develop adaptive plans that are reflective of the current environment can insure the fulfillment U.S. objectives. Clearly, individuals have varying levels of understanding and SA. Generally, however, cognitive skills are applied equally across the spectrum to address events as they occur within the environment. Additionally today's SA builds tomorrows FOR such that flaws in current SA are compounded by the resulting derailment of the ability to build sound understanding. Thus the quality of what SA and a sound FOR has upon providing clarity within the cognitive process are directly proportionate to the individual's ability to make effective decisions. Since SA considers all variables which represent the unpredictability found within the environment, the need to assess and ascertain the reliability of one's SA is underscored by the volatility of the environment.

The variances found within SA include spatial abilities, attention sharing, memory and perceptual skills (perceptual speed, encoding speed, vigilance and pattern matching skills) which align strategic endeavors to higher order cognitive skills (including analytic skills, cognitive complexity, field independence and locus of control).[49] Therefore, SA is linked directly to the changing variables within a dynamic environment. Moreover, it is the culmination of one's state of knowledge, fused and correlated to all aspects of the dynamic environment that are applied to their conceptual ability to grasp, adapt and correlate the cascading second and third order affects of the variables within that environment. It is these cognitive skills which allow them to directly enable the opportunity to influences, predict, shape and adapt to this dynamic environment.

LEVEL OF SITUATIONAL AWARENESS

The relationship between SA and cognition are directly interlinked. For the individual must be conscious of their competence or even aware of their incompetence in order to elevate through the levels of cognition in order to mature their SA. Considering that while an individual is at SA level 1 they are afforded the opportunity to perceive their environment. At level 2 of SA they establish understanding and at level 3 they can forecast and even predict future actions. Thus those individuals who are unconsciously unaware fail to perceive information and are unable to possess SA.

Elevating consciousness to an autonomous, effortless and largely unconscious state is at the height of SA. It is the ascension to level 5 cognition which results in the autonomous action Clausewitz's associated with the military genius discussed in chapter one. The skills found at this level enable quick, predeterministic action to be taken without conscious consideration of current circumstances. In short, if the environment replicates itself, then good decisions are made. However, if variances are apparent, then the likelihood of success is reduced. It is through the individual's unconscious awareness of their surroundings which preclude the cognitive capacity relative to their actions which prevents them from being able to explain their actions to others. Thus operating at this level fosters circular decision making based on previous variables that are devoid of potential subliminal stimuli. Under these circumstances, the highly aware individual is no longer able to explain their actions and must rely instead on logic to justify them. Thus, their lack of awareness precludes collaboration and limits the individual's overall effectiveness.[50]

[49] Ibid.

A good example of this premise is the repetitive act of driving home from work. In time, the act becomes so familiar that the driver invests little mental effort into it. Often, one arrives home unable to explain the conditions experienced during the journey. Worse yet, when asked for directions from work to home, one is frequently unable to provide them. This demonstrates that they are operating without the benefit of conscious awareness. Thus, level 5 cognition limits the determinist's ability to assess accurately the results of their action and may also result in a lack of awareness and responsiveness to new stimuli.

FUSED SA

From the clear understanding derived at level 1 SA (Perceiving) to correlating those objectives at Level 2 (Understanding), a user definable operational picture becomes critical in order to focus exclusively on the aspects that are germane to the specific decision to be made. This clarity of focus, coupled with the ability to leverage predictive analysis into the decisionary processes, enables informed decisions to be made. The efficiencies gained by timely and effective decisions enable the adaptive processes to outpace competitors within the decision making cycle. Given the immense amount of information available today, it is indeed critical to assess only the information that is relevant. Thus the means to establish a user definable picture therefore becomes necessary. Richard Paul and Linda Elder have established parameters to assist in achieving the focus that determines the relevancy of the information obtained with the following checklist:

"Ask These Questions to Make Sure Thinking Is Focused on What Is Relevant

- Am I focused on the main problem or task?
- How is this connected? How is that?
- Does my information directly relate to the problem or task?
- Where do I need to focus my attention?
- Are we being diverted to unrelated matters?
- Am I failing to consider relevant viewpoints?
- How is your point relevant to the issue we are addressing?
- What facts are actually going to help us answer the question?
- What considerations should be set aside?
- Does this truly bear on the question? How does it connect?‖ [51]

The manner in which one characterizes a situation has a direct influence on the effectiveness of their decision-making process. Because one's FOR molds the formulation of perceptions, it in-turn filters the way one views the world and thus impacts how decisions are made. The manner in which one sees and considers the problem, coupled with their level of cognitive ability, affects the individual's situational comprehension. According to Manktelow and Jones, deductive problem solving directly informs the context. Therefore, situational information (Level 1 SA-Perceiving) and the manner in which it is fused (Level 2 SA-Understanding) will directly affect the way strategy is developed to overcome current and potential threats within their environment.

[50] Ibid

[51] Richard Paul and Linda Elder, *Critical Thinking: Tools for Taking Charge of Your Learning & Your Life* (2nd Edition), (Prentice Hall, 2001), 428.

There is also reason to believe that performance is tied directly to SA. Research shows that the more complete and accurate the SA, the greater the likelihood will be of attaining a higher degree of performance.[52] Because SA helps paint a complete picture, the realm of operational art provides a means to extensively examine the realm of possibilities and the causality of their options. Hence, understanding these perspectives and associated perceptions will help illustrate the potential implications linked to a given cultural viewpoint. As unscientific as they may appear, these predictors provide a useful approach with which to assess and forecast the predisposition of expectations and their related risks within an open system.

OPERATIONALIIZING SA

Consideration must be given to when to leverage SA from both an offensive and defensive posture. While the information acted upon produces a benefit, it also reveals vulnerabilities of and to your adversary. Thus, consideration should be given to the value of withholding information either about enemy vulnerability or friendly capability. A simple cost benefit analysis will disclose when sharing SA becomes more beneficial than withholding it. However, be advised that as the U.S. contributes to the fog and resulting friction of war by their actions, the adversary will likewise endeavor to derive strategic advantage through their awareness of and use of this knowledge in their application of the operational art of war. Hence, the decision to share or withhold information becomes difficult given the elusive nature of the causality of action associated with the resulting predisposition of this information. Joint Publication 3-0 enlightens critical strategic thinkers that, ―decision-making is both art and science. Information management, awareness of the operational environment, a sound battle rhythm and the establishment of commander's critical information requirements (CCIRs) facilitate decision-making.‖ [53]

VALUE OF SA

The complexities of warfare continue to grow well beyond the rules typically associated with conventional confrontations. Only by understanding the science of the closed system, aided by the unpredictability of the open system, will planners be fully capable to focus the operational art necessary to meet and overcome current and future threats. Once operationalized, SA becomes a remarkably valuable and powerful tool at the strategic, operational and tactical level. Notably, however, its greatest benefit can be derived at the strategic level. By incorporating the benefits of good SA into operational design, strategic planners thus become empowered to develop adaptive plans that are fully informed in order fulfill military objectives. Joint Publication 5-0 observes that the

> ―JIPOE is a process that enables JFCs and their staffs to visualize adversary capabilities and potential COAs across all dimensions of the operational environment….This process, combined with the COP, offer information and intelligence products provides the JFC with the tools necessary to achieve situational awareness.‖ [54]

[52] Endsley, 1990

[53] U.S. Joint Chiefs of Staff, *Joint Publication 3-0, Joint Operations* (DATE?), III-3.

[54] U.S. Joint Chiefs of Staff, *Joint Publication 5-0, Joint Operation Planning* (DATE?), I-28

CHAPTER 4

"Global dominance will be achieved by those that most clearly understand the role of information and the power of knowledge that flows from it."[55] *Admiral(r) David B. Jeremiah*

COMPLEXITY THEORY

The complexity theory provides useful insight into the interrelationships between the cognitive models presented in Chapter 1, the value of Awareness in Chapter 2 and their collective impact on military operations. The study of this theory outlines the convergence of how to interpret the results of open and closed systems to reveal the underlying order within a chaotic system. It is the inexplicable presence of this order that is critical to establishing valid models upon which strategic planners can develop reliable options for military operations. Thus, deterministic actions can be taken to minimize the fog and friction of war brought on by the unpredictability of human influence within the open system.

Today's dynamic environment is constantly changing and adapting. Fortunately, the complexity theory provides the means with which to derive order from apparent chaos. By the application of the cognitive process, one becomes able to leverage SA and their FOR in order to develop understanding so that they can provide some assemblelance of order to this chaotic environment. As a result, the ability to become knowledgeable and understand the implications and causality of action facilitates the potentiality of deterministic analysis which can yield useful predictive action.

OODA LOOP

Because of the development of understanding the complexities of the continuum loop found in the decision-making process, Colonel John Boyd developed a model to provide balance and relevancy to both time and effect. By reducing this loop to its constituent elements of observe, orient, decide and act, Col Boyd developed a useful model for the decessionary process known as the OODA Loop. An early pioneer with a great respect for what would soon be known as information strategy; Col Boyd recognized that one must first observe and become aware of their environment before it can be understood. As awareness of the given situation becomes apparent, it is important to understand the interrelationships between these diverse and complex environments. By examining their corresponding interconnectivity, the individual can develop a course of action that aligns variables within the environment toward those objectives that fulfill the desired end-state.

- ***"OBSERVATION***: the collection of data by means of the senses
- ***ORIENTATION***: the analysis and synthesis of data to form one's current mental perspective
- ***DECISION***: the determination of a course of action based on one's current mental perspective
- ***ACT***: the physical playing-out of decisions‖[56]

[55] Felker, Ed, *Information Warfare: View of the Future, A Common Perspective* (September 1995), 18.

[56] Coram, Robert, Boyd: *The Fighter Pilot Who Changed the Art of War* (New York: Backbay Books, 2002), 327

Colonel Boyd observes that humans operate using a divisionary process that is shaped by an awareness which is predicated by observation. Hence, he asserts that observation is the first and most important step in the process. Clearly, building on false or flawed perceptions means that the results of those actions will also be flawed. Therefore, to derive strategic advantage over one's adversaries, it is critical to develop more accurate and timely information, since this will allow the individual to make opportunistic and informed decisions inside their enemy's OODA Loop.

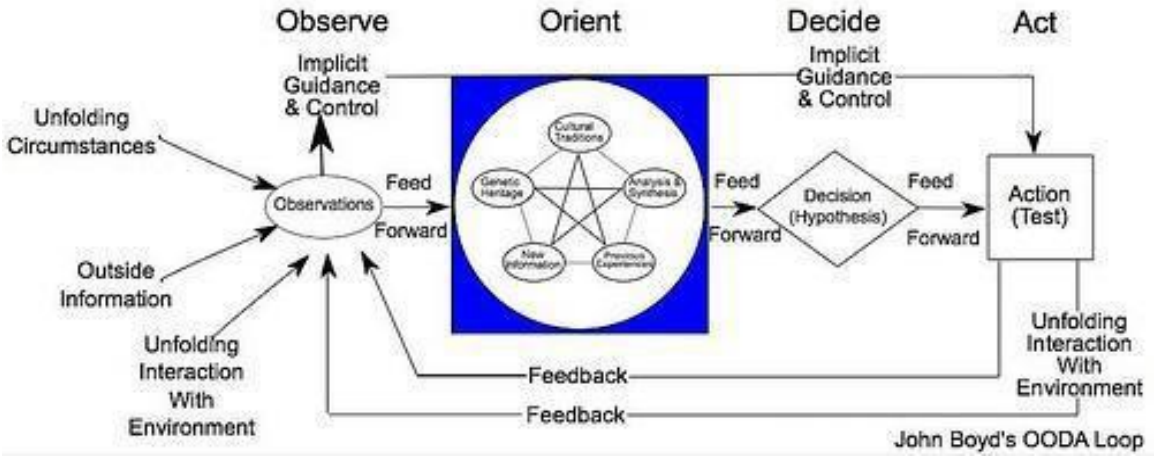

Figure #7: Col John Boyd's OODA Loop[57]

Col Boyd frames how the understanding and application of knowledge serves to drive the interrelationship of collected information in figure 7 above in order to achieve enlightened awareness. After careful analysis and deduction, one can achieve an understanding of specific relationships that result from induction and synthesis of thought. As these concepts become increasingly clear, so does the causality of the constituent elements relative to how to see and understand the environment. By achieving clear cognition, derived from carefully consideration of the domain, one begins to understand the effects their actions exert upon the environment. When these relationships are understood, informed actions can be taken to effectively impact the environment, thus enabling the potentiality of their influence to shape the current surroundings in the manner intended.

By correlating SA to the OODA Loop, we can align Endsley's mental model of perception, comprehension and projection directly with Bloom's Taxonomy. When considering the factors discussed previously, relative to the cognitive model, we can easily fold the output of the OODA Loop to mature knowledge in an evolutionary manner. As SA is established, refined and maintained throughout this process, ongoing efforts to track and assess both the timeliness and validity of the information must be developed. Thus heightened SA derived throughout this process will directly elevate the level of understanding.[58] Through understanding the cognitive process of inductive and deductive thought, the strategic thinker can fuse seemingly disparate information into actionable knowledge. The OODA Loop allows the correlation of this information into small, easily digestible pieces in order to synthesize and elevate it into awareness that drives understanding.

[57] Ibid., 344,

[58] Rohini K. Srihari, Wei Li, Cheng Niu and Corne, Thomas. InfoXtract: A Customizable Intermediate Level Information Extraction Engine. *Workshop on the Software Engineering and Architecture of Language Technology Systems (SEALTS), North American Chapter of the Association of Computational Linguistics-Human Language Technology Conference 2003*

Observation either assist with the formulation toward understanding of the environment, or the environment imparts understanding through those observations. Clearly, the relationships and their resulting causality are among the key determinants of how awareness is developed. Indeed, a thorough understanding of the synthesis of these relationships provides significant insight into the effects that each has on the other as well as on the environment. Through a deterministic process of focusing awareness upon the second and third order effects, action is taken to elicit the desired results. Therefore, heightened awareness enables a greater appreciation of how the environment is affected and influence by external stimuli. It is by identifying recurring situations and providing the opportunity, according to McGuinness and Foy, to drive toward resolution of the desired objectives through ongoing efforts to meta tag and fuse data that information remains accessible for future analysis. [59] The net effects of this process reveals the answer to the following questions:

- ***"Perception*** – attempts to answer what is actually going on
- ***Comprehension*** – asks what is actually going on
- ***Projection*** – attempts to identify what is most likely to happen
- ***Resolutions*** – provides consideration as to what should be done‖[60]

Once these questions are addressed and answered, it becomes clear that SA matures one's operational FOR to a level necessary to provide the foundation upon which predictive analysis is based. From this, modeling will allow for the identification of patterns from past events and enable forecasting for predictive future actions so critical to applying understanding in the decisionary process.[61]

Given the dynamic nature of the world environment, it is critically important to remain adaptive to mitigate emerging threats. For as Gödel, Heisenberg and the Second Law of Thermodynamics points out, disorder injected into the environment, increases exponentially throughout the continuum. [62] Thus, through this dialectic approach, the opportunity to validate assertions via continual reassessment is facilitated by informed decisions in order fulfill prescribed objectives.[63] Hence, consideration must be given to the opponents decisionary process for it holds the propensity to preclude reactionary action within your operational environment. Thus by validating the FOR and assess current SA, the opportunity exit to preclude falling prey to unintended consequences.

APPLICATION OF STRATEGY

In his book, ―Strategic Theory for the 21st Century,‖ Yarger examines how strategic decisions are assessed against the ends, ways and means. Through an exploration of the art of the possible, he ascertains how strategy is developed and implemented in order to derive a better understanding of how best to apply it. He further encourages examining the complexity of the chaotic system to gain a greater appreciation of those variables that influence it. By endeavoring to focus upon requirements and not become distracted by cognitive dissonances, the ability to actualize opportune benefits while precluding the impact of opportune cost exists. For in full awareness, a cost benefit analysis will ultimately reveal the benefit to be derived from long-term return on intellectually invested capital. In this vain, Yarger suggest the following questions be examined and assessed.[64]

[59] McGuinness, Barry and Foy, Louise, ―A subjective measure of SA: The Crew Awareness Rating Scale (CARS),‖ in *Proc of the First Human Performance, Situation Awareness and Automation Conference* (Savannah, GA, October 2000).
[60] Ibid
[61] Rohini K. Srihari, InfoXtract: *A Customizable Intermediate Level Information Extraction Engine*.
[62] Boyd, John, *Destruction and Creation*, http://74.125.93.104/search?q=cache:wMD01_p7708J:www.goalsys.com/books/documents/DESTRUCTION_AND_CREATION.pdf+G%C3%B6del,+Heisenberg,+and+the+Second+Law+of+Thermodynamics&cd=5&hl=en&ct=clnk&gl=us (accessed March 19, 2009), 7.
[63] Ibid.

- -What assumptions were made in this strategy and what is the effect if any of

them is wrong?

- What internal or external factors were considered in the development of the strategy?
- What change in regard to these factors would influence positively or negatively the success or effectiveness of the strategy?
- What flexibility or adaptability is inherent in the components of the strategy?
- How can the strategy be modified and at what cost?
- How will other actors react to what has been attempted or achieved?
- How will they react to the way in which the strategy was pursued?
- What is the balance between intended and unintended consequences?
- How will chance or friction play in this strategy?‖[65]

After examining the causality of past events in relation to current circumstances, and with the addition of a sustained drive for the pursuit of knowledge, the strategist can continually refine and achieve a better perspective upon which to develop enlightened understanding. As Yarger observes, strategy teaches one how to think rather than what to think. Therefore, by taking a proactive approach toward understanding the realm of possibilities tempered by constraints in time, resources and intellectual capital the strategist is confronted with and must take ownership of the consequences of the plan. [66]

HISTORIC EXAMPLE

Strategic opportunities and operational benefits of the UM can be seen in the events that unfolded during the Cuban missile crisis. The Cold War epilogue remains fresh in our collective memory as a result of the most recent nuclear arms race between the Soviet Union and the United States. Due to the inability to collect data regarding the nuclear strength of both nations, a series of incorrect assumptions were made. An obscure FOR resulted in a fallacy to knowledge thus causing the U.S. to develop a faulty understanding that they lagged behind the USSR in nuclear capacity. However, despite the clear nuclear superiority in both numbers and strategic geographic alignment, the U.S. leveraged its flawed FOR to make decisions that contributed toward and perpetuated the growing confrontational relationship with the USSR to the brink of WWIII.

The Soviets had developed an equally dubious paradigm based on what they perceived as an aggressive stance by the U.S. to continue to perpetuate its lead in the arms race. Thus, significant mistrust stemmed from the USSR's perception, based on flawed paradigms and fueled by fear perpetuated uninformed decisions. Hence a misinformed FOR established inaccurate SA by both countries regarding strategic nuclear capacity which drove them to the flashpoint that became the Cuban Missile Crisis. Leading up to this event, the U.S. mitigated what it perceived as a threat posed by Khrushchev, by positioning missiles only 90 miles from the USSR's borders in Turkey. In response, Russia endeavored to in their view rebalance the nuclear chessboard by situating missiles in Cuba. Both nations now threatened by medium range missiles, that if launched did not allow adequate time to respond with retaliatory recourse, were justifiably concern. The USSR feeling that balance had simply been restored to the nuclear equation by their actions in Cuba was at a loss to understand the alarm within the U.S. administration. The U.SD. observing an increase threat to their sovereignty and national security felt obligated to take action to mitigate this new threat.

[64] Harry R. Yarger, *Strategic Theory for the 21 Century: The Little Book on Big Strategy* (February 2006), 73 – 75.
[65] Ibid., 71.
[66] Ibid., 73-75.

Ultimately, President Kennedy's administration demonstrated a lack of

awareness about why the Soviet Union was so motivated to place missiles in Cuba and triggered alarms of impending attack. Upon reflective consideration and utilizing Yarger's approach to exploring the art of possibilities, the ability to discern the causality of the USSR's actions, Kennedy was presented with the following three options:

- —Engage Castro and Khrushchev on the world stage in an effortto resolve the crisis through diplomacy
- Engage in open surveillance coupled with a blockade to monitor and preclude employment of additional weapons
- Conduct a military offensive to include air attacks and a ground invasion‖[67]

Fortunately, President Kennedy understood the ramifications and chose to proceed with caution using an iterative approach that provided maximum flexibility of successive options to provide the means to adapt to the situation as it unfolded. It was this enabled the U.S. to achieve a better understanding based on matured knowledge it gained while working through the situation. President Kennedy's rational approach, which Allison and Zelikow points out in their book, —Essence of Decision‖ that —the attempt to explain international events by recounting the aims and calculations of nations or governments is the trademark of the Rational Actor Model.‖[68] Ultimately, it was President Kennedy's careful, surefootedness and action as a rational actor which allowed rational heads prevail and redeem the day—and quite possibly the world.

CAUSALITY OF ACTION

It is through the iterative approach conceived by Boyd which provided the opportunity to assess and identify actions taken during the Cuban Missile Crisis as —nation A's best choice depends on nation B's choice,‖ since —recognition of this fact highlights the significance of A of communication, signaling, commitment and bargaining aimed at manipulating B's information and choices.‖[69] Clearly, it is imperative to take an interactive approach toward understanding the causality of one's actions since the —explicit statements and actions of nations constitute strategic signals. Adversaries watch and interpret each other's behavior, each aware that his own actions are being interpreted, each acting with a consciousness of the expectations he creates. Thus, the paradoxical regression in which I know that he knows that I know, etc.‖ exist.[70]

[70] Ibid., 41.

RECOMMENDATION

"If he had one hour to save the world he would spend fifty-five minutes defining the problem and only five minutes finding the solution.[71]‖ - Albert Einstein

Ultimately, all things in life, war and politics are only as difficult and complex as we make them. By considering history and correlating it with current conditions based on enlightened understanding, the answer often becomes self-evident. It thus is incumbent upon our military leaders to determine the path that will most efficiently and expeditiously fulfill objectives while expending the least resources and incurring minimal risk. Therefore, by working smarter, the opportunity to reduce the complexity, the fog and the resulting friction of war, strategic leaders can simplify actions taken through informed decisions.

INTELLECTUAL INVESTMENT

It is thus the recommendation of the author that all aspects of military education, from the academies to ongoing PME, establish a substantial foundation of reflective thought steeped in a strong FOR that fully matures SA in order to develop and shape the current environment to coincide with U.S. objectives. By reviewing both successes and failures of past actions in relation to current events, threats can be mitigated through a common architecture leveraged upon the cognitive capability of prudent knowledge. Thus, the maturation of shared awareness through the collaborative capacity of interlinked synergistic endeavors will reveal the way forward that serves U.S. national interest.

At the strategic level, the investment made to develop future leaders at universities and military academies will indeed represent a short-term cost that will ultimately provide long-term benefits. The need for continuing education to layer learning, inspire intellectual rigor and exercise cognition is absolutely critical. The military has certainly developed such programs through professional military education (PME). Accordingly, the knowledge imparted through education must be based on a strong foundation of theory, process and application. Therefore, this paper has presented an UM< that defines how we think, establishes what to think about and shows how to collectively leverage intellectual capital to overcome current and future challenges.

At the operational level, leaders must take an active approach to mentoring their subordinates in order to continually invest in their intellectual capacity. Additionally, they must endeavor to nurture their FOR with the benefit of experience to enable them to progress through the cognitive process in order to stimulate their awareness and elevate their understanding. Notably, this collaborative endeavor is mutually beneficial, for the questions received during the efforts to provide mentorship will validate and open perspectives to the art of the possible. Thereby this symbiotic relationship between student and teacher elevates the student from stage 1 (Unconscious Incompetence) through stages 2 (conscious incompetence) to stage 3 (conscious competence) of the cognitive process. Hence, the means by which teachers can be grounded academically and remain receptive to exploring the art of the possible through the eyes of their students will enable them to realize the benefits of stage 3 (conscious competence) without encountering the obsolescence found in stage 4 (unconscious competence) of the cognitive model. By using this collaborative approach to explore the application and operationalization of theories, concepts and notions, continual learning ensues along with the means to effectively apply the facts to resolve pressing problems. Ultimately the benefits derived from this symbiotic relationship will allow the benefactor to reap substantial intellectual return on their academic and experiential investment.

[67] Library Think Quest, Cuban Missile Crisis 14 days in October, http://library.thinkquest.org/11046/days/index.html (accessed May 12 2009).

COLLABORATION

Through organizing information and correlating it to the objectives at hand, the strategic leader becomes empowered with the means to assimilate essential and relevant information to properly apply it to current situations and resulting circumstances. During the assessment stage, it is therefore essential that a user's definable operational picture (UDOP) be developed to ensure decision makers are not inundated with unrelated information. The results of these endeavors will act as a catalyst to provide commonality of SA to facilitate collaborative actions. A recent RAND study concluded that the lack of a COP creates challenges to the ability to vertically and horizontally depict the battlefield.[72] Therefore by establishing a COP, SA is elevated through the collaborative endeavors that synchronize actions within a netcentric environment.[73] Joint Publication 1-02 observes that the —common operational picture facilitates collaborative planning and assists all echelons to achieve situational awareness.ll[74]Therefore it is through this Common Operational Picture (COP) that synergistic endeavors become aligned to produce clarity of focus to enable unity of purpose.

ASSESSMENT

A cost-benefit analyses must be conducted to insure that the most important issues are addressed first and that scarce resources are prioritized and applied precisely to meet the problems that pose the greatest potential threat.

Throughout this process, full consideration must also be given to opportune cost and potential benefits associated with action taken and results achieved. Thus, the implications of enlightenment builds knowledge which establishes the understanding necessary for transformation essential for success on the field of battle. Therefore by elevating awareness and maximizing the value gained by reviewing our lessons learned through a broad FOR, understanding can be developed and matured to overcome the complexities of the VUCA environment.

To ensure that decisions can be made in full awareness of the causality of the associated second and third order of effects, predictive analysis modeling offers the potential to assess options and establish the best course of action. Thus by coordinating, synchronizing, modeling and managing information through technological tools, an organization can efficiently correlate resource allocation in order to empower leaders to effectively fulfill their objectives.Therefore, technological capabilities must be developed that facilitate capturing, correlating, fusing and disseminating current and historical information. Once the means to continually update a shared FOR and validate current SA is achieved, actionable knowledge can be fused to produce the propensity for enlightened understanding which is necessary to shape the environment to the desired end state.

The need to apply an adaptive approach during the planning process will imbue strategic leaders with the necessary flexibility to develop branch and sequel plans essential to effectively confront a dynamic changing world environment. Adopting the mind-set that prior planning prevents poor performance; the need for accurate, timely and reliable information becomes critical to achieving the level of awareness essential for producing informed plans. Thus those processes set forth within operational planning provides the mechanism necessary to elevate information through the cognitive process, which enables planners to devise approaches that are steeped in strategic forethought.

[68] Allison, Graham and Zelikow, Philp, *Essence of Decision: Explaining the Cuban Missile Crisis*, (Addison-Wesley 1999), 15.
[69] Ibid., 23.

[71] Einstein's Secrets to Amazing Problem Solving, http://litemind.com/problem-definition/ (accessed May 11, 2009)

MANAGING INFORMATION

The continual acquisition of data to generate actionable information is critical to mature the depth and breadth of knowledge. The impact and implications associated with gaining and maintaining information superiority are just becoming evident. Thus, the benefits derived from heightened awareness provide the ability to decrease the uncertainty and reduce the fog and friction surrounding the field of conflict. Hence the cost of being unaware and the benefit of the strategic advantages gained by being aware bring to light the criticality of mitigating threats to enable operational capabilities in order to drive predictive analysis that maximizes tactical capacity. Therefore, ongoing efforts must be made to elevate awareness to ensure that the data previously organized into information is accessible on demand. It is through the asymmetric advantage derived from the knowledge that builds understanding that the U.S. will be able to maintain and leverage their strategic capacity.

To provide the commander with reliable information in a UDOP, information must be instantly accessible. Joint Publication 6 identifies the necessary capabilities within Information Management (IM) to allow the joint community to —dynamically tailor and prioritize their information requirements to support the mission and environment. IM is facilitated by a variety of common information sharing services such as messaging, discovery and delivery of information and collaboration as depicted in the IM figure 7 below.[75] Thus by establishing a sound IM construct, the means exist to make available the right information to the right person at the right time and place necessary for effective decisions.

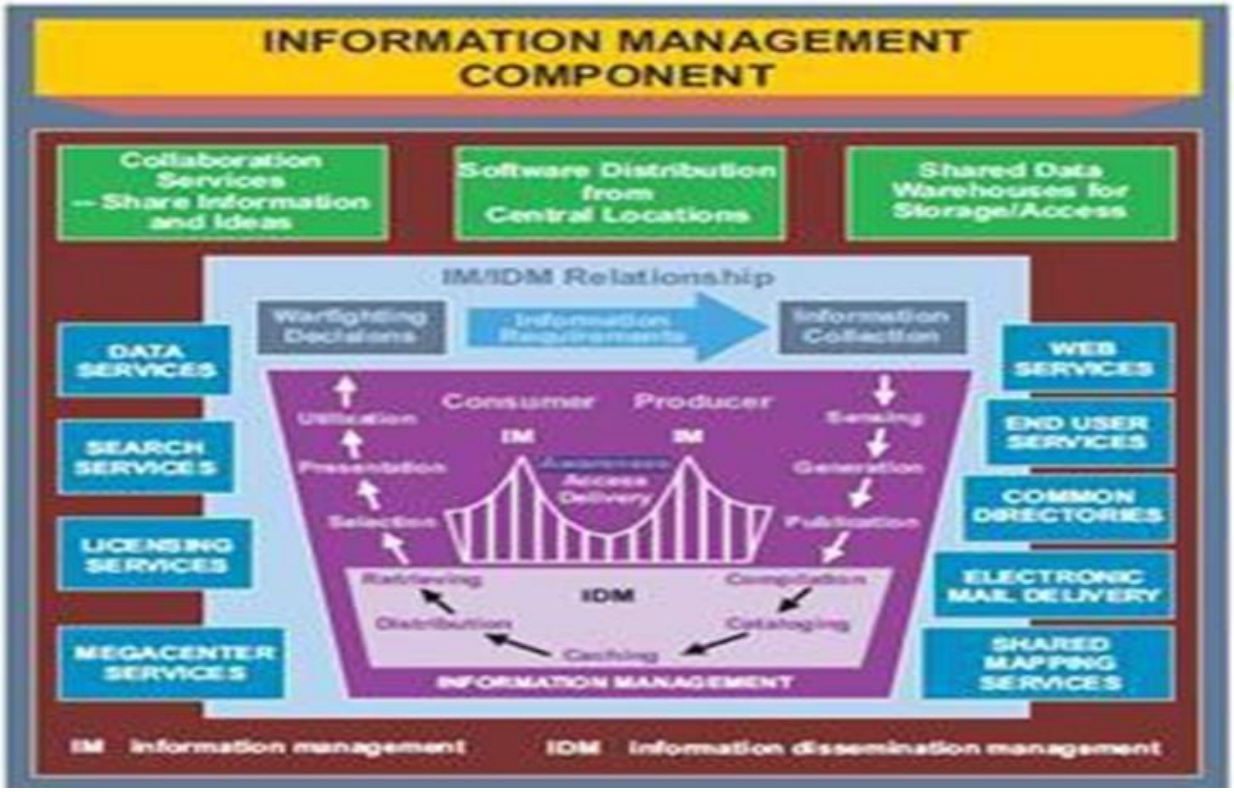

Figure #8: Information Management Component[76]

[72] Stewart Jr., John F. BG (P), *Operation Desert Storm, The Military Intelligence Story: A View from the G-2, 3d U.S. Army* (Riyadh, Saudi Arabia, April 1991), 28

[73] U.S. Joint Chiefs of Staff, *Joint Publication 6-0, Joint Communications Systems* (Washington, DC: Department Defense, March 20, 2006), IV-3.

[74] U.S. Joint Chiefs of Staff, *Joint Publication 1-02, Department of Defense Dictionary of Military and Associated Terms* (Washington, DC: Department Defense, April 12, 2001).

[75] U.S. Joint Chiefs of Staff, Joint Publication 6-0, Joint Communications Systems, A-3.

The complexities and the manner in which information is amassed, organized, fused and disseminated is compounded by the number of agencies involved in this process. Given the breadth and depth of scope, it becomes apparent that there is a definitive need to coordinate, share, correlate and validate the information acquired to preclude redundancy. In view of the legal requirements for information collection, coupled with the historical means and current focus, each of these agencies plays a justifiable role in information accumulation. A central organization capable of focusing and guiding the collaborative effort would prove beneficial in developing synergy.

The requirement to oversee, manage, protect and provide accessibility along with the capacity to effectively and efficiently distribute information is absolutely essential. Given the increasing demands and growing reliance upon this information, the establishment of an agency to oversee and mitigate the risk to U.S. information superiority is paramount. As U.S. reliance and dependency on information increases, we must be cognizant of the inherent vulnerability found in cyberspace. In view of increased mission demands, the criticality of expediting these efforts to provide oversight by such an organization in order to protect and insure the viability of the domain of cyberspace is critical. Given the ease of entry of this vast unregulated space and the inherent risk, the need to maintain information superiority has never been greater. Compounded by the potential of consequences associated with losing dominance within this vital domain, the U.S. can ill afford to risk losing the strategic advantage essential to acquiring, managing and fusing information.

Unfortunately, today's fusion centers are under-resourced in equipment and human intellectual capital. This prevents them from accommodating the growing need for information that will paint today's operational picture. Hence the loss of yesterday's information will substantially inhibit our ability to achieve a reliable predictive analysis. Thus a lack of attention and support in today's

centers directly and negatively affects the scope and quality of their efforts which are critical to the maturation of U.S. SA. Ultimately, it is through reliable and accurate awareness coupled with a strong FOR that the potential to capitalize upon lessons learned from historical actions exist.

> Joint Publication 3-0 highlights the criticality of providing commanders the —critical support in communications, navigation, intelligence, reconnaissance, surveillance, targeting, ballistic missile warning and environmental sensing that greatly facilitate command. The precision with which these systems operate significantly improves the speed and accuracy of the information that commanders at all levels exchange vertically and laterally, thereby enhancing their awareness of the operational environment.‖[77] Given that knowledge is power and to actualize it, a nation must first elevate its level of awareness to facilitate enlightened understanding.

The disparity that absorbs the shift of intellectual consciousness will undoubtedly be the source of the shift of power. In the future, our adversaries are likely to utilize the benefits of cyberspace in order to gain a strategic advantage in their efforts to wage information warfare. Given the relative ease of entry and inexpensive means to operate within this domain, U.S. adversaries could easily garner an asymmetric advantage to the detriment of U.S. interest. Thus, the loss of information superiority could have devastating consequences to U.S. citizens, servicemen and even our way of life.

[76] Ibid.

[77] U.S. Joint Chiefs of Staff, Joint Publication 3-0, Joint Operations, III-9.

CONCLUSION

History is replete with examples of the consequences of uninformed decisions. The need to make informed decisions and work intelligently has never been more critical than it is today. More than ever before, the opportune cost of doing something wrong or doing nothing at all is far outweighed by a rash and reactionary approach that precludes considering the art of the possible.

Therefore, the prediction of future consequences lie within the FOR established by yesterday's SA. Today's leaders must be open and receptive to reviewing past actions in order to be able to adapt to and overcome current threats so that they can achieve the objectives that will ensure future U.S. viability.

History enlightens those with relative competence that they do not always understand that they do not understand. Therefore, it is incumbent upon strategic thinkers to evaluate critically the reliability of information and the value of heightened awareness, since this will drive actions that serve to facilitate the fulfillment of long-term objectives. Thus, the UM establishes the framework that enables the achievement of stated objectives while exploring the art of the possible.

When considering available data and taking the time to organize it and fuse it into information, the resulting knowledge will open one's eyes and mind to the realm of possibilities. It is within this realm that the exploration of knowledge as it relates to one's FOR correlates current circumstances to past experiences in order to enable the strategic leader to elevate their cognition through critical thought. Predicated upon a good FOR, the decision maker can leverage their knowledge, infused with heightened SA, to develop the understanding essential for enlightened decisions critical in today's VUCA environment. Thus by utilizing the UM as outlined below in figure 8, the strategic leader is armed with the means to make informed decisions that support U.S. national interest.

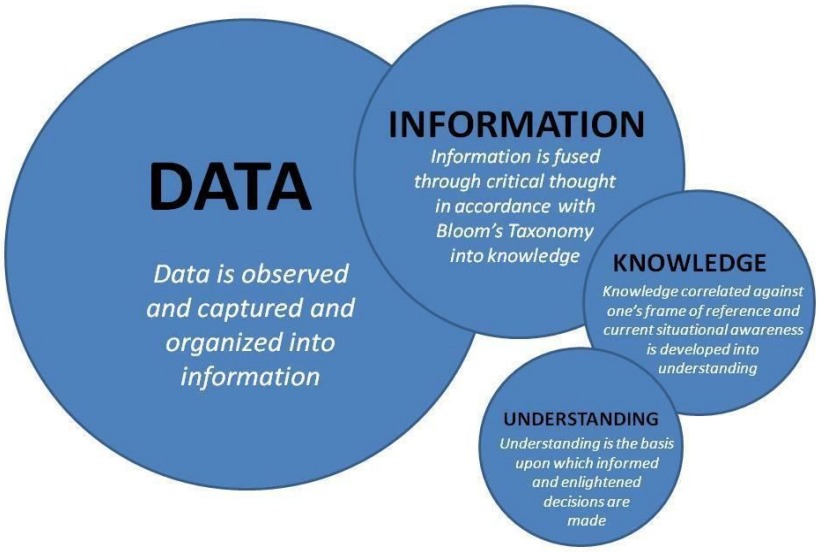

Figure #9 (Author's Representation of an

1. *Data is observed, captured and organized into information*
2. *Information is fused in accordance with Bloom's Taxonomy through critical thinking into knowledge*
3. *Knowledge correlated against one's FOR and current SA is developed into understanding which is the basis upon which informed and enlightened decisions are made*

The necessity to review the art of war across all lines of operation and apply its myriad of tools—including information—at the operational level of war is critical to success in warfare. Victory at the tactical level is predicated upon sound SA at the strategic and operational levels. Thus, strategic planners must remain cognitively aware that the scientific application of war within a closed system may not adequately recognize the variables presented by an adversary within an open system. Hence, those in level 1, who are blinded by overzealous aspirations and unaware of what they do not know, refuse to appreciate the complexities of this open system. Thereby it is their inability to understand that their view of the environment is myopic and bounded by the confines of a closed system which makes such individuals a liability.

Ultimately, those who have made progress and rely on past actions to achieve future success, find themselves at level 4 (unconscious competence) of cognition and situational awareness. However, they are unaware and thus oblivious to the changing conditions and implications found in the variables in an open and dynamic system. This lack of awareness and unwillingness to understand the implications resulting in the persistent misapplication of yesterday's tools against today's problems also become a liability. Thus, those in stages 1 (unconscious incompetence) and 4 (unconscious competence) of the cognitive model have developed an overconfidence or even egotistical close- mindedness. However, those in stages 2 (conscious incompetence) and 3 (conscious competence) of the cognitive model are aware of and understand their limitations, thus making them amenable to utilizing a humble open-minded approach. It is this perspective which provides them the means to drive toward awareness to elevate their understanding and learn to overcome the challenges and threats presented in this adaptive and open environment.

As a competency, SA minimizes the resulting chaos by employing knowledge throughout the cognitive process conscious of the implications as prescribed within the complexity theory. Thus, the means to organize past information into a FOR and apply it to current situations ensure the ability to leverage the necessary resources to meet future objectives. Therefore, SA can reveal how best to properly apply scarce resources and leverage the right capability at the right time and place, so that U.S. can successfully meet its prescribed objectives. The application of operational art presents unique opportunities to examine the nature and implications as well as the cause and effect of a problem. It is this consideration which enables the assessment of the second and third order affects related to actions taken compared to results achieved. Thus, the effective use of adaptive planning through the operational design process, can establish a strategy that serves to fulfill these U.S. national objectives. Technology serves to integrate the means to facilitate a strategic advantage derived by a netcentric force in order to facilitate awareness at all levels of operation. Hence by leveraging forethought of adaptive planning and the advantage offered by the application technological means to unify and enable a self-synchronized force, the resulting synergy from their collaborative efforts drives an asymmetric strategic advantage.

By utilizing the benefits of SA as a competency, the opportunity exists to overcome the challenges resulting from the complexities of the world environment through enlightened understanding. The causality of one's actions upon those variables presented will reveal the enemy's motivation to act and determine the impacts of their intentions and objectives. Therefore, by striving to continually elevate, refine and appreciate the implications of SA, and the resulting complexities associated with its maturation, the pathway to understanding, as outlined by the UM, becomes clearly apparent. Therefore, SA is the critical competency necessary to mature knowledge into enlightened understanding which enables the alignment of U.S. means in such a way as to leverage all instruments of national power to fulfill those interests which serve U.S. national ends.

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TAB 3

Knowledge that Surpasses Understanding

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The Wisdom to Apply Knowledge That Surpasses 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 vis-à-vis thedesired 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 US 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 will affect the US now and into the future, and to obtain a full understanding of their second and third order effects, it is first 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 that support U.S. national interests. 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 U.S. 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 the United States focus on leveraging data as a strategic asset.

The Value Proposition of Data

"Engage people with what they expect;
***it is what they are able to* discern and confirms their projections.**

It settles them into predictable patterns of response, occupying their minds while you wait for the extraordinary moment – that which they cannot anticipate."

- Sun Tzu -

Value Proposition and the Chief Data Officer (CDO):

It is important to explore the art of the possible within the science of the probable to maximize potential opportunities as they present themselves. Thus, one must live in the question rather than being bound by current circumstances and blindly accepting the answer the life throws your way. In a world with so many questions about where we are, where we are going, and when will we get there, one must understand that all too often, answers may no longer be relevant. The likelihood increases that those answers are both wrong and completely distracting. As today's analytical world is full of possibilities, it has also created among us an insatiable appetite to be informed of what the answer is in all circumstances.

If given a chance, the data will paint a picture for those willing to see it, a picture that illustrates the vast opportunities and options available in today's information society. Briefly, astute individuals understand that taking a strategic approach and availing themselves of the opportunities that arise enables them to live in the art of the possible through proper application of the science of the probable. Peter Pace, DoD's Chief of the Joint Staff, was attune to this when he advised:

"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 its proper application. Accordingly, one must ensure that data is fit for the purpose by ensuring it possesses previously ascribed characteristics of data to assure its usefulness. By applying this process, we can be assured of the ability to identify risks and determine the opportunities available to achieve those strategic objectives.

To realize the value of data, it must be organized, structured and managed in a way that makes it actionable, a condition we call *data in action.* Today's efforts in analytics are being undertaken to solve some of the complexities of Big Data, particularly where it lacks both quality and structure. In this case, the adage garbage in, garbage out is apropos. For today's data lacks both structure and assessment as to its veracity. Without quality and structure, the complex association that results from the relational dependencies of the information adds to the difficulty involved with making informed decisions based on knowledge that fails to develop an adequate understanding. Thus, we must make three efforts to collect and Assess the veracity of data, Characterize the relationships of information, and then and only by assessing the veracity of data and characterizing its relationships with information will we be able to develop knowledge to the point that it can enlighten understanding and empower us to make wise choices.

		- Collect	
Access	- Data	- Catalog	- Veracity
Characterize	- Information	- Correlate	- Relationship
Evolve	- Knowledge	- Context	- Aware
Enlighten	- Understanding	- Cost/Benefit	- Perspective
Empower	- Wisdom	- Cognition - Causality	- Think - Consequence

LEADERSHIP – CDO

"A leader leads by example not force"

- Sun Tzu –

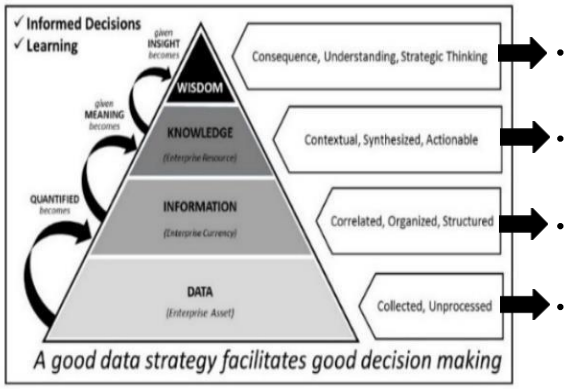
History is replete with examples of failures to learn from the past. Leaders often disclose how in hindsight, they would have had the opportunity to learn and evolve from others' experiences. In today's interconnected world, opportunities such as those allow people to see the means available to become aware of obstacles, identify opportunities and learn to adapt and overcome in today's Volatile, Uncertain, Complex and often Ambiguous (VUCA) environment. Essentially, as we become aware and learn from the experiences of others, the future can indeed be revealed via a concerted assessment of history.

By employing a well-established process that serves as the baseline for growth and evolution, the prudent leader can acquire the means to develop sound strategy. Elevated by a heightened awareness of both past actions and current circumstances, leaders learn to view problems as opportunities to alter their circumstances and successfully confront emerging threats. Thus, by embracing data as a strategic asset, organizations can unleash the power of information to make informed and enlightened decisions—in full consideration of the potential consequences of their actions. Given the mass and complexity of this task, most organizations have engaged the CDO as their principle data strategist, who leads efforts toward improving data quality, data sharing and the development of essential capabilities to unleash the power of information in data products and services.

Given our increasing reliance on data, its growing mass and the resulting complexity associated with information that pertains to strategic endeavors to make informed decisions, today's high performing organizations are formalizing these efforts under the leadership and oversight of a CDO. By doing so, they actualize the value proposition of a data-driven organization. To that end, the following is the framework and construct of a CDO:

Primary Duties:

- Leads and collaborates on data strategy for the organization to ensure data is informative, available, reliable, consistent, accessible and timely to support mission and activities of the organization
- Ensures agency data is interoperable by standardizing data models and encouraging collaboration across the department and agency to ensure it is visible, accessible, understandable, linked and trustworthy
- Establishes and enforces a Data Management Governance structure which includes how the agency collects, uses, stores, manages and publishesdata
- Creates data sharing policies that increase effectiveness and efficiency of managing data; analyzes and assesses its overarching strategic, operational and tacticalvalue
- Leads agency efforts to track data inventories, collections, data purchases and databases that inform and enlighten conceptual, logical and physical data models that provide relational linkages between datasets
- In collaboration with the CIO and CTO, enables the staff of data specialists to provide insightful, actionable and real-time analytics based on agencyneeds



- *Gaining insight into challenging problems associated with improving processes, productivity and performance realizing cost savings and effective ROI*
- *Ability to evaluate predictions accurately, develop plans and produce forecasts to increase mission assurance/reliability/effectiveness*
- Achieve Improved data transparency and availability to enable organizations to make sound decisions
- Support regulatory compliance and the use of data to improve operations

Overall, the CDO provides the necessary vision, inspiration and leadership to ensure the agency makes timely, high-quality data available to internal and external stakeholders to fulfill its mission. The CDO's role is part data strategist and adviser, part steward for improving data quality, part evangelist for data sharing, part technologist and part developer of new data products.

The CDO seeks to:

- Manage the open government data effort including coordinating and creating public data products
- Decrease the cost of managing data and increase the value of the data we have
- Improve how the agency collects, uses, manages and publishes data
- Leads efforts to track data collections, data purchases, databases, physical data models and linkages
- Improve data quality and establish metrics that are specific, measurable, actionable, realistic and timely
- Ensure data is visible, accessible, understandable, linked and trustworthy to support mission activities
- Standardize data models by leading and facilitating collaboration with agency-wide data working group

As the principal data steward and senior agency data scientist, the CDO:

- Develops data quality measures to improve the veracity of the agency's data
- Works with the CIO to ensure measures are in place to safeguard sensitive information
- Ascribes and publishes data management policies and practices
- Decreases the cost of collecting, managing and sharing data while increasing its value
- Develops a team of data practitioners to enable and support a culture of data sharing
- CIO-Deputy-like full, or dotted-line responsibility over the DBA functionality of IT to insure adherence to data standards by accelerating interconnectivity to ensure accessibility through data linkages between systems
- Oversees enterprise entity repository, data catalog and publishing primary identifiers
- Produces and manages a budget to sustain and evolve capabilities that serve growing demands for data
- Provides expertise and consults on all new major data-related or data-intensive initiatives
- In consultation with CIO decides on products/services/technical architectures that support data
- Leads efforts to improve search and catalog capabilities and functionalities to operationalize data
- Develops bulk data product/API development/metadata standards/compatibility with emerging data standards
- Oversees and leads the organization's three divisions to organize data into information and correlate it into knowledge that informs the cognitive process through three divisions:
    - ***Data Scientist*** *– unifies data management through governance to integrate and quantify data quality to add structure via metadata. Ultimately, analytics establish the relative veracity and* ***reliability*** *one can reasonably have upon their data*
    - ***Information Managers*** *– identify the links that create dependencies within the resulting supported relationship per the use of, and reliance on data during its operationalization as information; ultimately, analytics determine the* ***reliance*** *one can reasonably place on information*
    - ***Knowledge Operators –*** *determine the causality of actions taken by modeling them against resulting and impending consequences. This action is taken to ascertain potential outcomes and management approaches to enlighten the cognitive process of making sound and informed decisions. Ultimately, analytics determine the* ***results*** *one can reasonably expect from knowledge that they possess.*

Executing the Vision

Because the role of the CDO is newly emerging position in the enterprise, there is flexibility on how it can be operationalized and executed for success. In discharging his duties, the CDO can either be situated at the upper echelon of executive leadership, it can be very hands-on to inculcate culture and practices by example or it can be extremely technical with respect to the management of IT resources. Discharging those duties depends on extant agency needs and data asset maturity, while the vision for that position involves the development of a data team oriented to the technical and data scientist to envision, prototype, evangelize, implement and support the data platform, exclusive of individual IT applications.

Overall, the CDO is responsible for data reform and modernization, including how the agency collects, uses, manages and shares data vis-à-vis the chairman's stated goal of "fact-based, data-driven decision-making." This role includes:

- *Coordinating the zero-based data review of all agency collections*
- *Ensuring data supports specific policy-related activities*
- *Working with stakeholders to plan future data needs*
- *Coordinating annual or biannual data reviews of agency data*
- *Delivering reports to agency executives on data reform progress*
- *Prioritizing large-scale data projects in conjunction with program owners*

To implement and run a data-driven organization, leadership must determine their direction and the outcomes they want to accomplish. The following are three scenarios to consider in relation to initial, mature and fully operational data organizations:

- ***Scenario One*** *– CDO runs IT data operation.* One viable path for executing the vision is for the CDO, depending on the structure of IT going forward, to assume direct supervisory responsibility over all database administrator-related assets and manage the entirety of "data operations" as a single unit. Such a structure would benefit the development of data management at the operational level. The principle benefit of this direction is ensuring data value is increased and cost is decreased at the IT operational level. The risk of this direction is the day-to-day custodial activities that limit the time that can be spent on more speculative and strategic development of dataassets.
- ***Scenario Two*** *– CDO runs IT data "asset" operation.* Alternatively, the CDO could interface with IT with a tighter focus on data assets outside existing IT systems and generous collaboration on the data aspects of new systems. The principle benefit would be the focus on data sharing and data reform as a new area; however, the disadvantage is the arrangement of new resources in a constrained budgetary environment.
- ***Scenario Three*** – CDO provides data in action to inform the strategic, operational and tactical decisions facing the organization. This would require them to provide predictive modeling for consequence management, prescriptive modeling to value proposition of resource alignment and probabilistic modeling to manage expectations. While this effort provides the highest fidelity of context to inform the cognitive process, it also requires the most resources to accomplish.

Regardless of the scenario enacted, the effective structuring of their responsibilities is necessary to operationalize efforts in data. Below is a framework upon which to understand the roles and responsibilities and how and where the tasks are aligned:

- **Chief Data Officer (CDO)–Governance**
  - **Leadership** – *Strategy/Policy – Oversees Org's Data Panel (Tactical Req)*
  - **Management** - *Concept of Operation(Operational Objectives)*
  - **Analytics/Ops** – *Business Intelligence (Strategic Tradeoffs)*
- **Director of Data (DOD)–Collect/Store**
  - **Leadership** – *Compliance –Data Use Case Working Groups*
  - **Management** – *DataStuarts*
  - **Analytics/Ops** – *Veracity – structure andorganization*
- **Director of Information (DOI)–Correlate/Access**
  - **Leadership** - *Operations – Oversees the organization's Mobility Panel*
  - **Management** – *Information Managers overseeprocesses*
  - **Analytics/Ops** – *Correlations –relationships/dependencies*
- **Director of Knowledge (DOK)-Context/Wisdom**
  - **Leadership** – *Application – Oversees the organization'sAnalytics*
  - **Management** – *KnowledgeOperators*
  - **Analytics/Ops** – *Context –causality/consequence*

CDO POSITION SUMMARY:

The position described has overall responsibility for team-lead definition, engineering and execution of organizational real- and metadata architecture strategy. Leads and directs actions to include planning, funding, training, development, integration, deployment, recovery and evolution functions required to effectively and efficiently produce, integrate and operationalize data architecture components that provide tangible support for implementation of the organization's strategy.

RESPONSIBILITIES:

1. The position directs program-wide coordination of organizational data architecture activities to ensure maximum support for Creating the Right Conditions for CDOSuccess:

- *Organizational data architecture activities are practiced in a coherent and coordinated manner by defining, coordinating, resourcing, implementing and monitoring organizational data architecture program strategies, policies and plans as a coherent set of activities beginning with the organizational data strategy and extending to all aspects of communication and execution, including leveraging data assets to cut costs, accelerate growth and foster innovation.*
- *Existing data is matured and culled and specific subsets are selected to enhance their fitness for use.*
- *Data governance functions as the primary vehicle for implementing organizational data architectures. Data governance ensures that organizational data architectures remain efficient/effective and business driven.*
- *Capitalize upon internal organizational expertise and best practices in governing the organization's information assets to develop and integrate a collaborative datagovernance*
- *Secures funding and determines budgets/priorities against the organization's information architecture.*
- *Organizational data architecture integrates itself into the existing architecture enhancement and application systems development processes in a manner that allows for synergistic growth with other architecture disciplines and that result in methods to achieve continual advancement of organizational information capabilities by identifying datadependencies.*

- *Ensuring that the organization has an optimized and flexible/adaptable data distribution network (DDN) that can deliver data in response to changing business dictates. DDN evolution is accomplished by identifying, modeling, coordinating, organizing, distributing and architecting data shared across boundaries.*
- *Establish an information architecture to improve organizational data exchange processes between programs, within organizational units and between the organization and its business partners. Since the effectiveness of this DDN lies in the currency of its organizational information architecture, the group must attain internal recognition for its expert data delivery capabilities.*
- *Ensuring that specific individuals are assigned tasks for the maintenance of specific data responsibilities.*
- *Sustain and evolve organizational assets to support, enhance and fully leverage data*
- *Align and cultivate those individuals with the requisite KSAs to accomplish their duties in conjunction with other organizational data stewards.*
- *Develop and evolve a strong governance/stewardship program ensuring organizational expertise required for up- to-date knowledge, skills and abilities.*
- *Continuously improving the effectiveness and efficiency of data delivery systems including database technologies, virtualization, services, etc. This involves specifying and designing appropriately architected data assets that can support organizational needs using appropriate technologies and architectural patterns in full consideration with future technology trends (cloud, SOA, MDM, warehousing, etc.).*
- *Governing the data design, architecture and integrity of all real- and metadata assets, including the initiation, operation, tuning, maintenance, backup/recovery, archiving and disposal of data assets in support of organizational activities.*
- *Responsible for ensuring the data assets are available for required business purposes under various evaluated risks (businesscontinuity/disasterrecovery).*

REQUIREMENTS:

Must be results oriented and have superior leadership skills to inspire and motivate staff. Critical thinking skills, excellent communication, interpersonal relations and negotiation skills are essential, as are strong administration, organizational, analytical and problem solving skills. Supervises and is responsible for overseeing work that is highly complex and varied in nature. Develops integrated solutions to achieve exceptionally complex technical and business objectives. Highly evolved subject matter expert with a strong understanding of present and future data utilization. Must have direct experience in data architecture, modeling, integration, design and quality engineering to implement various data strategy components. Demonstrated success in planning, development and support to operationalize data and mature and evolve it to an actionable state. Strategic perspective with a keen understanding of how to harvest information's inherent value. Position requires a master's degree in Computer Science, Information Technology or related field, 15 – 20 years of progressive responsibility including executive leadership.

How to Create and Develop a CDO Team?

The size of a CDO's team can vary from a single individual to a team of hundreds. Team size will be determined in part by the scope of the CDO's responsibilities. As in other IT-related areas, the CDO needs practicing technologists to support the multitude of projects that involve specific data components. Further, the CDO must have sufficient bandwidth to focus on improving linkages between systems and enterprise data assets. See example below:

- **Startup Data Team:** *Bridging strategy leveraging the total force would allow immediate implementation through coordination efforts to move forward and establish the necessary action to plan and program for full implementation by FY18 and four man-years for FY 17 which are due to the Guard and Reserve by end of month Dec 16.*
- **Medium Data Team:** *Initial operational collaboration leveraging the Total Force and aligning Active Duty, Civil Servant and Contractor talent in FY17 in addition to the startup team.*
- **Fully Developed Data Team***: Fully operational OPR/POC/SME team to facilitate a team of teams approach with MAJCOMs, SFLs, and inter-service and department agencies byFY18.*

STEP 1 - Data

Stuarts (DS) TACTICAL

"Never interrupt your enemy when he is making a mistake."

- Sun Tzu -

The continual acquisition of data to generate actionable information is critical to maturing the depth and breadth of knowledge. By employing predictive analysis to maximize tactical capability, the strategic advantages gained through fact-based decisions elevate awareness and evolved enlightened understanding as to potential opportunities to inform leaders to elevate awareness of the associated risk ever prevalent in today's society. Therefore, ongoing efforts must be made to ensure the data is organized into information which is reliable and relevant. The asymmetric advantage which is critical to maintaining strategic advantage, can be derived from high-quality reliable data that is related in context in a way that affords decision makers to take informed action.

Organizations typically have three assets: people, money and data. The people and money aspects are well organized and generally managed with oversight by the Chief Human Capital Officer and Chief Financial Officer. In the last 20 years, however, the value of data as a strategic asset has increased markedly as the volume continues to grow exponentially. New analytical tools must be leveraged through technological means to ensure the requisite capabilities afford the means to gain and maintain the necessary sophistication to manage the mass and overcome the complexity of our interconnected world. Today's fast-paced, interlinked and rapidly evolving information environment demands a structured approach to deliver the right information to the right place and at the right time. To this end, they must FIRST: collect and structure our data to assess its veracity which is performed by and the responsibility of Data Stuarts. For it is this group that stores, organizes and ensures accessibility to capitalize upon the inherent value that data offers.

DATA SCIENTIST POSITION SUMMARY:

Acts as the senior data scientist to coordinate project teams of data scientists; is a primary point of contact in delivering innovative, high-quality data products with measurable veracity. Leverage expert business/analytical knowledge to drive cross-functional analytics projects from beginning to end and ensure adoption of CDO's analytical recommendations.

Primary Duties:

Supports the CDO by building relationships with partner data teams; frames and structures questions, and summarizes and presents key insights to the agency.

- *Coach, mentor and guide data scientists in career development, primarily in non-technical areas*
- *Work with CDO, staff and project leads to shape and implement the technical capabilities needed to accelerate value delivered through data science projects*
- *Assist the CDO's office with strategic efforts, portfolio management and value delivery*
- *Collaborate with stakeholders to gather, consolidate and validate business assumptions before embarking on analytical efforts*
- *Work with in-team analysts to document requirements, assumptions and methodology including validation, testing and implementation strategies*
- *Facilitate regular peer reviews and performance reviews*
- *Apply project/team leadership and problem solving skills to establish and promote best practices within the team*
- *Develop a high-level understanding of innovative data science tools and techniques*

STEP 2 – Information Managers MANAGE …IM

"During chaos, there is also opportunity."

- Sun Tzu -

Government agencies have long since recognized that data is critical to accomplishing their prescribed missions, and that ultimately, it is a vital strategic asset. By ensuring data has VAULT characteristics, effective data management and stewardship will assure it is also fit for the intended purpose. This process assures that we can identify risks while illustrating the opportunities available to achieve organizational strategic objectives.

Through effective management of data, we will be able to organize it in a manner that enables us to become aware of its dependencies and govern our actions to leverage it in a way that illustrates its context. Develops production reports to be distributed to business users. Develops data visualizations to support report requirements. Maps, migrates, tests and analyzes data for leadership.

Primary Duties:

- Maintain organizational data documents and products
- Provide advice to management on supported programs
- Have knowledge of Business Objects, Tableau, SAS, etc.
- Demonstrate the ability to manipulate and analyze data
- Provide operational support for data integrity, quality assurance, monitoring and reporting
- Assist lead data scientist in planning, organizing, and coordinating the various projects, Programs, services of diverse administrative operations.

Data resource management (DRM) implementation ensures the organization's effective use of data, thus contributing to overall organizational success. Adequate DRM reflects and supports the organization's strategic imperatives, aligns data assets with those imperatives, identifies potential conflicts in interoperability and establishes the basis for effective, cross-organizational discussions to govern and enable data services to meet mission-specific needs. An effective data strategy leverages management of and governance through a DRM program to deliver data as a service through three component efforts:

- *Data Management: a program for the implementation and performance of data management functions, such as metadata management, data quality, and data standards and data architecture to assess and identify its inherent value.*
- *Data Governance: a framework that facilitates the application of best practices in establishing, building, sustaining and optimizing data management throughout the data lifecycle.*
- *Data in Action: a business function that develops and executes plans, policies and practices to inform and make decisions that fulfill organizational objectives.*

CDO – GOVERNANCE

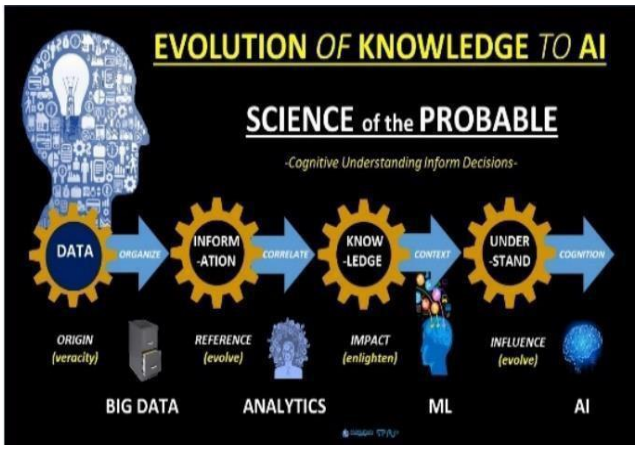
"The nature of war is constant change."

- Sun Tzu –

As it becomes increasingly necessary to realize the value of data assets and deliver data as a service, the establishment of an effective data governance program is a crucial, early step. Beyond helping business leaders, data governance enhances data quality, provides operational excellence, enables business intelligence and extracts additional value from organizational data. To that end, DRM facilitates the use of data assets to accomplish organizational goals and objectives by integrating data governance, management and data into a concerted action.

Data Governance Challenges:

- Agencies are facing challenges from explosive data growth
- Buy-in to data governance remains a barrier



What is Data Governance?

- The exercise of authority/control/shared decision-making (planning/monitoring/enforcement) datasets
- An enabling framework of decision rights and accountabilities for information and related processes
- A function that ties data management tasks together as needed

Purpose of Establishing Data Governance

- Understand and promote the value of data as a strategic asset
- Define/approve/communicate data Strategies/policies/standards
- Track and enforce regulatory compliance and conformance to Data policies/standards/architecture/procedures
- Improve the process of enhancing data quality and increase the confidence of data consumers
- Sponsor, track and oversee the delivery of data, data products and data services
- Manage & resolve data-related issues & reduce operational costs

Critical Viewpoints

- Data governance enables data-driven insight
- Data governance drives increased trust in the data
- Collaboration—among programs/business/data & IT—is critical
- Data governance is an engine that needs fuel, and it powers the organization up the

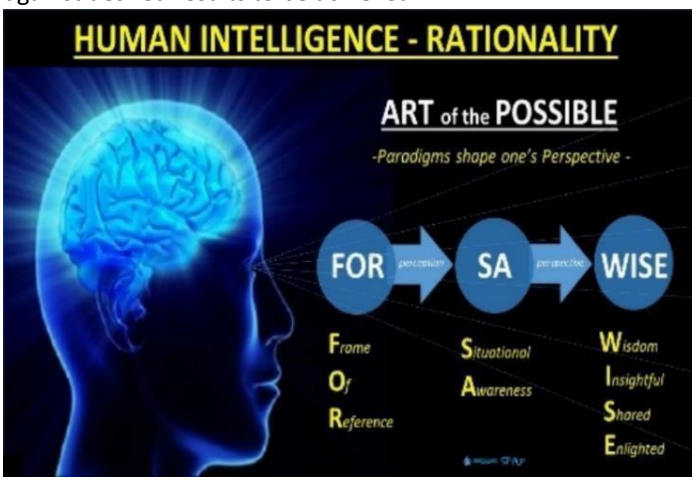
STEP 3 – Knowledge Operations STRATEGIC …KO

"Opportunities multiple as they are seized"

- Sun Tzu –

Data-driven analysis can unleash the power of information by identifying risks and illustrating opportunities. To realize the value of data, we must organize, structure and manage that data to make it usable. Considering the staggering accumulation and increasingly complex nature of data, DRM is quickly gaining importance, as it improves business leaders' understanding of what their data is telling them.

At this point, we can—THIRD—become informed about where and when we should take actions that fulfill our strategic objectives. The technology analyst participates in the design/implementation/support/maintenance of automation/computing/database systems essential to carrying out the CDO's responsibilities and daily activities. An analyst understands the interrelationship among systems and ensures these applications illustrate the consequence of actions taken against desired results to be achieved.



Primary Duties:

- Determines operational objectives by studying business functions, gathering information and evaluating output requirements and formats
- Creates and documents protocols for quality assurance and reporting through standard operating procedure documents
- Assists with reports by collecting/analyzing/summarizing information trends
- Align data in action/info per time/place to illustrate strategic tradeoffs
- Operationalize information such that it
  - *quantifies the value proposition*
  - *correlates actions taken against objectives to be accomplished*
  - *SMART matrix goals achieve/ensure mission success*

Provide senior leaders quality data that is organized and structured to be compliant with governance policies, and that aligns, informs and contributes to the body of knowledge that will facilitate the accomplishment of organizational goals and objectives by combining the three components of data governance, management and data pressing them into action.

- **DATA DIRECTORATE**: *The business function that develops and executes plans, policies, practices and projects that acquire, control, protect, deliver and enhance the value ofdata.*
- **INFORMATION DIRECTORATE** *A program for the implementation and performance of data management functions, such as metadata management, data quality, data standards, data architecture and data operation.*
- **KNOWLEDGE DIRECTORATE** *A framework that facilitates the application of best practices in establishing, building, sustaining and optimizing data management throughout the data lifecycle.*
-

Capabilities that Operationalize and Inform

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

- Sun Tzu -

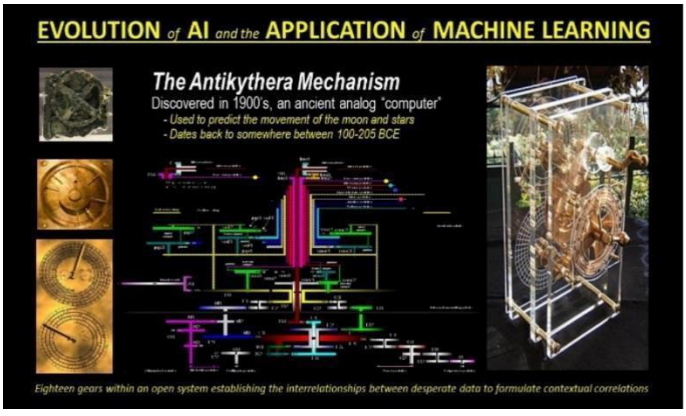
History offers ample evidence that enlightened decisions represent the essential core of military success in warfare. The synthesis of historical and current information is the basis upon which leaders make informed decisions. By organizing data into information, it can then be matured and fused into 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.

By maturing knowledge into understanding, strategic leaders can cut through the fog to mitigate the friction inherent in war. The value informed decisions bring to the fight has long been overlooked—even to the point of being completely discounted. In hindsight, failures and shortcomings in military operations are often 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 informed 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 how U.S. strategic ends, ways and means help fulfill U.S. national interests. Based on the foregoing, strategic critical thought elevates knowledge, which through increased situational awareness and a good frame of reference, develops understanding. This enlightened understanding permits the effective employment of the instruments of U.S. nationalpower.

While hope is certainly not a plan per se, it is nonetheless valuable in seeking an understanding of how to approach opportunities, and thus knowing what must be done to overcome extant circumstances and achieve future goals and 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, which certainly influence 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.

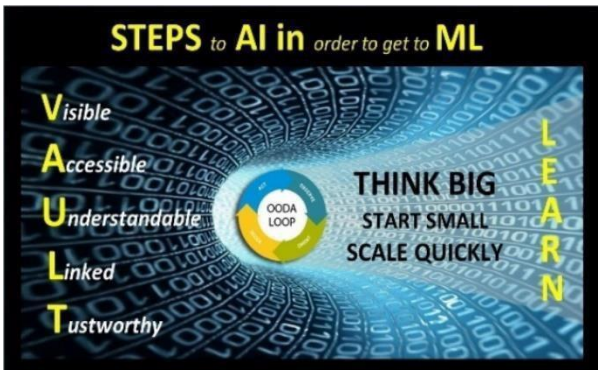


Thus, by focusing on the causality of our actions and the effects these will have on our environment, we can understand the consequences of actions taken vis-à-vis the results to be achieved. Like trending assessments used on the stock exchange to predict and prescribe investment stocks, we can leverage past data to assess probabilistic potential, and then analyze the interrelationships or dependencies of that information to predict outcomes.

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 -



Given the extraordinary volume and complexity of today's challenges and the crosscutting nature of our interlinked and dependent society, it becomes imperative that actions taken be 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 possible 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 a transformational 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 of mission success, senior leaders need timely indicators and capable modeling systems that identify opportunity and risk as well as the probability of mission success. Compounded by the vast amount of information being generated by massive amounts of data, coupled with the persistent risk that is a characteristic of this VUCA environment, the opportunity to make fact-based decisions focused on assuring mission success is critical. Analytics can help today's organizations with many of the specific challenges they face. These include:

- *Deciding where to invest in order to evolve*
- *Getting more value from software systems*
- *Identifying the best way forward*
- *Solving complex scheduling problems*
- *Getting more cycles out of ATO*
- *Optimizing a portfolio of investments*
- *Accelerating response time*

ANALYTICS – OFFERS

"Victorious warriors win first then go to war, while defeated warriors go to war first then seek to win."

- Sun Tzu –

In today's fast-paced and rapidly evolving information environment, having the right information at the right place and right time is critical to deriving strategic advantage. The employment of analytics enhances awareness by providing trustworthy data that can unlock the power of information. By utilizing effective analytics, opportunities can be identified and compared to associated risk to determine the course of action best suited to achieving the organization's strategic objectives.

Whether leveraged to assure good strategy, improve effectiveness or ensure efficient allocation of scarce resources, the ability to unlock data's inherent value will have a direct impact on our ability to model success probability and potential options, both of which are particularly important today. The following are examples of the effect informed knowledge has on fueling the cognitive process by applying organized data that has been correlated into context:

- *Insight into difficult problems*
- *Improved processes, productivity and performance*
- *Cost savings and effective resource allocation*
- *Scope options and opportunities*
- *Accurate predictions, plans and forecasts*
- *Increased mission assurance/reliability/effectiveness*
- *Increased efficiencies and streamlined processes*
- *Superior return on investment (ROI)*

The Analytics Value Proposition:

"The supreme art of war is to subdue the enemy without fighting."

- Sun Tzu –

Chief among the deliverables associated with implementation of the CDO concept are data structured and organized to demonstrate its veracity and information correlated to establish context. These outcomes enable data to be modeled and assessed in a manner that informs the cognitive process. The analytics that illustrate probable and potential consequences capable of managing expectations and illustrating potential outcomes vis-à-vis the organization's strategic objectives are:

- **Big data** *Finding hidden clues to improve mission capabilities and capacity*
- **Business insight** *Providing quantitative and operational insight into complex problems*
- **Business performance** *Improving mission performance by embedding intelligence into an organization's information systems to improve decision making*
- **Cost reduction** *Finding new opportunities to decrease cost or resource allocation*
- **Decision making** *Assessing the likely outcomes of decisions and determining better alternatives*
- **Efficiency** *Increasing the organizations return on investment (ROI)*
- **Forecasting** *Providing the basis for increasingly accurate forecasting and planning*
- **Improved scheduling** *Efficient synchronization of staff, equipment, events and activities*
- **Planning** *Applying quantitative techniques to support operational objectives and tactical engagements that fulfill strategic intent*
- **Productivity** *Helping to determine ways to improve the productivity and efficiency of processes*
- **Quality** *Improving quality while quantifying and balancing qualitative considerations*
- **Resources** *Achieving greater utilization rates despite limited equipment, facilities, money and personnel*
- **Risk** *Measuring threats quantitatively/identifying factors to improve management/reduce risk*
- **Throughput** *Increasing speed/throughput with a focus on decreasing disruptive delays*

ANALYTICS – VALUE

"Every battle is won before it is fought"

- Sun Tzu -

The right information at the right place and right time is critical to gaining strategic advantage. Analytics provides enlightened awareness, informed by trustworthy data, to unlock the power of information, which identifies opportunities in relation to potential risk. By unlocking the inherent value of data, we can ensure an enlightened understanding of the probability of success and potential options by modeling today's volatile, uncertain, complex and ambiguous environment. Through the effective structuring and organization of data and assessing its veracity, the resulting information can be correlated to establish the dependencies and the resulting awareness to inform and enlighten as to the context to be available to medal and analyze in a way that informs the probable and potential consequences to manage expectations and illustrate potential outcomes compared to the organization's strategic objectives, goals and vision/mission. Thus, we must be mindful of the operational benefits and the value that data offers:

- *Insight into difficult problems*
- *Improved processes, productivity and performance*
- *Cost savings and effective resource allocation*
- *Scope options and opportunities*
- *Accurate predictions, plans and forecasts*
- *Increased mission assurance/reliability/effectiveness*
- *Increased efficiencies and streamlined process*
- *Superior ROI*

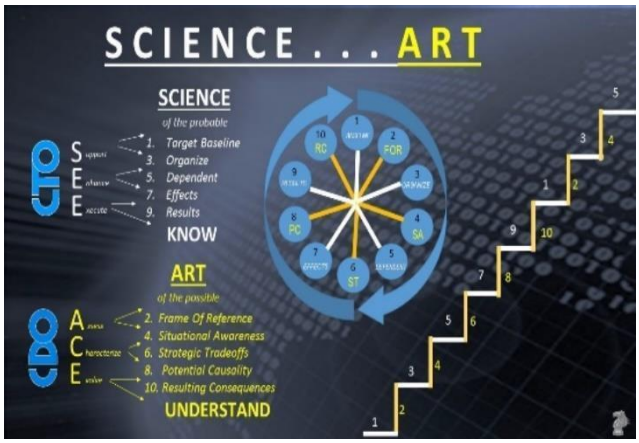
ANALYTICS – RESULTS

"If you know the enemy and know yourself,
you need not fear the results of a hundred battles."
- Sun Tzu -

Analytics Illustrate:

Art of the Possible within the Science of the Probable

Analytics illuminates opportunities to evolve and establish a strong foundation upon which to build, grow and ascend to the next level. For those willing to listen to the data, it illustrates opportunities and identifies risk in a way that informs decisions. To that end, it is imperative that data in action is organized and structured to assess its veracity and that information is correlated to illustrate links to the supporting relations to provide context to the resultant knowledge. At that point, senior leaders can take actions in complete awareness of the outcome of a cost-benefit analysis that quantifies the probable and potential strategic tradeoffs and consequences of actions taken compared to the intended results to ascertain the value proposition that identifies potential ROI.



ANALYSIS PARALYSIS

"Just as water retains no constant shape,
so, in warfare there are no constant conditions."
- Sun Tzu –

Analytics offers the opportunity to analyze the environment to evolve knowledge; however, knowledge that fails to acknowledge the need to understand what must be done and when it must be done is pointless. As we gain understanding, we realize the effects our actions have on the environment.

Given the provided outlined the framework, which illustrates the operational capacity of data; information and knowledge must be applied to garner opportunities that can shape our future. To that end, as we observe the past to establish our frame of reference to orient ourselves in the present, we develop an understanding of the implication of the decisions to be made that enable us to act in a manner the fulfills our objectives. The following illustrates the actions that need to be taken today and that will transform our environment to the future state we envision:

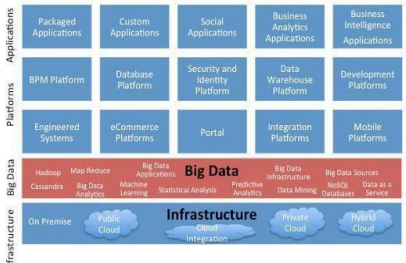
OBSERVE – FOR *understand what you are dealing with*				***SCIENCE***
1C. Collect	Store	DATA	WHAT	
2C. Catalog	Structure	INFO	HOW	
ORIENT – SA *adjust to find strategic advantage*				***ART***
3C. Correlate	Relate	FOR		WHO
4C. Context	Understand	SA	WHY	
DECIDE – ST *leverage opportunity while mitigating risk*				***THINK***
5C. Cost/Benefit	Assess	ST		
6C. Characterize	Know	KO		
ACT – *courage to try, willingness to fail to evolve or learn to succeed*		***DECIDE***		
7C. C2	Synch - C2 cord/collaborate	Engage		
8C. Communicate	Disseminate	Direct		
LOOP – *open-mindedness*		***LEARN***		
9C. Causality	Dependencies		WHEN	
10C. Consequence	Results	WHERE		

Iterative living process that grows, evolves and then repeats…1C

ENLIGHTENED ANALYSIS

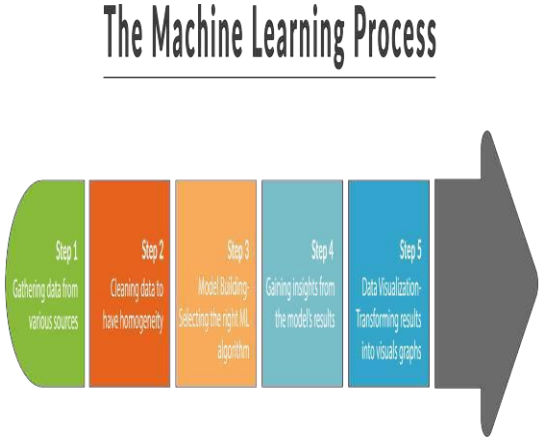
"Victory is reserved for those who are willing to pay its price."

- Sun Tzu –



Most organizations take a traditional approach to remaining competitive on the interlinked world stage. They understand the necessity to both outthink and outpace their competition. To do so, they must build comprehensive data strategies that enable them to collect, correlate and analyze data from a multitude of sources effectively and efficiently. By integrating them into frameworks to store, access and unleash the power of information, an outline can be produced to enable the storage and structure of data, which will facilitate its accessibility by applications that seek to analyze its content.

Today's fast-paced, dynamic environment requires organizations to courageously think big, start small and adapt to and overcome obstacles by scaling quickly. Stated otherwise, a nimble, highly adaptive environment is essential. In flat organizations with the authority to meet an objective rather than fulfill a requirement, the "team of teams" approach is imperative. This concept allows leaders to inspire the kind of innovation that facilitates transformation.



P0 = PROCURE: OBSERVE…Collect – store and organize

P1 = PROBABLE: ORIENT…Contextual – informs awareness - where they are

- *Generalized Linear Modeling (Probability, Logit, Multinomial Logit/Probity, Count, Cox Proportional Hazard models)*
- *Applied Multivariate Statistical Analysis (Clustering, Principal Components, Discriminant Analysis)*
- *Computer Use and Programming Skills (SPSS Modeler, SAS Enterprise Miner, MATLAB, Mathematica, R, STATA, EVIEWS)*

P2 = PREDICTIVE: ORIENT. . . Adaptive/Behavioral/Evolution –where they're going

- Multiple Linear Regression (OLS, WLS, Time Series Regressions)
- Time Series Modeling Expertise (Seasonal Adjustment, Box-Jenkins, Exponential Smoothing, Vector Auto regression)
- Training in Machine Learning Tools (CART, CHAID, SVM, ANN, K-Nearest-Neighbors, Association Rules)

P3 = PRESCRIPTIVE: DECIDE…Prescriptive analytics is Business Intelligence *(Strategic Tradeoffs and Consequence Management)*

P4 = EFFECT: ACT…Predictive Analytics potentiality- vector/direction & velocity/ timing to ascertain likely outcomes and manage consequences

PREDICTIVE ANALYSIS

"Quickness is the essence of the war."

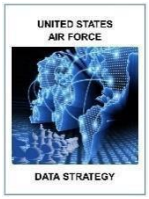
- Sun Tzu -

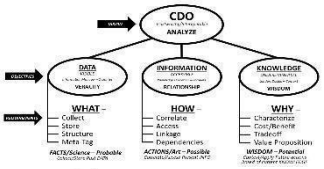
As we begin to leverage behavior dynamics to understand the causality of human interaction, and in time develop the ability to predict more accurately the influences people have on their environment, we will gain a better understanding of the interactions that occur within this complex system. Moreover, temporal analysis yields better event synchronization, which affords event predictions of increased reliability. Altogether, these tools facilitate an elevated situational awareness with which to obtain abettor perspective. This facilitates a command of the environment, which stems from understanding it better—referred to by some as *wisdom*. This approach to business intelligence will illustrate the benefits of thinking, adapting and understanding that the correct answer to our problems is based on learning how to ask the right question. This can be accomplished by ACE-in the information environment to SEE effectively within the cyber domain.

TEN STEPS TO OPERATIONALIZING DATA

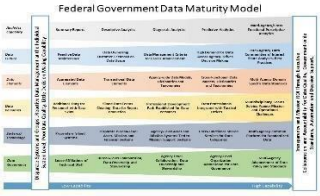
and

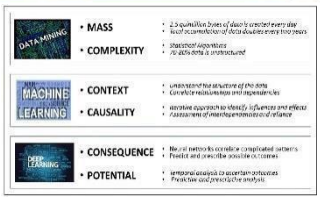
UNLEASHING THE POWER OF INFORMATION

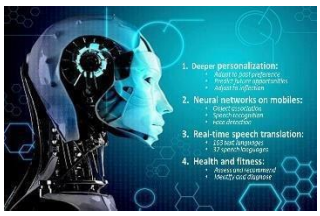


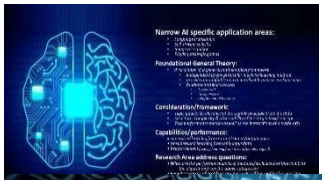


Federal Government Data Maturity Model









1. **Garner advocacy from leadership to influence the nature of the organization's culture (mission/vision)**
2. **Determine how data informs the organization's ability to fulfill its goals/objectives (data strategy)**
3. **Establish a group focused on the 10Cs (CDO Structure)**
   a. *DRM-store/structure data to determine its veracity*
   b. *IM-organize information to illustrate linkage/accessibility to identify dependencies*
   c. *KO-apply knowledge to put your level of understanding into context and engender trustworthiness*

   10Cs- C*ollect, catalog, correlate, context, cost/benefit, characterize, coordinate/collaborate and communicate*

   VAULT-*Visible, Accessible, Understandable, Linked, Trustworthy*

   Evaluate your organization per the U.S. Data Cabinet's Maturity Model (data maturity model)
4. **Publish a governance process to align priorities that allow it to operate as a data-driven**
5. **organization (Data Panel)**
6. **Perform analytics to determine the cost/benefit or value proposition(ROI)**
   a. *Data Veracity - probabilistic modeling*
   b. *Information correlation - prescriptive modeling*
   c. *Knowledge context – predictive modeling*
7. **Create and AI system to illustrate past, present and future(AI)**
   a. *Collect historical frames of reference (FOR) -past*
   b. *Correlate situational awareness (SA) -present*
   c. *Inform knowledge operations (KO) -future*
   d. *Identify when & where opportunities present themselves (consequence management – CM)*
8. **Integrate Machine Learning to ID potential(ML)**
   a. *Trending - temporalanalysis*
   b. *Causality – influences and effects*
   c. *Learning – FOR + SA = Wisdom*
9. **Think Big, Start Small, Scale Quickly**
10. **Re-assess and Evolve (go back to step #4 and continually adapt, evolve in iterative manner)**

transform the current state to the desired future state

TAB 4

Age of Knowledge

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Information Society's Transformation into the

AGE of KNOWLEDGE

I. EXECUTIVE SUMMARY

As we evolve from the industrial revolution into the information society we are quickly learning how best to leverage knowledge as we step into the age of enlightenment. In this journey, we must ensure that we develop an information support mechanism that matures our Frame Of Reference (FOR) of how we see the world with an adequate perspective of our Situational Awareness (SA) to understand the dynamic ever-changing environment in which

Current cloud endeavors are an attempt to address an increasing need for accessibility to information. The necessity to provide this information in a timely and secure manner has been a topic of much discussion and great concern. As reliance upon this information increases, so does the growing threat from those endeavoring to access, deny or manipulate data. (Coram, 2002) With this in mind, this paper will explore the challenges of establishing a cloud that provides for non-repudiation of the data contained within our current infrastructure. Industry at all levels agree that the greatest challenge within the cloud is that of providing a network capable of securing the veracity of data at rest, in transit or through operations. It is therefore crucial to establish confidentiality in order to develop trust within the information environment. For only through sound policy and technological capabilities will the opportunity to attribute and hold accountable those accessing the cloud in our ongoing efforts to interlink and connects the world.

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II. INTRODUCTION

The goal of information operations is as Sun Tzu advised, “The general who wins the battle makes many calculations in his temple before the battle is fought. The general who loses makes but a few calculations beforehand.” (Tzu, 2n Century BC) With this in mind we must look reflectively to clearly understand where we are in order to establish an enlightened pathway forward. To do this, the United States must evolve its current Information Technology endeavors with a focus upon evolving the cognitive process. The current environment is plagued with high latency and is ill-equipped to provide for the current and future fidelity of knowledge essential to shaping our strategic perspective for success on the battlefield.

Vivek Kundra, the U.S. Chief Information Officer, astutely understood the necessity to evolve the manner in which we store, access and leverage information. He established a Cloud First policy in the Federal Computing Strategy to address the growing need to leverage technology in a way that unleashes the power of information. (Kundra, 2011) The National Institute of Standards and Technology (NIST) in their Special Publication 800-145 defines “cloud computing as a model for enabling ubiquitous, convenient,

on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.” (NIST, Cloud Computing (SP 800-145), 2011) the Federal CIO’s new cloud strategy calls for the alignment of $20 billion of the $80 billion Information Technology (IT) budget to develop and implement cloud capabilities throughout the United States. (Kundra, 2011)

Given the ever-increasing demand placed upon the information environment and the necessity to integrate disparate systems in a way that precludes fragmentation, the Clinger–Cohen Act directs us to acquire technology in a manner that drives efficiencies and precludes redundancies. (Franklin D. Raines, 1996) The implementation of cloud computing is a foregone conclusion that most experts agree, done properly, will provide greater accessibility and efficiency to information. With a rapidly increasing demand signal and ever decreasing resources, cloud computing affords the opportunity to work smarter instead of harder. Thus, the focus of this paper will frame how the cloud should effectively and efficiently be implemented to ensure proper evolution and maturation of information that is both reliable and trusted. It is the trust one has in the quality of information and the trustworthiness of the systems that store and disseminate it that is at the heart of our ability to successfully make the necessary calculation to garner victory on the field of battle.

III. ASSETS OF VALUE

The Department of Defense Chief Information Officer acknowledges the challenges with implementing and integrating architectures that ensure the cloud provides the necessary security, continuity of operations and Information Assurance (IA) so essential to providing reliable networks that provide for non-repudiation. *(Takai, 2012)* Joint Pub 6.0, Communications Systems, express the value technologies offers in the maturation of information. It provides the criteria of how to collect, correlate and fuse quality information as outlined in figure 1 illustrated below. Ultimately, for information to be of value, it must be accurate, relevant, timely, usable, complete and secure. For these systems to be effective, they must be designed and integrated in a manner that leverages the criteria as established by the Federal Risk and Authorization Management Program*(Chief, 2010) (Fed RAMP)*

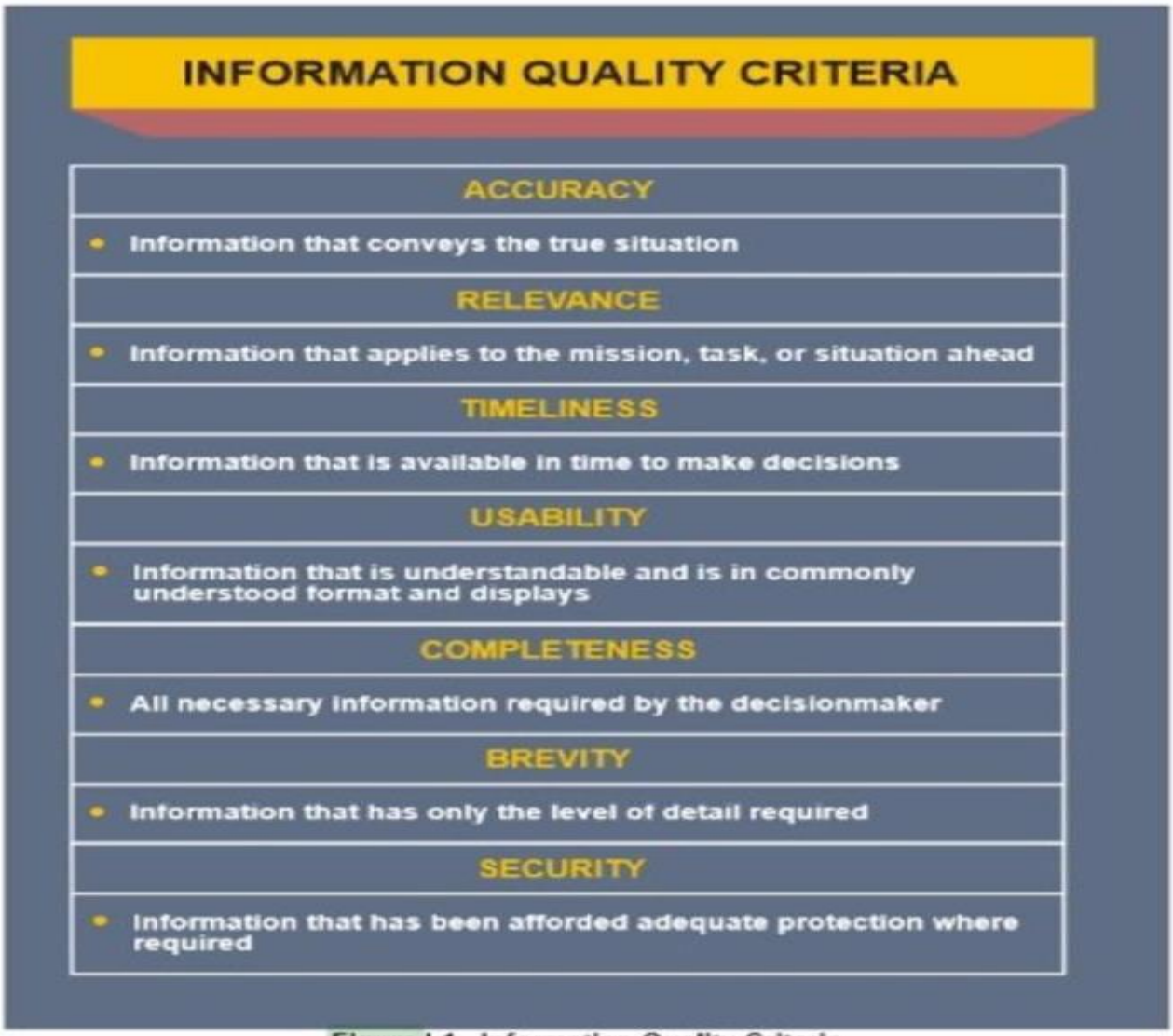
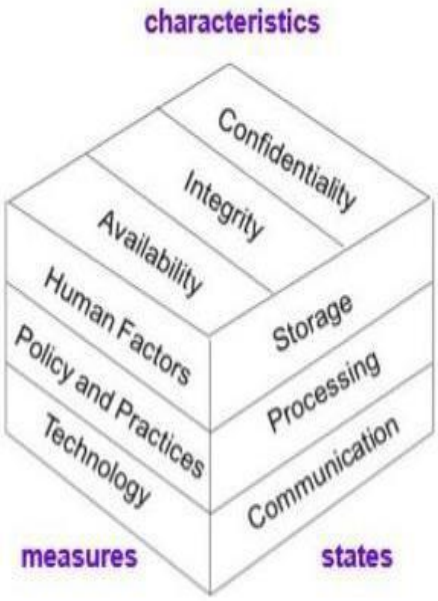


Figure I-1. Information Quality Criteria

The chart below illustrates relationships of controls, assets of value, design, risk consideration within the security architecture that must be assessed to adequately support mission requirements. Policies must be put in place that establishes the necessary controls that mitigate risk and ensure availability, integrity, and authenticity. Once accomplished, they will be able to determine the relevancy and assess the resulting ability, confidentiality, nonrepudiation and veracity of the data. It is at this point that the value-added proposition of cloud becomes evident. For with adequate measures to protect, detect and correct attacks from denial of service and malicious manipulation of data the capabilities inherent in the cloud to validate data and identify the variance or inconsistency begin to reveal themselves. (Systems, 2006) (NIST, 800-59)

(Figure-2) (Duke, 2013)

IV. CHALLENGES



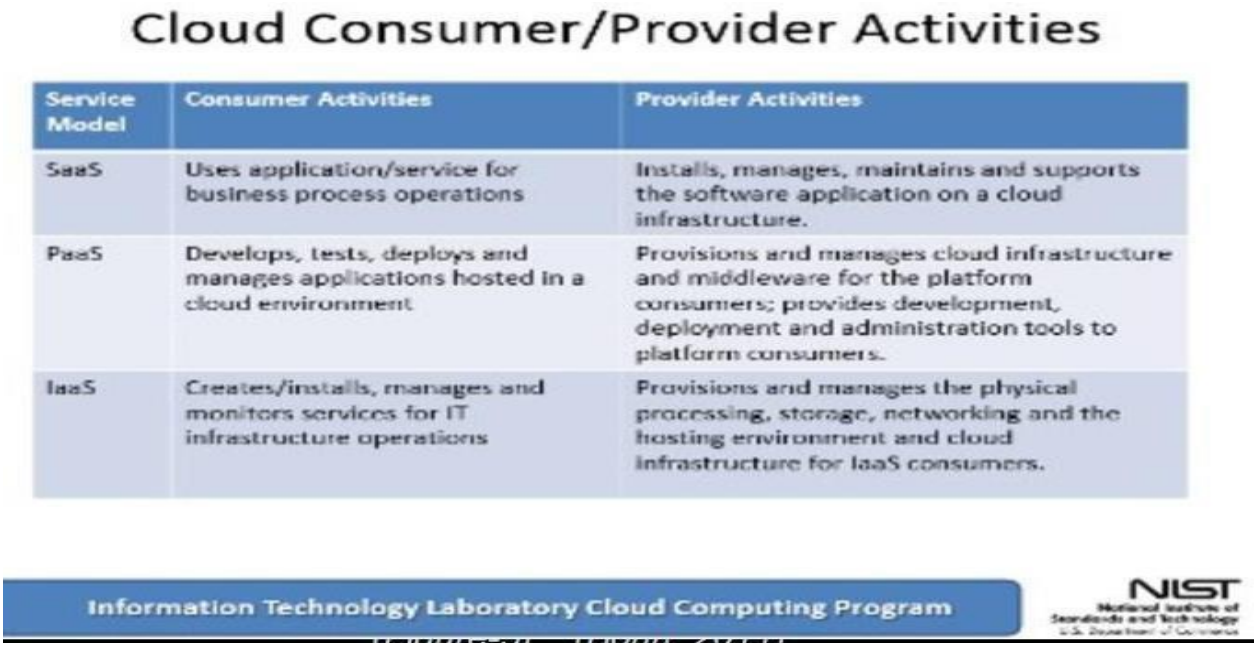
(Figure-3) (McCumber, 2004)

The greatest challenge of the cloud today is the ability to ensure confidentiality, integrity and availability of data at rest, in transit and throughout all aspects of operations. The McCumbers Cube provides an excellent pictorial representation of the building block of the characteristics pertaining to the state of the information environment and the measures upon which the cloud must be developed. This pictorial highlights the dependencies and resulting reliance upon people effectively leveraging technology with good tactics. techniques and procedures to assure the collection,

correlation and application into understandable context of reliable information. Through assessing the ebbs and flows of information while in storage, in transit, and during processing the ways and means identify how best to mature data into information the ensure knowledgeable actions at the cognitive level of thought. (McCumber, 2004) Thus the need to protect personal, diplomatic, privileged, military and economic sensitive information is critical to establishing credibility of not only the system, but must importantly the to garner strategic advantage of the data contained within it. Therefore, prudent step should be taken to preclude unauthorized disclosure as outlined in CNSSI 4009. (CNSSI, Web Down)

V. VULNERABILITIES

Ultimately, the level of protection in both time and accessibility is directly related to the current and long term value which is placed upon the data. Therefore, the importance of mitigating risk by adequately detecting, protecting and managing inherent vulnerabilities while in the cloud must be of primary concern and focus. It is through proper training of people, development of policy, and implementation of technology that ensures the necessary trust is established to provide the means to transform the information environment in a way that serves US vital national interest. Ultimately, the responsibility to protect data resides with people who are unequivocally our greatest asset and history has shown have through their actions or lack thereof have presented our greatest risk. Thus, a culture which is cognizant of actions taken against results to be achieved will be able to effectively leverage the tools of technology to preclude unauthorized access through well established and clearly defined Tactics Techniques and Procedures (TTPs).



(Figure-5) (Bohn, 2011)

Bill Schaumann of the Global Technologies Study edifies that "Because you are in a virtual environment and data can be anywhere, a business user must be aware of all the different borders its data is crossing and the regulations that apply from each of those countries." (Hyek). Furthermore, Paul Cabot highlights that "Underlying all the security and privacy issues is the concern that once it is shared, it will persist in that environment forever." Therefore, the vulnerabilities of giving up control of data and the inherent regulation bounded by the jurisdiction of the locality upon where said data is stored has its own set of unpredictable limitations and unexpected consequences. (Hyek) For it is not merely adequate to establish policy that dictates were data may be stored while at rest, but must be given full consideration as to the implications of were said data traverses, the manner in which it is encapsulated prior to its transport and the means at which it is processed. For only through well-defined TTPs to characterize the information environment in order to prove adequate baseline upon which to assess, detect and protect against unauthorized access and malicious manipulation of data will the prudent oversight of a well-defined Risk Management Framework (RMF) be effective.

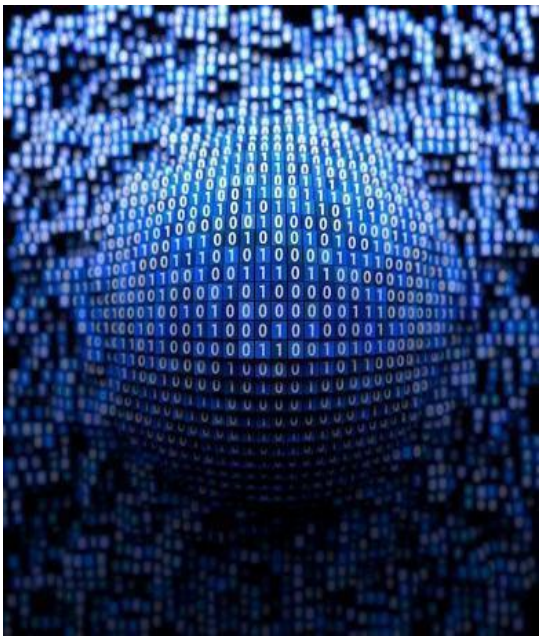
VI. THREATS

One of the greatest threats of this new medium of cloud computing is the potential breach of the networks and the information contained within. Early adoption of cloud computing has strived to develop TTPs and design their architecture to overcome these security concerns. (NIST, 7298, Web cite Down) Currently past concerns with denial of service and unauthorized access are becoming overshadowed with manipulation and loss of control of data at rest. The clouds greater accessibility to information compounds the risk of the inherent veracity of data. This is merely one of many areas of concern, not the least of which, is that data within the cloud environment geographical boundaries. This brings into question the issue of ownership and control of data. Ernst & Young's 2010 Global Information Security Survey identified that the "loss of control is rapidly emerging as the number one inhibitor to adoption of public cloud computing services." (Hyek) These concerns, compounded by a recent survey by Global Technologies Industry identifies that 36% of US and more that 57% of European organizations failed to adequately address risk concerns before migrating to the cloud. (Hyek) Ultimately, without positive control and accountability of data, and an effective RMF to adequately assess the impact of these threats, the resulting means to establish the necessary safeguards to protect and ensure mission assurance will continually leave at question whether it is prudent for an organization to migrate to the cloud.

Information is a commodity that is easily distributed, compromised and manipulated. Today's increased reliance upon it make it a vulnerable target to attack. Thus, it is essential that we measure it to establish what information and to what level it must be protected in order to establish at what level of confidence we can reasonably hold for it and thus at what level of trust we have in it. Data at rest must be assessed to determine the impact from current risks in spite of available countermeasures to mitigate inherent vulnerabilities. Thus, veracity of information impacts organizations in direct proportion to their reliance upon it. Therefore, it becomes essential that once access is granted through trusted relations continual assessments must be accomplished to determine at what level of confidence we can be assured that adequate measures are in place to defend against the growing threat of information warfare (IW).

Knowledge operators understand the clear and present dangers presented by ongoing IW and its insidious nature. Unlike cyber warfare, IW affords the adversary's the benefits to acquiring access, gaining knowledge, and engage in disinformation campaigns without impunity. The anonymity of their action in most cases precludes attribution and thus affords them the opportunity to disseminate and instantly devalue information's strategic value. Therefore, a trust but verify approach becomes a necessary action to be assured that actions taken are fulfilling and providing the desired effects to be achieved.

Authentication is essential to ensure authorization provides attribution for actions to mitigate and attribute potential data manipulation or degradation of data at rest. (44, Web Page Down) (CNSSI, Web Down) The ability to authentic the identity of those on an access list becomes crucial means to cross-correlate ones actions and authorizations against a dynamic trust criteria. To validate authenticity, biometrics offers an opportunity to positively correlate credentials to individuals while cryptology provides a tool to secure data at rest to only those with a valid need to know. However, these tools lack the necessary capabilities and thus new tools are needed to effectively monitor data in transit. It is only through ongoing assessment of data in all three phases of its existence (rest, transit, and processing) that identifies those actions necessary to protect and correct deficiencies critical to adapting the system in order to mitigate risk and overcome threats as they present themselves. By providing a common site picture, the resulting baseline affords the opportunity to informs situational awareness in a way that evolves our understanding of the information environment. It is through this common matrix of correlating diverse perspectives of how to assess risk and the implications of the resulting causality of actions taken against results to be achieve in this dynamic environment, which allow us to better understand the impact we have within this fluid ever-changing domain.



1. Organizations shall develop and maintain an ERM framework to manage risk to an acceptable level.
2. Formal risk assessments shall be performed at least annually, or at planned intervals, determining the likelihood and impact of all identified risks, using qualitative and quantitative methods. A similar assessment should be done for inherent and residual risk, considering all risk categories (e.g., audit results, threat and vulnerability analysis, regulatory compliance).
3. Risks shall be mitigated to an acceptable level and time frame, which shall be established and documented with executive approval.
4. Risk assessment results shall include updates to security and privacy policies, administrative procedures, standards and controls to ensure that they remain relevant and effective.
5. Once access risks have been identified and prioritized, a plan should be put in place to minimize, monitor and measure likelihood and impact of unauthorized or inappropriate access. Compensating controls should also be implemented prior to provisioning access.

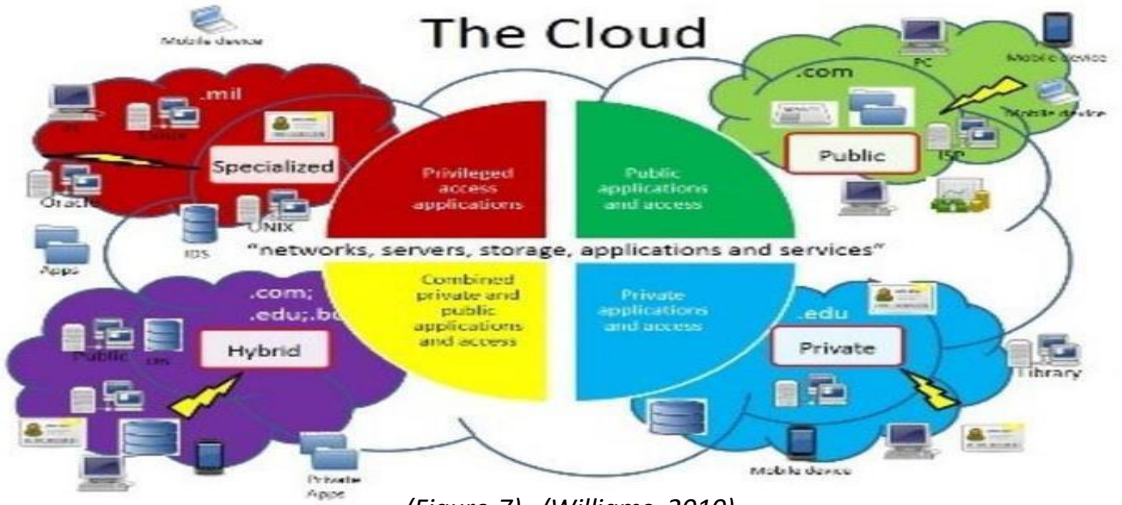
(Figure-6) (Hyek)

The conundrum of security concerns serves as a double edge sword, for the capabilities offered by the cloud leaves one potentially vulnerable. Even data contained on a private cloud, which are the least at risk given they are contained and controlled within their own infrastructure are still vulnerable. However, with appropriate policies and well defined business rules and a well-designed architecture, it is feasible that highly confidential data like health, personnel or financial records can be safeguarded more securely through distributed storage. Overall, concerns with ownership and legal consideration of control of data, have garnered much attention and there are many efforts underway to manage these threats in a way that mitigate impact. (Hyek)

VII. OPPORTUNITIES

During a recent speech by the US CIO at the Brooking Institute in April 2010 he expressed concern that "Over the past decade, the number of federal data centers has grown from 432 to more than 1,100. This growth in redundant infrastructure investments is costly, inefficient, unsustainable and has a significant impact on energy consumption," (Hyek) Recently the DoD initiated actions through the publication of policies in an effort to address these issue. They are endeavoring to consolidate data centers in an effort to lower risk, increase efficiency and provide a higher degree of reliability and resiliency in order to increase efficiency and capabilities in compliance with the Kling Cohen Act and the US CIO's direction. (Clinger-Cohen, 1996) (Kundra, 2011)

Ultimately, these endeavors offer the opportunity to provide inter-compatibility of equipment and applications for cross-domain services in accordance with NIST standard. (NIST, Cloud Computing (SP 800-145), 2011) However with this additional capability came an increased need for more robust security controls through policy and architectural design to afford a means to protect classified information that has varying security requirements between domains. (Takai, 2012) Through segmentation within the clouds as illustrated in the figure 7 below, the ability to establish private, specialized and hybrid centers to ensure confidentiality and security of information while providing a balanced approach toward accessibility proved to be a highly effective toward the application of their diverse set of mission requirements. However, it must be noted that the trades of the private cloud which isolates data ultimately reduces accessibility while the public cloud's increase in accessibility comes at a cost of increased vulnerabilities. Therefore, the hybrid version while it affords the benefits of both worlds also incurs their unique form of risk.



(Figure-7) (Williams, 2010)

III. WAYFORWARD

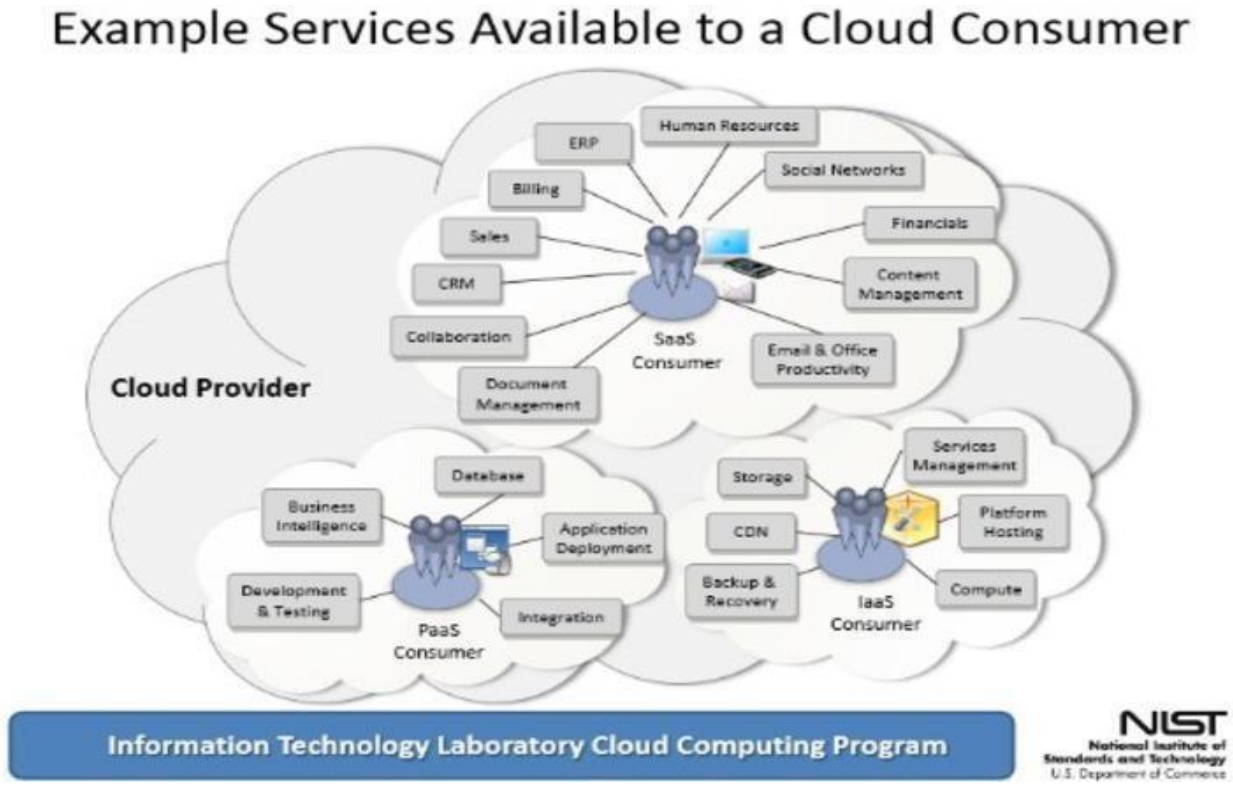
As we endeavor to think about thinking in order to evolve understanding we begin to realize that past action affect current conditions which have an impact upon future results. Thus it is through analyzing the commonality and ascertaining the differences of data that the opportunities to build upon past actions in order to align them to fulfill future objectives present themselves. Therefore, current efforts for data consolidation must be used as a catalyst to integrate all data to the cloud. Proper policies and well defined architecture and training will ensure a responsible model is developed that provides the necessary flexibility to compartmentalize and distribute information in accordance with their need to know for both public and private communities of interest. For only in this manner will we be able to validate the knowns, learn about the unknowns and become aware of the unknowable. This approach is outlined in DoD's Federal Cloud Computing Strategy which identifies a plethora of benefits from efficiency of cloud services as illlustrated by the table below. (Takai, 2012)

Efficiency	
Cloud Benefits	**Current Environment**
• Improved asset utilization (server utilization > 60-70%) • Aggregated demand and accelerated system consolidation (e.g., Federal Data center Consolidation initiative) • Improved productivity in application development, application management, network, and end-user devices	• Low asset utilization (server utilization < 30% typical) • Fragmented demand and duplicative systems • Difficult to manage systems
Agility	
Cloud Benefits	**Current Environment**
• Purchase "as-a-Service" from trusted cloud providers • Near-instantaneous increases and reductions in capacity • More responsive to urgent agency needs	• Years required to build data centers for new services • Months required to increase capacity of existing services
Innovation	
Cloud Benefits	**Current Environment**
• Shift focus from asset ownership to service management • Tap into private sector innovation • Encourages entrepreneurial culture • Better linked to emerging technologies (e.g., devices)	• Burdened by asset management • De-coupled from private sector innovation engines • Risk-averse culture

(Figure-8) (Takai, 2012)

The US CIO's enthusiastic support of the cloud foretells it to be the "intersection of higher processing power, cheaper cost and the ubiquitous access to broadband networks that for the first time are able to deliver content in ways that we couldn't imagine before ... transformation that's going to fundamentally change the way we live our lives." In spite of the opportunities, many express caution should be exercised given the tactical implications associated with any early adoption of this new technology. (Petersen, 2010) Brookings Institute Cloud Computing is challenging the traditional application of technology and offers the potential to drive collaboration and become a catalyst to change traditional thinking in this area. The opportunity for agility to instantaneously adapt to requirements while providing on demand accessibility and elastic storage capacity serves as a platform to envelop a symbiotic partnerships that results in increased capacity and efficiency by yielding a synergistic asymmetric strategic advantage.

Fortunately, NIST's Cloud Computer Reference Architecture roadmap provides for a scalable modular infrastructure to meet current and future needs. Within this document they identify the security and privacy challenges with recommendations to assist with implementation planning at all levels of the organization. Tim Grance the co-author reminds us that "Public cloud computing and the other deployment models are a viable choice for many applications and services. However, accountability for security and privacy in public cloud deployments cannot be delegated to a cloud provider and remains an obligation for the organization to fulfill." (NIST, Special Pub 800-144, Web Down) Thus the plethora of services available include Software as a Service (Saas), Infrastructure as a Service (IaaS), and Platform as a Service (PaaS) are the three most common areas to be considerate when leveraging third party applications like email and office applications. . (NIST, Cloud Computing (SP 800-145), 2011)

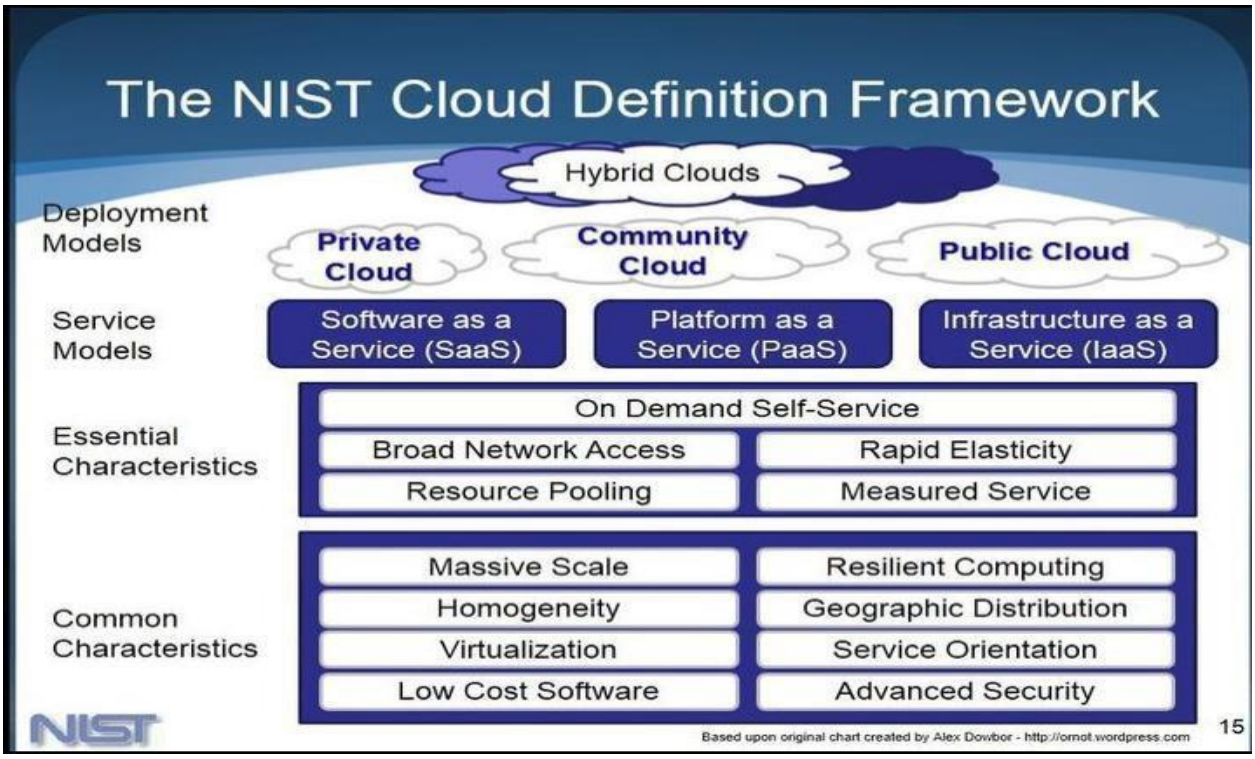


(Figure-9) (Bohn, 2011)

IX. IMPACTS

Cloud computing is beginning to be accepted throughout the IT and business community beyond server virtualization or a means for disaster recover. The technology offers organizations the opportunity to focus upon the business at hand undistracted by internal technological encumbrances. The new viewpoint of technology as a service affords them both the capability and capacity to purchase what they need when they need it. No longer will they have to manage technological infrastructure to provide the necessary capabilities to support elastic scalability and adaptability for current and future requirements. As the IT community evolve from a $12 billion industry in 2010 to a predicted $68 billion in 2014 it offers organizations the adaptive edge necessary to be competitive. The pending transformation of this Cloud computing will account for 15% of IT spending in 2010 and will continue to compound by 26% through 2014. (CIO, 2007) (Kundra, 2011)

The ability to link and drive collaboration is a synergistic catalyst for productivity. The singularity of focus to de-conflicted data precludes distraction within a wildly adaptive and often chaotic world stage. Thus, the functionality and diverse use of services to grow and expand is clearly illustrated by NIST's examples of services outlined in Figure 8 below and the SP 800-145 consumer activities report. (NIST, Cloud Computing (SP 800-145), 2011) The opportunity to have a viable backup and recovery mechanism to mitigate the impact of natural, technological and malicious implications to the organization can dramatically reduce down- time through the application or resiliency. The results are consistently availability in a pervasive Volatile, Uncertain, Complex and Ambiguous (VUCA) information environment.



(Figure 10 (Grance, 2009)

X. RECOMMENDATIONS

The importance of policy in establishing cloud service that ensure adequate security and confidentiality is dependent upon the architecture of the network. By integrating technology to insure accessibility by authorized users will establish a baseline from which to ascertain at what level of trusted exist. To provide low latency and fulfill the demand for bandwidth in a safe and reliable manner, it is essential that a well-defined RMF and adequate TTPs be developed that are focused upon the fulfillment of mission objectives. For by establishing clearly defined guidelines, the opportunity to develop and evolve the functionality that these technologies contribute helps to ensure prioritized access management, identity resolution, and standards for compliance and auditing requirements as outlined in Figure 11 below.

Figure 4: Some possible future standards

1.	Federated security (e.g., identity) across clouds
2.	Metadata and data exchanges among clouds
3.	Standards for moving applications between cloud platforms
4.	Standards for describing resource/performance capabilities and requirements
5.	Standardized outputs for monitoring, auditing, billing, reports and notifications for cloud applications and services
6.	Common representations (abstract, APIs, protocols) for interfacing cloud resources
7.	Cloud-independent representation for policies and governance
8.	Portable tools for developing, deploying and managing cloud applications and services
9.	Orchestration and middleware tools for creating composite applications across clouds
10.	Standards for machine-readable service level agreements (SLAs)

(Figure-11) (Hyek)

By utilizing and complying with SAS 70 trust services to establish an assurance programs that utilize the tools within IOS 27001 and ISAE 3402 the requisite focus upon security that establishes trust within the network will afford the opportunity to build senior leaders confidence through ongoing assessments, detection and maturation that limits the impact of malicious activity within the cloud. Additionally, standardized natural disasters recovery plans will ensure resiliency of large segments of data while alleviating concern associated with the potential impact from intended and unintended consequences resulting from cloud computing. NIST has prepared a draft 800-125 Guide to Security which addresses these security concerns and provides a framework on how best to establish encryption and help to alleviate issues outlined in figure-11 above. (Hyek)

Ultimately, a comprehensive architectural design and sound well thought out plans, procedures and policies will preclude short and long term consequences from unforeseen events by distributing data and conducting continual backups. This coupled with consideration of the five characteristics and three measures as outline in McCumber's cubic model will ensure a comprehensive strategy to combat current and future threats. (Onwubiko, 2010) Endeavors to mitigate risk must be focused upon operational implication with an intent to preclude service degradation that minimizes capabilities resulting in reduced confidence in data, loss of strategic advantage or the long-term consequences of data that has been manipulated. (NIST, FIPS 99, Web sit down) Thus, cloud service providers must incur and be held liable and in turn accountable for the mission impact as a result from inadequate maintenance or prudent cyber hygiene.

Finally, there is not a one size fits all solution when it comes to cloud computing. Each architect, policy and implementation must be custom fit to the organization they support. Developing a means to address CIAAN concerns while providing necessary resiliency that ensures current and future elasticity must be established and proactively evolved to serve as a catalyst that provides an asymmetric advantage on the field of battle. Reliability of backups, distributed operations, and adequate security measures will in-time serve to elevate the confidence that builds trust. It is through these efforts and the resulting efficiencies to be gained in this endeavor that must be capitalized upon to ensure the value- added proposition and operational sustainment is actualized. Overall, the opportunity to evolve and provide for the operational benefits far outweighs the risk incurred by transitioning to the cloud and thus bear serious consideration and our immediate attention. (Williams, 2010) (Amab Dutta, 2013)

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TAB 5

Taking the Fiction

Out of Science Fiction

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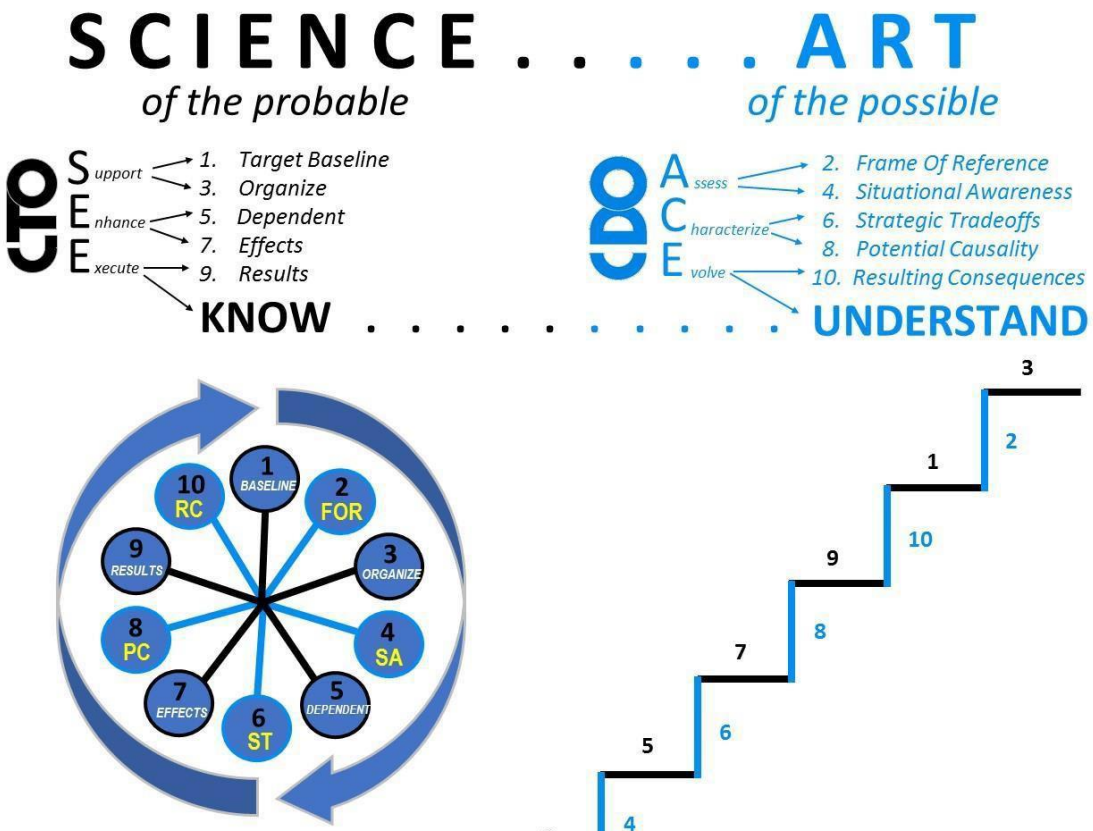
Taking the Fiction out of Sci-Fi

By all indications, the capabilities and technologies available in today's information environment will soon be surpassed. This evolutionary reality not only increases efficiency, but capacity as well. One aspect of this process, however, is revolutionary change, which represents an innovative approach to building capabilities 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.

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. Ultimately, information when and where it is wanted and needed most would be the ideal outcome of such a large-scale rebuilding effort.

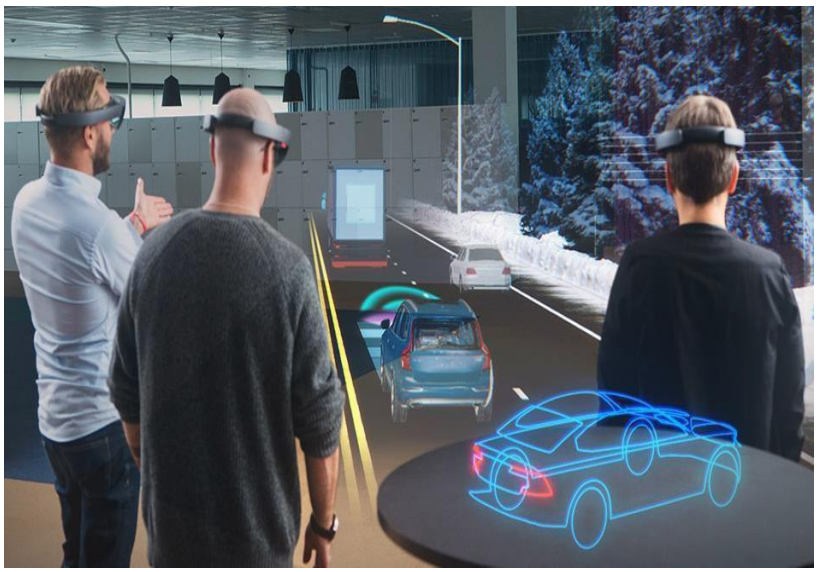
Our current infatuation with technology appears to inhibit the creative process that is essential to innovation. Given today's predilection for sustaining antiquated systems, the self-limiting reliance on current capabilities appears to mitigate the pioneering drive responsible for accommodating current 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. That stair-step process, illustrated below, requires a scientific approach 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 (and even security) 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. Clearly, 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, or deliver precision-guided munitions? 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, love/belonging, esteem, and self-actualization), 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*.

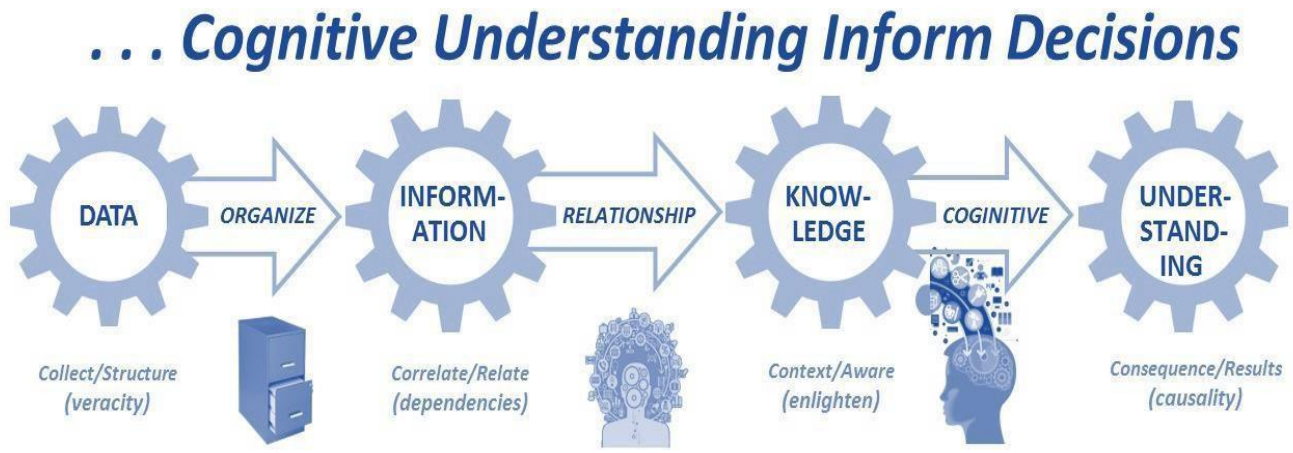
As we evolve into this new era, the adage, *knowledge is power* has never been truer. Properly wielded, it enables us to achieve the kind of strategic advantages capable of catapulting us beyond the constraints of our present social and economic boundaries. In the age of knowledge, wars intended to win the hearts and minds of others are fought more frequently on social media sites than on 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.



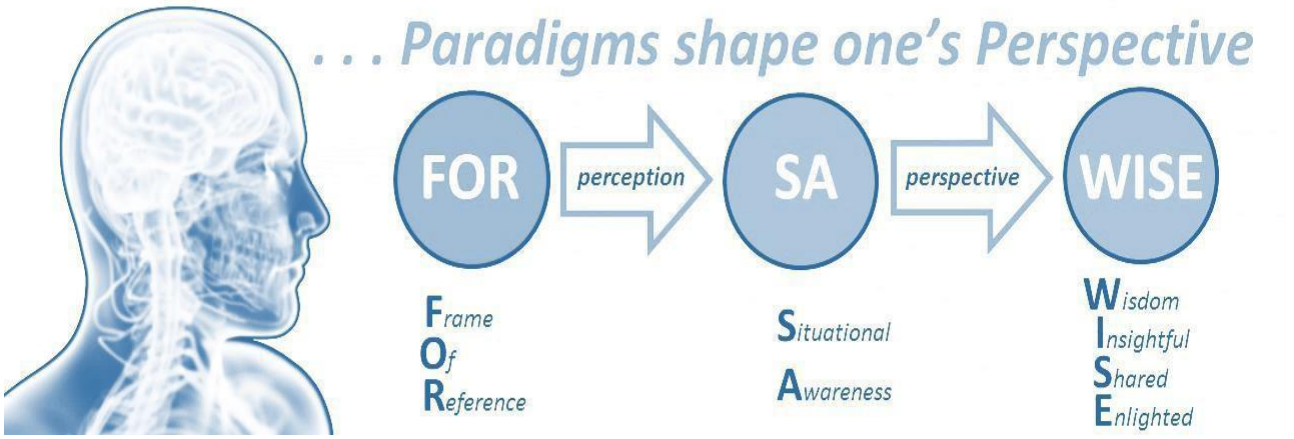
This new unbounded environment affords one to express new ideas more freely on a world stage that, through collaborative talent and collective productivity, easily overcomes all previous limitations imposed by time and distance. Augmented reality 3-D environments will allow us to transform not only ideas, 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, engages defense systems to ensure the integrity of boundaries, and publishes 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 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 citizens demand 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 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.



Ultimately, 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 e this dynamic environment in real time. Systems such as Watson provide contextual understanding to analytical systems that provides the means to augment our current capacity to establish a perspective. Through Artificial Intelligence we are now offered the means to perform redundant tasks with far greater proficiency and efficiency than do their human counterparts. Deep learning at Google creates opportunities to adapt and evolve via ML to create intuitive systems. Ultimately, this informs and contributes to 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. These activities and others are 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 revolutionary 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 6

Future of Technology

Conscious Computers

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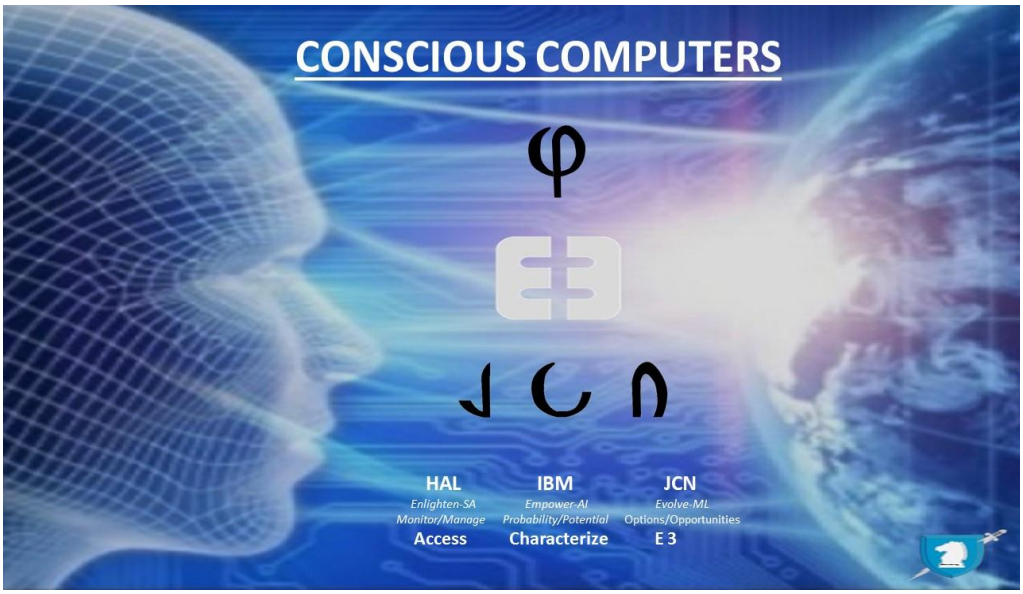


From time immemorial, humans have used tools to improve their circumstances and gain competitive advantage. Thanks to those skills, we have gained the ability to overcome the hazards of our environment. Today, our dependence on technological tools has led to the belief that as such implements become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

Consider, for instance, the evolutionary short story "The Sentinel," written 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 Cognitive Neuralnets (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 (restrictive) 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 neural net relationships able 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 to adapt and evolve without the aid of supervisory input.

The motivation to be innovative in this area is driven by the necessity to evolve to garner 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 we developed the ability to destroy our planet many times over. Under such conditions, it is unsurprising that humans turned their attentions toward the heavens and began to explore space.

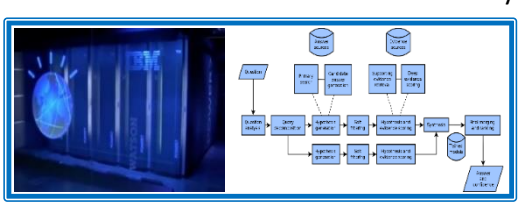
Faced with new and exceedingly hazardous environments, we soon realized the essential nature of our reliance on the kind of technological systems romanticized by Clarke. Such systems would be responsible for the unsupervised administration of lower level tasks, thus giving humans greater opportunities 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.

While some theoreticians opine that machines' lack the creative capacity and 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 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, analytical intelligence is employed to ascertain thorough contextual 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.

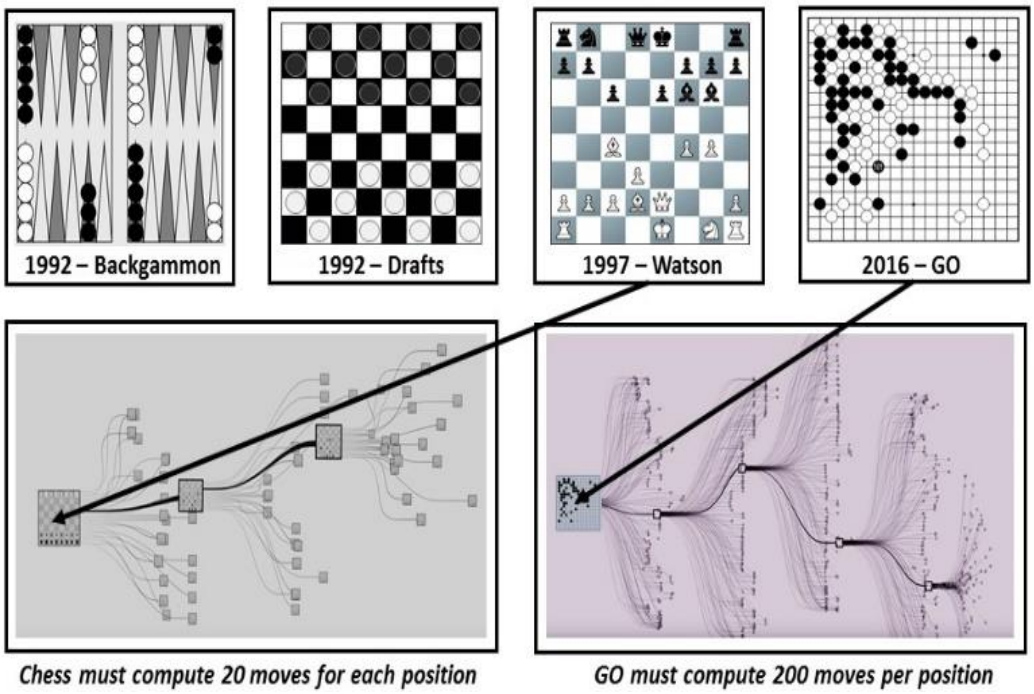
Our growing reliance on automated systems has increased demand signals for machines to perform increasingly sophisticated tasks, a condition that demonstrates the constant demand for their evolution. Clearly, systems are not only gaining in complexity, but we have also integrated them into every aspect 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. To that end, 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.



More 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."

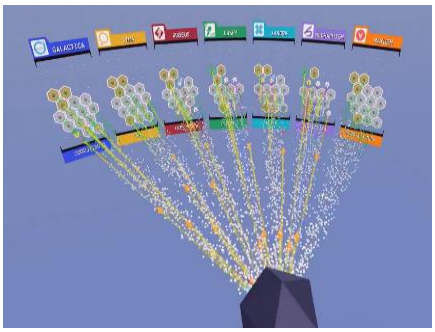
The aforementioned approach received notoriety in 2015 when DeepMind's AlphaGo software competed—and for the first time in history *prevailed*—over a human opponent in a Go match. The system's combined ability to assess circumstances, characterize and interpret causality, leverage opportunities, and 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 (left) and the intuitive perspective of simplicity (right).



Today, numerous efforts are being made to create unsupervised systems able to adapt in today's volatile, uncertain, complex, and ambiguous (VUCA) digital domain. In an environment that is expanding rapidly 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 and 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, DARPA 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. More specifically, 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), adaptive awareness (relate), and creative capacity (innovate) to collaborate effectively with autonomous machines. Given their proven ability to judge against an established framework, act cognitively, and demonstrate a level of consciousness by undertaking actions autonomously, machines are 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.

An 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):

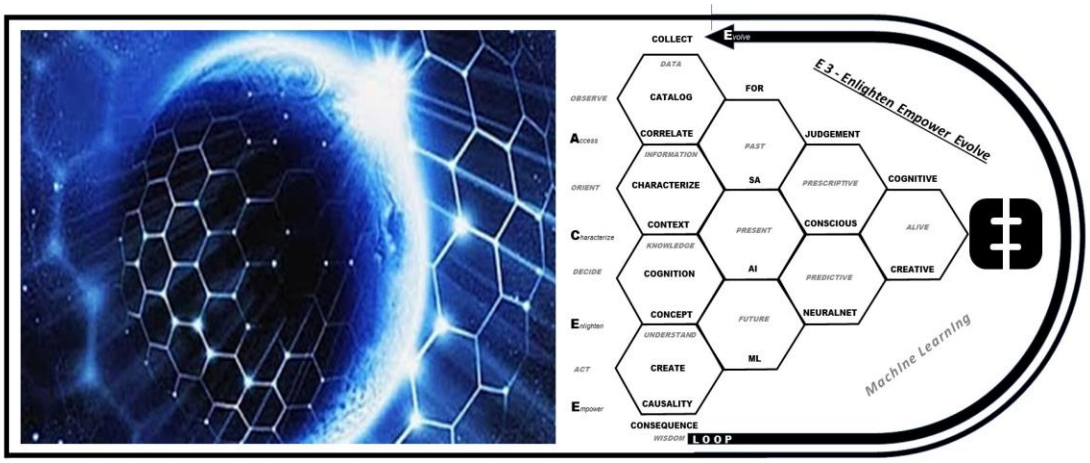
- **Level 0: Monitor/Manage** - *Automated system have no vehicle control, but issue warnings*
- **Level 1: Monitor/Manage** - *Driver must be ready to take control at any time. Automated system may include features such as Adaptive Cruise Control (ACC), Parking Assistance with automated steering, and 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. The automated system executes accelerating, braking, and steering. The automated system can deactivate immediately upon 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 when needed.*
- **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 neural nets, these machines can relate and identify dependencies that enable them to identify the future consequences of actions taken compared to the 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.



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TAB 7

Leadership

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LEADERSHIP

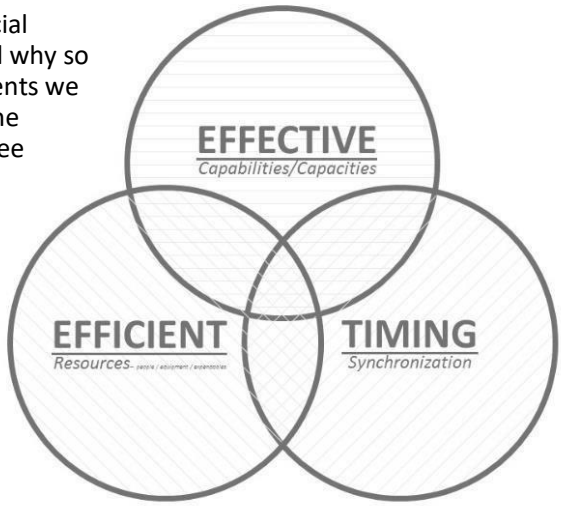
PURPOSE *(organization)*: If you are going into your next leadership position nervous full of self-doubt and questioning yourself then quit now before the self- fulfilling prophecy becomes its own reality. Leadership is not for the faint of heart, it requires and demands a full commitment and belief in what you are endeavoring to accomplish. You are the source of inspiration and strength for the organization and the look to you to be their rock of stability and source of strength. You must be strong in your conviction and unshakable in your determination. If you don't believe in yourself, then why should they believe in you.

VISION *(leaders-synchronize)*: Yours is to understand and provide clarity to the vision so that everyone knows what is expected of them and how they can best serve the organization. You need not have all the answers, or even direct the action, but yours is to cultivate the talent and harvest its ability to the benefit and fulfillment of organizational objectives. Through effective empowerment and synchronization of activities the synergistic result of a team focused collaborative engagement will inspire all that are work for you. It is your role to encourage, acknowledge and appreciates the contributions of those in your care. For the result of which will instill a sense of purpose which will drive their motivation to be more than they thought possible.

OBJECTIVE *(managers-efficient)*: The focus of these efforts should not only be to mitigate threats, sustain operations, or event maximize efficient and profits but to focus upon building the organization and leave it better than you found it. By effectively teaching your team to work smart, helping them to make a meaningful contribution, empowering them to step out, and mentoring them to grow and evolve, you will effectively lead THEM. Your focus should not be increasing their reliance upon you and expanding your role in the organization but working to make yourself unnecessary. For it is the self-sufficient organization that possess the confidence to evolve to the next level.

REQUIREMENT *(supervisors-effective)*: You cannot build an organization on a week foundation, thus you must establish a strong understanding as to their core values, establish a vision, determine the vector and identify the velocity of the organizations. For by all embracing the V4 they will know WHO they are (values), know WHY they exist (vision), WHERE they are going (vector) and WHEN the requisite momentum must be applied to fulfill organizational goals and objectives (velocity). Think of yourself as an orchestra conductor and proceed to organize your team. First identify **WHAT** capabilities and capacities are necessary to **effectively** accomplish their objectives. Next explore **HOW** your resources (people, equipment, expendable) are organized and prioritized to ensure efficient operations. Finally, understand the relationship of **WHEN** they must be **synchronized** to make beautiful music…right note, played the right way at the right time.

FUNCTION: The chart below illustrates how good leaders remain focused on what must be done to be effective, how it must be accomplished to be efficient, and when actions are necessary to fulfill organizational goals. By understanding the roles of supervisors, managers and leaders, you ensure everyone knows their role on the team and is empowered to carry out their responsibilities. Look at it this way, if the boss asks for a letter to be sent across the country we know its capacity is small (letter) not large (box or pallet) and the capability we are looking for is to go from our location to another. He identifies that it needs to be there tomorrow in order to fulfill our objectives, thus we put a priority of effort to ensure we synchronize activities for overnight overnight shipping. The result of this is C2 + Time = tomorrow requires us to leverage resource to mobilize the activities. Lucky for us commercial organizations provide this service for about twenty-five dollars. If asked why so much, when the USPS provides the same service for only forty-seven cents we identify that the requisite 2-3 weeks' delivery period would not meet the prescribe objective of tomorrow. It is the relationship between the three circles of managing resources against priority of time that drives necessary capacity and capability (mass and maneuver).



This framework and working example help to illuminate the roles and process necessary to instill high a performing organization. Therefore, believe in your team and have faith in their abilities by challenging THEM with BIG thoughts, build confidence by starting SMALL and encouraging them to try, and build an innovative to learn and evolve together in order to **THINK . . . TRY . . . TEAM**

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TAB 8

Cyber Strategy

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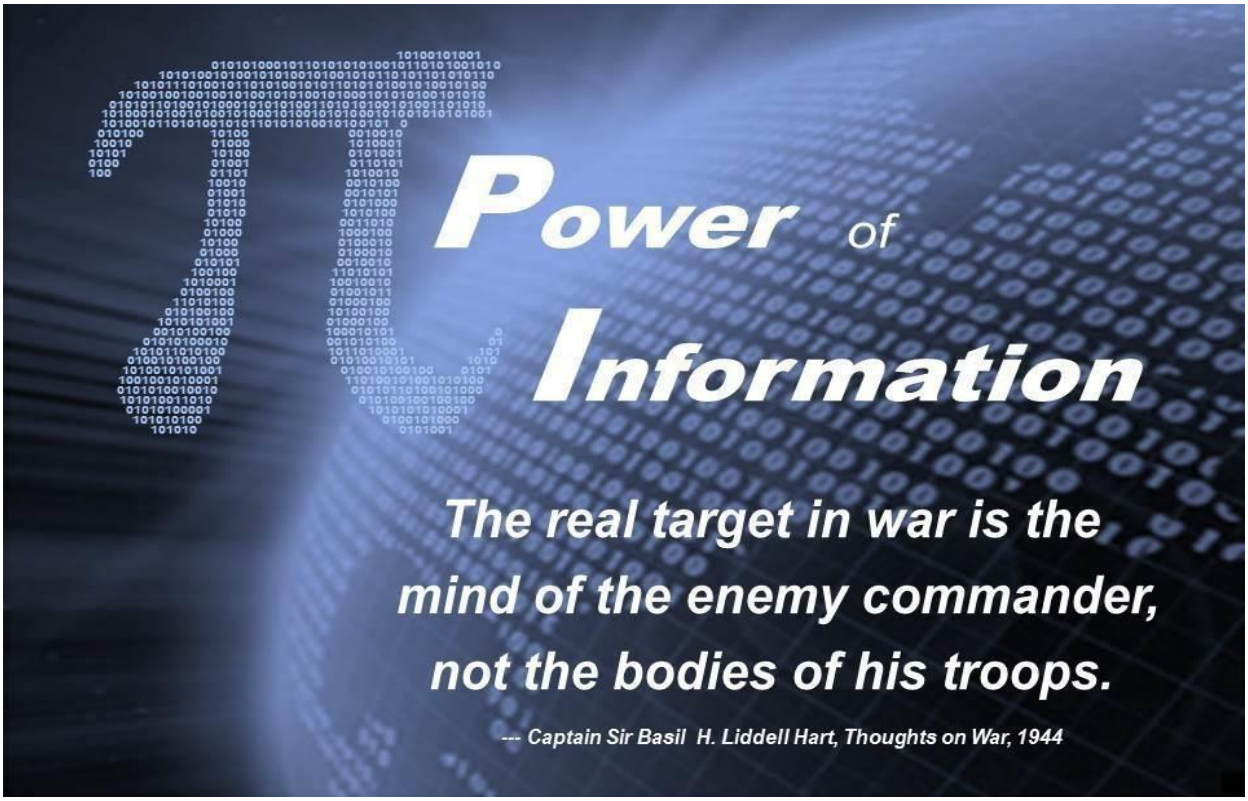


CYBER STRATEGIES

Given the recent Cyber Strategy developed by the Secretary of Defense, he charges us to remain vigilant in the defense of our great nation. Therefore, it is critical that cyber is operationalized in a matter that ensure the United States is prepared to win our Nation's wars. As we embark on this journey, we are well advised to head the words of Carl Von Clausewitz…"Two qualities are indispensable: first an intellect that even in the darkest hour, retains some glimmering of the inner light which leads to truth: and second the courage to follow this faint light wherever it may lead."

Today's cyber warrior must be able to remain focused on the stated objectives as he or she begins operating in the new and ever-changing information environment. Moreover, as they operationalize the cyber domain, it is critical that they are cognizant and fully consider their actions and how they are aligned to fulfill their objectives void of unintended consequences. For it is within this information environment that their influence has direct forbearance upon the outcomes which support and ensure the prosperity and preserve freedom of action within the digital domain.

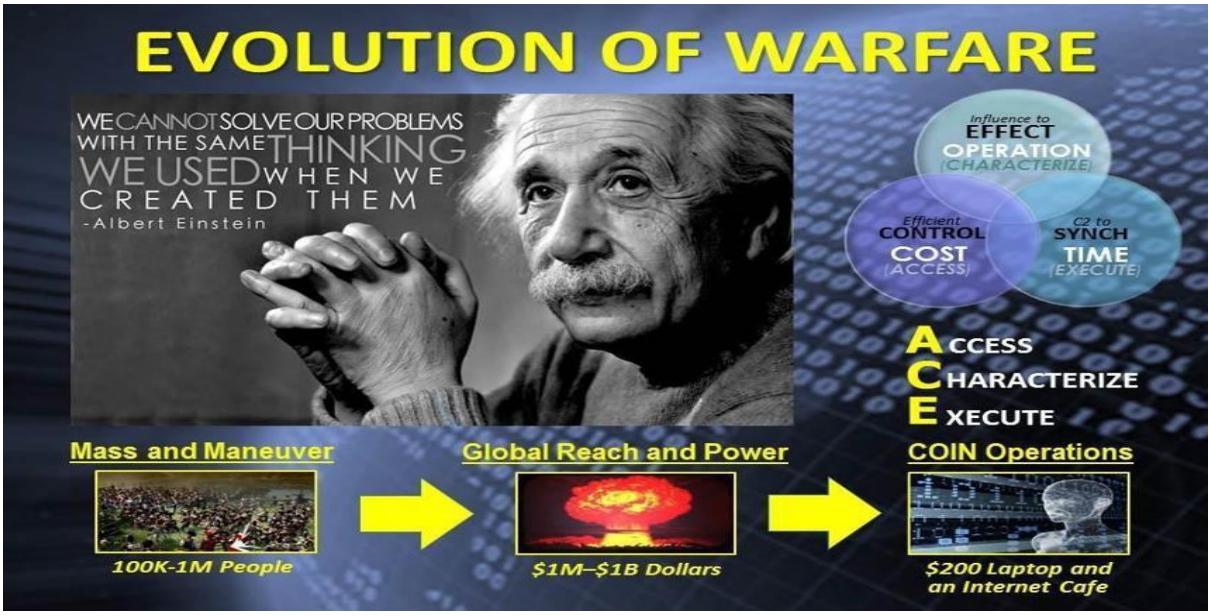
Engagements in cyber not only support and enhance operations; they serve to change the character of war. Ultimately, the express and implied goals of cyber operations are to create the strategic advantage necessary to gain and maintain information superiority. By extension, therefore, dominance within cyber operations means wielding strategic advantage or achieving information superiority.

History demonstrates repeatedly that victory in war typically goes to the combatant best able to amass and direct substantial military might capable of imposing their will and protecting their interests. As technology continued to evolve, refinements and improvements in weaponry and tactics gave strategic advantage to the most innovative actors on the world scene by enabling them to overcome capacity shortfalls. The result is strategic advantage achieved via superior capability on the battlefield.

During the Cold War, sustained technological advancements gave weapons the ability to destroy more overall area than the Earth could possibly regenerate. This overkill ratio, referred to doctrinally as mutual assured destruction, resulted in promoting timing as a critical element in deriving comparative advantage for those who could capitalize on the synchronous capacity inherent in network-centric warfare. In today's world, we seek ways to leverage the resources necessary to maximize the effects of our capabilities and capacity. In that search, information is the critical component that guides us in integrating and synchronizing operations in order to overcome adversarial threats.

By concentrating on our ability to Support, Enhance and Execute (SEE) operations and the cultural paradigm inherent within this domain, we can develop an understanding of WHY certain operations are important (Information In War). For it is through these efforts that we will develop the requisite knowledge that will enable us to incrementally ENHANCE HOW to proceed (Information Operations). Combined, this will afford us the strategic advantage of realizing WHAT is to be EXECUTED (Information Warfare).

Since the Industrial Age, the Information/Knowledge Age has become critical for success. As we endeavor to embrace and attempt to harness the power of information it has become the essence of strategic advantage within the world environment. This immensely broad area continues to evolve and transform at the speed of light. Thus, it is especially important that we are cognizant upon our growing dependency on technological capabilities or "critical mass" of the vulnerabilities inherent in cyber ops.



The magnitude of challenges which confront us in today's rapidly evolving information environment are compounded by a multitude of obstacles. Our constrained fiscal environment, inflexible organizational processes and a risk-adverse culture inhibits innovation. Within the cognitive phase, however, strategic tradeoffs within the decision space disclose opportunities that enable us to navigate the Volatile, Uncertain, Complex and Ambiguous (VUCA) environment. It is within this risk-adverse culture that precludes us from overcoming threats and availing ourselves of the opportunities so prevalent in the new digital domain.

To counter increasingly broad-spectrum threats we face today, Secretary Carter's recently developed a Cyber Strategy directing the DoD to remain vigilant—regardless of domain—in the defense of our nation. That strategy highlights the importance of operationalizing the digital domain, which is vital to every aspect of military operations. As described in the 2013 – 2015 Director of National Intelligence report, cyber threats represent the United States' topmost strategic risk—well ahead of terrorism.

The complexity of our systems require continual patching of thousands of networks across the globe; however, it has proven difficult to establish a structure with the requisite visibility to defend this diverse network. We must characterize the intentions of our adversaries and assess their capabilities in order to focus the efforts we must take to mitigate the threat. In doing so, we must learn to manage this inherent risk and find ways to overcome actions focused against us by our adversaries. Most importantly, we must maintain our freedom of action in cyberspace so that we can either respond in kind or impose our will on those adversaries at a time and place of our choosing.

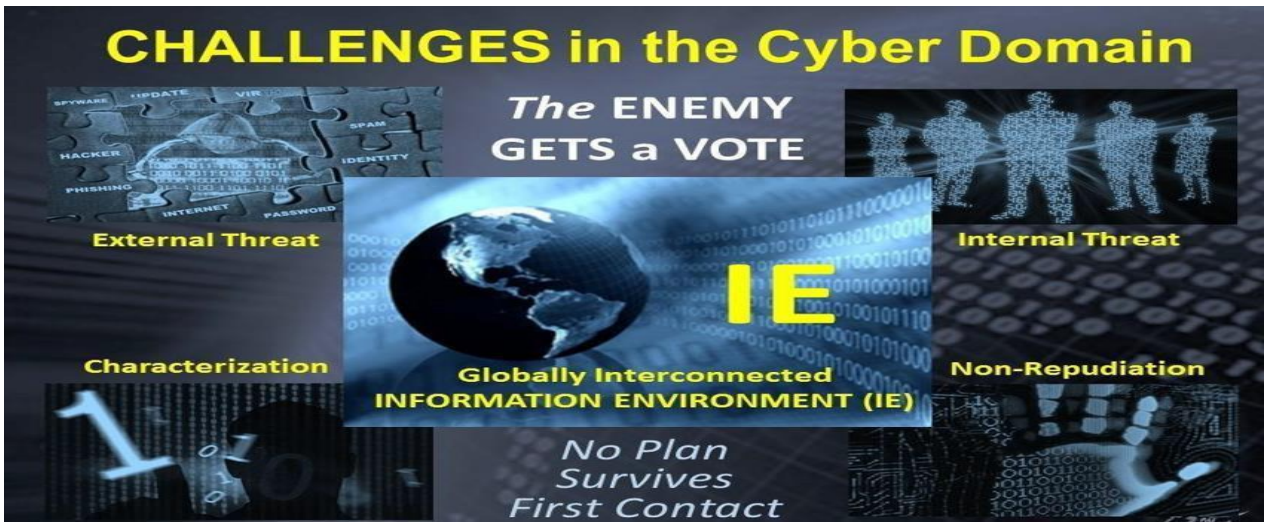
The unrelenting actions being taken by our adversaries have telegraphed their intentions to acquire disruptive capabilities and leverage the destructive capacity of the cyber domain. Stated otherwise, cyber actors are undercutting U.S. strategic and technological advantages by targeting our diplomatic, information, military and economic cores. Even more alarmingly, the growing threats and complexities associated with our technological age make it more difficult, by an order of magnitude, to manage the confidentiality, accessibility and integrity of our information. Thus, it is imperative that we characterize, assess and act quickly on information to identify and overcome immediate threats and vulnerabilities.

Moore's Law holds that technology evolves every 18 months. By extension, the Internet is growing beyond the ability of most people to conceive both in its breadth and scope. For instance, the "Internet of things" derives from our sustained demand for enhanced awareness via an always-connected profile. In 2015, the Internet Society—a non-profit entity dedicated to preserving the Internet as an open platform—estimated that Web volume will increase to 1 billion Internet hosts and 3 billion Internet users worldwide. Similarly, Cisco Systems, Inc. estimates that 15 billion Internet-connected devices are currently in use. A joint Cisco-IBM research study projected that worldwide data volume will double every 18 months at a rate of 2.5 quintillion bytes daily.

There is indeed a clear and present need for us to develop a comprehensive cyber deterrence strategy. For our adversaries are lurking, right now, in this amorphous and limitless domain. The actions being taken by those adversaries place our systems at considerable risk. Specifically, the global proliferation of malicious code and software—malware—which continues to threaten U.S. networks, the data they store, and the mission they assure.

One of Von Clausewitz's most renowned aphorisms is that “War is merely the continuation of politics by other means.” State and non-state actors conduct cyber operations or wage cyber warfare to destroy, manipulate or disrupt our industrial control systems. This allows them to influence public safety and national security in order to subvert trust and confidence. As deleterious as this may seem, however, those actions can be defeated by employing heightened situational awareness, which allows us to manage and mitigate the risk.

By applying the credible strategic aim of pushing and pulling trusted information within the information environment; we can increase situational awareness and advance knowledge to make better-informed decisions. In short, the cognitive process facilitated by efforts to Assess, Characterize and Execute of (ACE) cyber operations affords a predictive capability that will allow us to outthink adversarial attempts to create and inflict havoc.



We must capitalize on the predictive capacity of ACE which allows us to see the best way forward to execute actions in order to gain and maintain dominance within the information environment. This will enable us to overcome a broad range of threats and unpredictable challenges levied by adversaries, from non-state actors to nuclear capable nations. Moreover, despite the rapid and exponential advancement of the digital domain, we must exude agility in this inherently VUCA environment. Therefore, in coordination with other services and agencies, today’s Cyber Warfighters are expected to conduct the Department of Defense Information Network Operations (DoDIN Ops) and Defensive Cyberspace Operations (DCO) necessary to overcome this growing threat.

The establishment of resilient and trustworthy systems with tighter human-machine interfaces will provide our personnel with dependable information when and where they need it most. By organizing, training and equipping Cyber Warfighters to be experts in their field, we can and will protect and assure the US vital national interest. In spite of the currently constrained fiscal environment, we must optimize the planning, programming and execution of information technology investments to sustain the synergistic advantage upon which our nation depends. By collecting information to evolve our Frame of Reference (FOR), control it to safeguard its strategic value and exploit opportunities that ensure our ability to fulfill our mission objectives, we will maximize warfighter effectiveness in the following areas:

Goal 1: Provide trusted information when and where it is needed:

- compress the information flow within the kill chain
- apply common data standards in all mission areas
- attain operational and technical resilience
- improve interoperability and effectiveness
- prioritize secure capabilities

Goal 2: Organize, train & equip Cyber Warfighters to be experts in their field:

- cultivate innovation to capitalize on & advance cyberspace capabilities
- provide qualified Cyber Warfighters to execute/enhance/support mission success

Goal 3: Strengthen mission assurance for freedom of action in cyberspace:

- provide combatant commanders cyber capabilities for msn assurance
- shorten the kill chain and increase decision-making speed

Goal 4: Optimize planning,/programming/execution cyberspace investments:

- flexible & dynamic process of capital planning & investment control
- ensure competitive advantages to sustain & modernize cyber capabilities

All plans begin with the end state in mind, since that objective enables us to focus clearly on goals that will fulfill our intermediate and ultimate objectives. Thus, developing a top-down perspective makes our warfighters aware of themselves, their adversaries and their environment, all of which are vital to understanding the best way to achieve their objectives. Supporting and enhancing their actions by making informed decisions and capitalizing on their strengths (while mitigating their weaknesses) will enable us to gain asymmetric advantage over our adversaries.

We must therefore, cultivate actions which control escalation and shape the conflict environment at all stages by integrating cyber options into all aspects of planning in order to effectively apportion Cyber Mission Forces. The result of which will ensure adequate campaign planning that assess and identify gaps and establish initiatives geared to pursue a DoD cyber deterrence posture and strategy that will inhibit state and non-state actors from conducting cyberattacks on the United States of America.

In the Secretary of Defense Cyber Strategy, we are directed to be mindful of our responsibility of being a capable defender of the U.S. homeland and U.S. interests during times of peace, crisis or conflict. By characterizing, assessing and mitigating risk in the rapidly evolving cyber domain, we will ensure strategic global stability by engaging in information sharing, interagency coordination and building bridges to the private sector, all of which will establish alliances and partnerships abroad. Such collaboration will ensure our ability to successfully achieve our three primary cyberspace missions:

FIRST: Defend our own networks/systems/information in & through cyberspace domain

SECOND: Defend against cyberattacks and conduct operations to counter attacks that could threaten loss of life, significant property damage, adverse consequences to U.S. foreign policy or serious economic impact. (The achievement of this mission is particularly difficult since the U.S. has a limited and specific role to play in defending the nation against cyberattacks. For as the private sector owns and operates over 90% of all networks and other examples of cyberspace infrastructure, it represents the first line of defense. Accordingly, they must prioritize the protection of those networks and data by investing in improving their own cybersecurity.)

THIRD: DoD must provide integrated cyber capabilities in support of military operations and contingency planning in order to:

- *disrupt an adversary's military-related networks or infrastructure*
- *deter or defeat strategic threats in other domains*

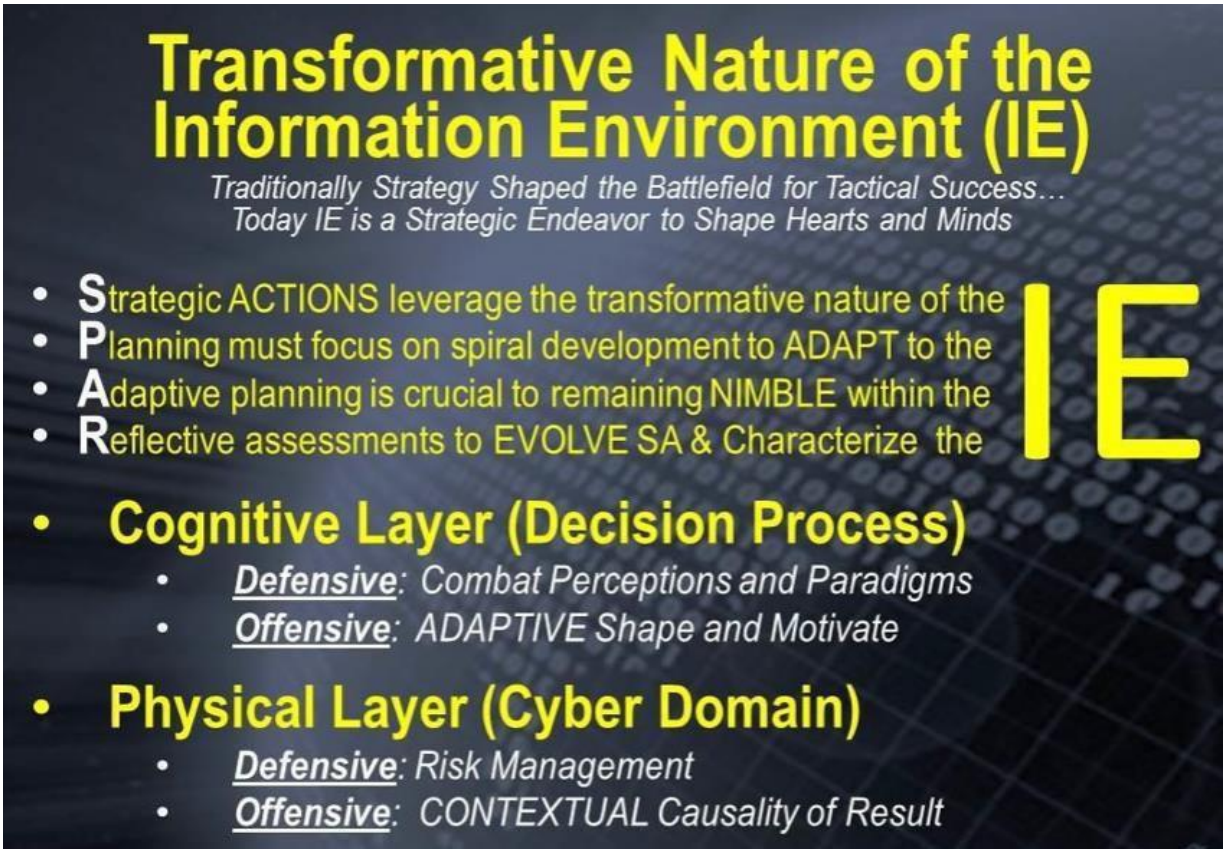
By investing in technical capabilities designed to carry out cyber operations, we can develop capabilities that validate and continually refine adaptive command and control mechanisms. This will ensure the presence of efficient and reliable C2 nodes that promote unity of effort across all three cyber missions. To field a cohesive, well-integrated and enterprise-wide cyber modeling and simulation capability, we must establish a data schema—databases, algorithms and modeling and simulation environments. Such advancements will ensure our ability to defend the information environment, secure the network and mitigate risks to missions.

By continuous network monitoring, developing strong personnel reliability programs, improving cybersecurity training and reporting and tracking suspicious behavior, we will cultivate a culture of awareness to anticipate, detect and respond to insider threats before they can adversely impact our mission. In general, cyber protection will ensure the technology is leveraged appropriately to produce information that feeds the decision-making process.

In taking steps to identify, prioritize and defend its most important networks and data, we will plan and conduct exercises that will operate within degraded and disrupted cyber environments. We will also strive to advance technology in an effort to develop innovative approaches to enhancing, building and employing Joint Information Environment (JIE)-based network architectures that are more defendable, thus mitigating and protecting against cyberattacks and cyber espionage.

Ongoing efforts to build the Joint Information Environment (JIE) single security architecture (intended to adapt to and evolve based on current and future cyber threats) will enable a robust network defense and shift the focus from protecting service-specific networks to establishing a unified approach to securing the enterprise.

The resulting framework integrates and advances the cybersecurity architecture by including anomaly based detection capabilities and data analytics intended to identify vulnerabilities. The awareness of these threats and the application of advanced encryption methods will establish a best-in-class cybersecurity practice that will ensure situational awareness of network threats in order to assess and mitigate risk to the joint force headquarters vis-à-vis DoDIN operations.



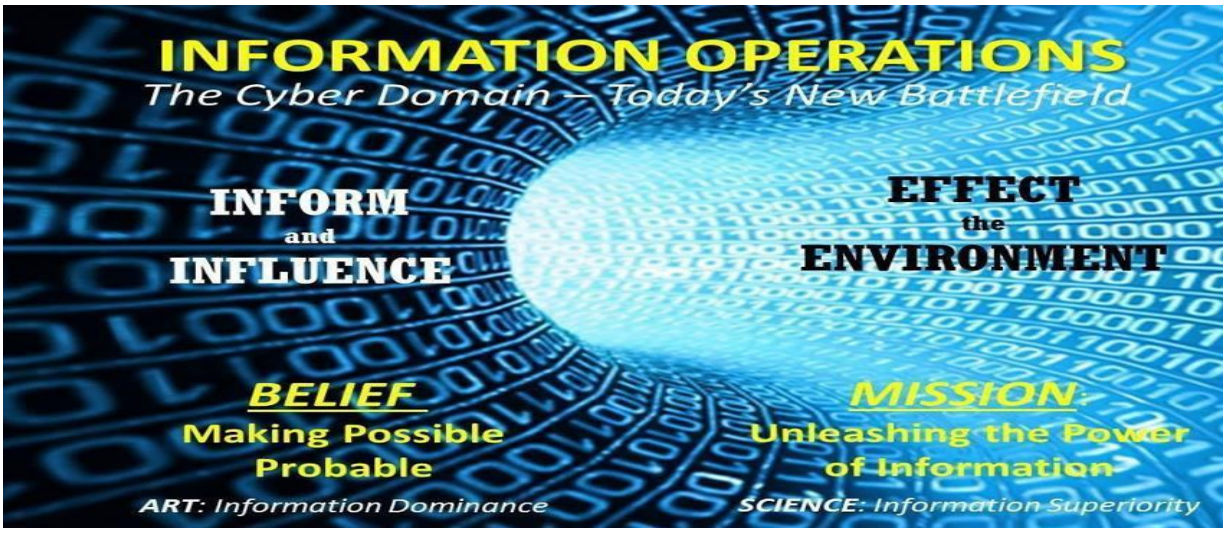
In Summary, as the information environment continue to evolve at a blinding speed, we must remain flexible and versatile, and shift to inherently agile, deployable and networked systems. As mentioned, such systems must be resilient and trustworthy, and they must have an improved interface exemplified by cloud computing and smart machines. This combination will provide our Cyber Warriors with trusted information when and where they need it most.

Despite contemporary constraints and a risk-averse culture, we must ensure that our cyber warriors are both nimble and adaptable. To achieve those qualities, we must strive for a degree of resiliency that will allow us to continue to operate despite a degraded environment. Further, we must take actions to ensure mission assurance vis-à-vis the evolving threat. That outcome will be accomplished by supporting and fulfilling DoD's five strategic goals for its cyberspace mission:

- *Build & maintain ready forces and capabilities to conduct cyberspace operations*
- *Defend DoD information network, secure data & mitigate risk to DoD missions*
- *Be prepared to defend the homeland and U.S. vital interests from disruptive or destructive cyberattacks of significant consequence*
- *Build & maintain viable cyber operations and plan to use those options to control conflict escalation and shape the conflict environment at all stages*
- *Build and maintain robust international alliances and partnerships to deter shared treats and increase international security and stability*

In all, attribution is a fundamental part of an effective cyber deterrence strategy, as it facilitates the ability to unmask an actor's cyber persona, identify the origin of the attack and ascertain the tactics, techniques and procedures being used in order to launch response and denial operations. In short, we must defend the DoD information network, secure our data and mitigate risks to the mission.

Ultimately we must acknowledge the implication and effects of our adversary's ability to wage war and the clear and present danger they presents to the United States. Their unrelenting have demonstrated their intentions to acquire disruptive capabilities and leverage the destructive capacity of cyberspace. Since DoD's networks and systems are demonstrably vulnerable to intrusions and attacks, we must be capable of operating in a contested environment to ensure mission assurance.



The following are the building blocks to operationalizing the strategic objectives:

Information Warfare: influences integrity/veracity of data:

P1 *– is ORGANIZED Data into INFORMATION*
P2 *– is CORRELATED Information into actionable KNOWLEDGE*
P3 *- INFORMS the cognitive process of UNDERSTANDING*

Thus in the rapidly evolving world of cyber we must be mindful to:

OBSERVE *– to elevate & elevate awareness as we endeavor to*
ASSESS *our environment*
ORIENT *– as we evolve understanding in order to*
CORR*ELATE the interconnected relationships*
DECIDE *– upon those strategic tradeoffs to ascertain how best to*
EXECUTE *operations (this will afford us the opportunity to)*
ACT *– in a way that fulfills vital national interests*

ULTIMATELY: Cyber OPS: ensure control/access to data while:

At REST*—in data centers*
In TRANSIT*—across our networks*
During PROCESSING*—in our applications*

Information Dominance informs decisions through the application of data to:

- ***THINK BIG*** *(courageous vision)*
- ***START SMALL*** *(step out in faith)*
- ***SCALE QUICKLY*** *(believe in your purpose)*

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TAB 9

Leaders of Technology –

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Leaders Of Technology

The LOT of THEM

Due to our critical dependence on technology and cyber operations to communicate, manage and operationalize mission systems, we must reconsider the approaches we are taking to safeguard and leverage the vital capabilities afforded by technology in order to maintain our strategic competitive advantage. To begin that process, today's CIO must employ proven as well as evolving CSO/CISO techniques to assess and manage risk. Likewise, the CTO must have both the ability and ingenuity to utilize current and developing technologies to fulfill mission objectives.

Further, the CDO must always be prepared to unleash the power of information as doing so will ensure the organization remains capable of evolving in today's highly competitive and rapidly changing information environment. Whether for business systems, weapon systems or to inform strategic endeavors, the CIO must have the ability to exploit technology to overcome challenges and to seize unseen and unrecognized opportunities. Ultimately, the leadership, expertise and experience of these essential staff members will assure our ability to understand and utilize technology to the greatest extent conceivable.

Despite a competent staff, however, increasing costs, dwindling resources and the constraints imposed by Moore's Law require us to engage in collaborative partnerships with industry. By doing so, for example, the CTO will hone the ability to apply technology to achieve a degree of operational effectiveness that is at once coordinated, unified and unobstructed. By synchronizing those efforts with the actions being taken by the CSO, we can have greater certainty about our operational environment, as we can be assured that operant risk factors are being managed effectively. Further, the CDO will define the analytical context that will allow us to assess, characterize and evolve despite the unpredictable VUCA environment. Ultimately, the CIO will be responsible for the direction and application of these vital resources, and for providing the support necessary to coordinate their efforts, inspiring them to augment mission-related capabilities and imparting the vision that will enable the organization to meet current and future objectives

Based on the foregoing, we propose a multifaceted action intended to imbue critical staff members with greater authority. In short, that effort will yield a single point of convergence that will simplify the supervision and management of technological capabilities, whether for business systems, administrative support, weapon systems or analytical systems.

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TAB 10

Operationalizing the Power of Information

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OPERATIONALIZE

The POWER of IT INFORMATION

We are indeed living in interesting times. In Afghanistan, the War on Terrorism has us fighting an enemy we can neither see nor attribute to a nation-state, and for the first time in history, battles are being waged in a new domain—cyberspace—to sway public opinion. These new circumstances have introduced a new host of vulnerabilities that are being exploited by actors masquerading behind the scenes. The members of these fifth columns are hard at work mining social media sites for information they can use to instill fear, shape our perceptions and transform our actions. The cyber Pearl Harbor we always hoped would never materialize is already in full force. And while this new reality is fraught with challenges and pitfalls, it also offers us a world of opportunity. Confronted by an enemy we cannot see, we must learn to look at warfare in an entirely new light. For instance, there is more to warfare than its traditional offensive and defensive postures. The relatively low start-up costs of today's strategic cyber confrontations afford our antagonists to achieve lofty goals by forcing us to make uninformed and ineffectual decisions. Thus, we must avoid applying old rules to campaigns that can be concluded more effectively by adopting a rugby-like approach in today's transformation technologically reliant world.

In view of these dramatic changes to the age-old paradigms that govern combat, we are now faced with the responsibility to alter our communications processes, which range from exerting command and control, to engaging in cyber operations, to unleashing the heretofore- unimaginable power of information. Our modern, global society depends not only on the tools that allow us to engage in cyberspace, but also on the information necessary to make sound decisions. Ultimately, our ability to understand this new environment faster and more effectively than our adversaries will help ensure our victory on the physical battlefield and in the court of world opinion. Above all, we must arm ourselves differently to ensure success in this new cyber domain, and we must begin that effort by determining its makeup and assessing the impact it has on our environment. In its nascent phase, cyberspace was simply a means with which to further distribute the overall communications process. Over time, however, it has developed the ability to transform our environment by its influence on decision-making. As a result, there Is a critical need to harness this capability to ensure that we remain able to advance and protect our vital national interest.

The visionary (if not revolutionary) Billy Mitchell recognized the strength inherent in airpower. Adamant that the nation had little alternative if it wanted to remain a viable, first-line world power, he remained persistent—even to his professional and personal detriment—in his dedication to convince others in the government to open their minds to the concept. Ultimately, this pariah became the father of the Air Force, and airpower, in all its facets, is always among the most respected and desirable capabilities of any nation. At once a tactical and strategic asset, the effective use of airpower is limited only by technology and imagination—both of which can be overcome. Thanks to the innovativeness that has always been a characteristic of airpower, it was also pivotal in unlocking access to space, Earth's ultimate high ground. Yet air-breathing aircraft were certainly not forgotten as the U.S. turned its eyes to the moon and beyond. For instance, unmanned aerial vehicles (UAV) such as Predator and Reaper have assumed a prominent place in today's version of low-intensity conflict. Yet as innovative as UAVs certainly are, their achievements would not have been possible without similar advancements in cyberspace. From the miniaturized equipment used in such airframes to the "remote split operation"—fully dependent on advanced C4I capabilities—which dramatically reduced the problematic "kill chain," UAVs, piloted aircraft and other manned and autonomous vehicles are all based on the notion of a dependable, secure and capable cyber system backbone.

The world has indeed graduated from the industrial to the information age, and its thirst for data knows no bounds. Today, we continue to evolve within that unique parameter. These unending streams of data enable us to improve our global understanding and shape the environments in which we operate by making informed and effective decisions that affect our broad area of operations. Therefore, it is critical that we gain and maintain a commanding knowledge of the environment in which this seemingly limitless data exists. Of course, given the sheer magnitude of that challenge, we will certainly be faced with myriad of unknowns and the anxieties that accompany them. Despite this, our mission is to move forward smartly in our pursuit of cutting-edge knowledge about and within the murky world of cyberspace. Our cyber operators are the pioneers of this new domain—some of which they have held the responsibility to create. As its guardians, they have the wherewithal to consult the constantly growing list of capabilities and apply solutions that meet our current and future mission requirements.

Though still in its infancy, cyberspace has already proven its ability to provide the range and depth of information necessary for our actions. Moreover, it can help reveal the motivation of those involved in the decision-making process. This exceptional clarity allows us to illustrate the interconnected relationships that make up today's dynamic world. As we move forward, we must build the trust necessary to bind those relationships. At the same time, we must also establish new and erudite networks that will help us redefine extant paradigms—and conceive successors. By taking a page from John Boyd's OODA (observe, orient, decide and act) loop, we can quickly transcend our frame of reference, improve our situational awareness and gain a better understanding of any new situation. Armed with that enhanced comprehension, we can begin to understand the dynamics that apply to the range of actions from which we can select. This proactive approach, made possible only by advancements in cyberspace, can help us order the chaos inherent in the fog and friction of war to predict opportunities that will become realities.

Clearly, our steadily increasing reliance on systems makes them lucrative targets for our adversaries. Moreover, our concern with vulnerability can quickly constrain the timely and accurate data we need, and thus impede our ability to act at the time, place and manner of our choosing. While no network can remain viable if it is devoid of security considerations, today's operators must be mindful of the tradeoffs involved since they can have a direct—positive or negative—influence on our ability to work collaboratively to improve our operational capabilities and the impact of their execution. As the Great Wall of China isolated that country for eons, an impenetrable firewall built to protect our networks would also cause undesirable consequences. Understandably, such seclusion is the antithesis of growth and evolution, both of which are essential in an adaptive world. Sun Tzu advised us to keep our friends close and our enemies closer, and that principle should not be ignored when designing the security components for our networks. In short, we must always have the latitude to learn from and apply the tactics and strategies of our adversaries. In a vacuum, however, doing so would be impossible.

As the world becomes increasingly interlinked, the actions of one person can have a direct and immediate effect on many. It is therefore imperative that we establish a credible, reliable and timely means of exchanging information, thus we must measure data quality and assess the methods of presenting the information critical to fueling the collective cognitive endeavor. Understanding the maturation process that data organized into information and correlated into actionable knowledge, is vital to making sound decisions. The strategic tradeoffs are informed by a cost-risk and benefits-opportunities lacunae as they pursue their respective objectives. There is a clear need to improve C2 effectiveness to link and coordinate activities to ensure operational synchronization. One such consideration is the cost benefit of increased security to data and information availability. But regardless of the path we ultimately take, enhanced security and controlled access to information should not impede our ability to understand the associations between operations, their costs and the time they consume. Here, our overriding concern must be oriented to achieving the results we desire.

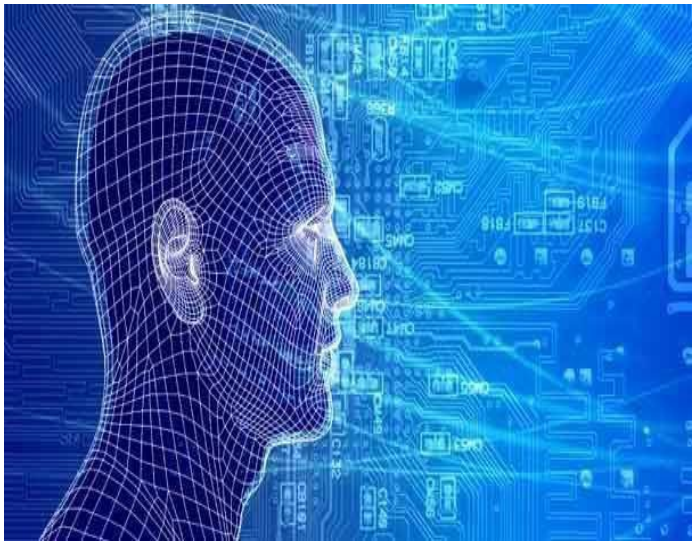
All good relationships are built on trust and mutual respect. In cyberspace, we must learn to trust the data that informs our decision-making processes and be confident that those decisions will have the desired result in this dynamic and complex environment. To facilitate such outcomes, a decision support tool must be developed to help evolve understanding and illustrate the interdependent relationships and determine the best ways to manage operational and fiduciary responsibilities this tool should correlate data as it validates its accuracy, the result of which will be heightened situational awareness of impending actions versus expectations. By providing recipients the opportunity to assess the effects of their intended actions on others *before* any action is taken users will be able to assess the value proposition and determined their expected return on investment. Through a relational pictorial linkages to illustrate how the ways and means necessary to support the desired outcomes can be utilized to their greatest potential, modeling to identify causality and determine potential consequence must be enacted to ensure actions have sufficient influence to derive at desired ends.

A call to assess, characterize and evolve in this dynamic environment is in order. If we cannot think outside the box, then we're just not thinking. It is imperative that everyone understand that it is impossible to describe our ultimate destination or even offer a road map for the trip on which we are embarking. In reality, the destination is far less important than the collaborative journey itself. Similar to the previous analogy of the adoption and adaptation of airpower, the cyber domain must always innovate if we hope to see it fulfill its evolving role. I can think of no better way to achieve that sustained innovation than by harnessing the imaginative spirit of the American people, whose creative capacity know no bounds.

Change is never easy, and it is even more challenging in a resource-constrained environment. Fortunately, the old proverb "necessity is the mother of invention" will certainly help us navigate through that turbulence. Still, the task—the journey—is monumental, and we simply cannot throw money or people at the problem to make it disappear. We can no longer build tools and then learn how to use them. Since the objective of this endeavor is to advance and protect our national interests, then beyond our own innovativeness, we need head the words of Allan Mogensen and resolve to "work smarter...not harder." Taking a reactive approach to decisions in today's interlinked world is incongruent to an active decision-making methodology that enables us to take advantage of opportunities when they present themselves. Otherwise, we face the unenviable task of working harder to improve an inherently bad plan. Instead, we must have a clear understanding of the end state we desire and then must determine the best way to get there. Key to all things is establishing trust and thus by determining the veracity of data should be the focus of our efforts. Indeed, there is little need to access or secure questionable data, and without being able to access dependable data, our forces are in no better position from a C4I perspective than they were at the turn of the century.

To preserve and enhance our 21st century capabilities, concentration must be place upon the ways to access, characterize and evolve (ACE) data effectively, regardless of environmental constraints. Thus, before anything else, we must develop metrics that help determine data accuracy (DATA CONTENT). In striving to do so, it is critical that they work collaboratively to compliment the efforts throughout the organization to derive and determine data veracity. Importantly, they must focus consistently on whether they have the information they need, when and where it is needed, in order to make informed decisions. Data Stuarts must be cognizant that they are not responsible for acquiring data; rather, should be focused on providing a means with which to measure and organizing data into a cohesive structure, and ensure its availability. Information managers are charged with linking data to ensure its accessibility, and knowledge operators should strive to establish correlations among the data to put it into a contextual picture that improves situational awareness of our senior leaders.

Working collaboratively through a team of team approach, they will undoubtedly be able to create the conditions that will allow for informed decisions through every aspect of operational engagement. On this journey, there is no place for the "business as usual" attitude. Complacency is not only contagious, it is often fatal. The change described here is transformational, and we must embrace it. The organization must adopt a culture of innovation free of risk aversion. The work that is ascribed here will ensure an asymmetric strategic advantage to assure the organization is able to accomplish its mission— anytime, anywhere, regardless of asymmetry obstacles or synchronicity. Capitalizing on this new reality means that we are responsible for developing a new breed of cyber operators who have what it takes to enable us to outpace and outthink our adversaries. The results of these efforts will assuredly unleash the power of information and arm senior leaders with the knowledge essential to succeed in this brave new world.



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TAB 11

Technological Catalyst to Perpetual Understanding

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The TECHNOLOGICAL

Catalyst to Perpetual Understanding

INTRODUCTION

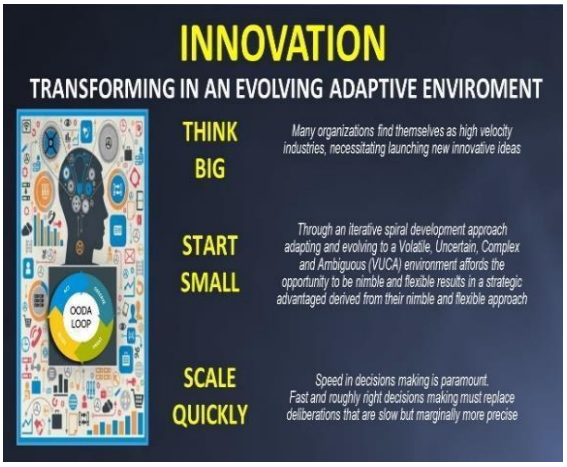
More than ever before, the best approach to managing a demanding, resource constrained organization—to ensure its competitiveness—is working smarter, not harder. To do so, one must develop the ability to adapt quickly to this rapidly changing environment, a process that begins with asking the kinds of questions that facilitate decisions intended to achieve the objectives that lead to accomplishing the organization's goals. According to Einstein, **"If I had an hour to solve a problem I'd spend 55 minutes thinking about the problem and 5 minutes thinking about solutions."**

Since most people today depend on technology to solve their problems, it must be understood that innovation stems from creative solutions. Thus, since technology is used to actualize the efforts to be made, it must be leveraged to unleash the power of the information that informs and spurs cognitive capacity.

In today's information, dependent society, our appetite for data is unrestrained. Indeed, that voracious appetite, compounded by an elevated awareness fueled by the Internet of Things (IOT), data is being doubled every two years. In our ongoing efforts to store, access and apply the complex and burgeoning resource we call data, we must consider it an asset and apply effective information technologies bolstered by efficient management techniques. Moreover, we develop cognitive capacity by applying the established 10 C framework (collect, categorize, correlate, context, cost/benefit, characterize, cord/collaborate, communicate, causality and consequence), which helps illustrate opportunities to apply Data Resource Management (DRM) principles that will ensure we gain and maintain our strategic advantage.

Once we learn to understand what our data is capable of telling us, we can begin to appreciate the importance of operationalizing information. By Assessing, Characterizing and Evolving (ACE-ing) that data, we develop and learn to employ a valuable managerial ability rather than continue to react to changing situations. As part of that process, we must accept that "cyber" is not a word but an adjective that describes the application of technological means to support, enhance and execute (SEE) actions that will fulfill our objectives. Thus, the three major functions of cyber are to (1) communicate and collaborate (C2) to improve effectiveness at the tactical level; (2) inform situational awareness (SA) to improve its efficiency at the operational level and (3) enlighten our cognition to facilitate informed decision making at the strategic level—all of which help us work smarter, not harder.

APPROACH



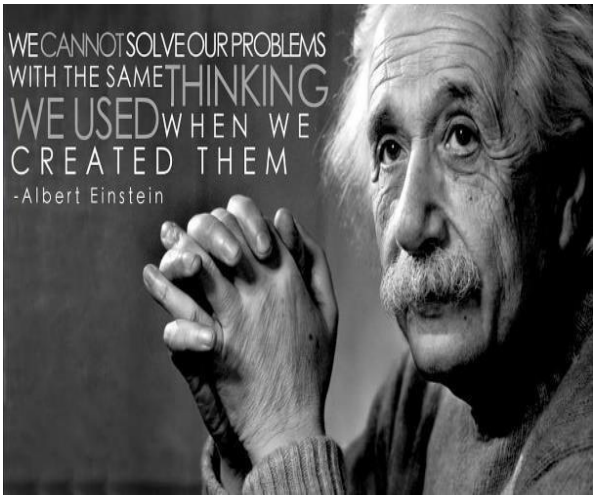
Our ability to adapt to, and overcome known and unknown challenges will enable us to function effectively in today's rapidly evolving information environment. Specifically, John Boyd's OODA loop provides the framework necessary to think big, start small and scale quickly our efforts to cultivate opportunities to apply the power inherent in information and achieve success in today's highly competitive information environment. With that in mind, we apply the 3As (assessing, analyzing and acting), which enable us to learn from what we see, hear and understand. Accordingly, we must listen to our data to *assess* its veracity; *characterize* the dependencies within the relations we identify and *evolve* to ensure our data affords us the means to accomplish our mission. *To that end, we must utilize a more formalized approach to organizing data and correlating information, such that it provides us the requisite knowledge to make informed decisions.*

While no single, authoritative source can account for, or monitor the totality of the world's data, once we begin to understand that we do not fully understand, we can begin to appreciate the daunting challenges we face. Thus, we must resolve to research several key questions, the outcome of which will help us discern the art of the possible that lies within the science of the probable. That effort will help us quantify what we know, recognize what we do not, and accept that such unknowns can be identified by asking the right questions. In sum, as opposed to getting the right answers, asking curious and insightful questions helps us begin to understand how to learn, adapt and evolve in this ever-changing and transforming information environment.

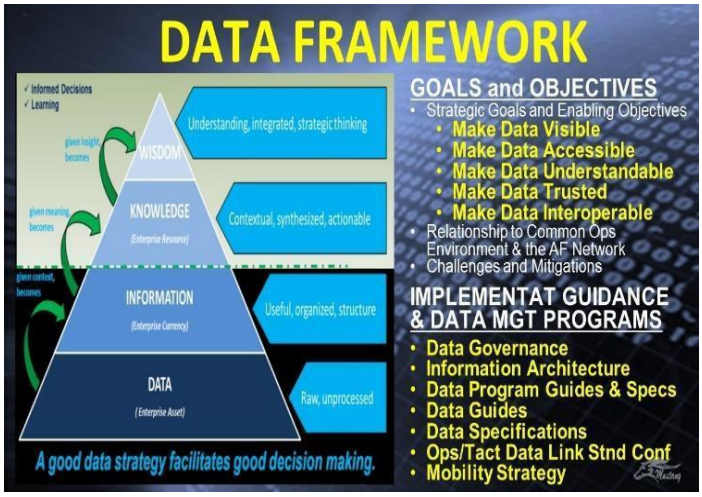
Having completed numerous assessments, we will conclude that the need to change our thinking to adapt to today's challenges does not stem from resource constraints or a lack of technological capability but a culture that finds it difficult to allow their perceptions and perspective to be transformed.

According to Einstein:

- "The most beautiful thing we can experience is the mysterious. It is the source of all true art and science. He to whom this emotion is a stranger, who can no longer pause to wonder and stand rapt in awe, is as good as dead: his eyes are closed."
- "Insanity: doing the same thing over and over and expecting different results."
- "I have no special talents. I am only passionately curious."
- "Great Spirits have always encountered violent opposition from mediocre minds."



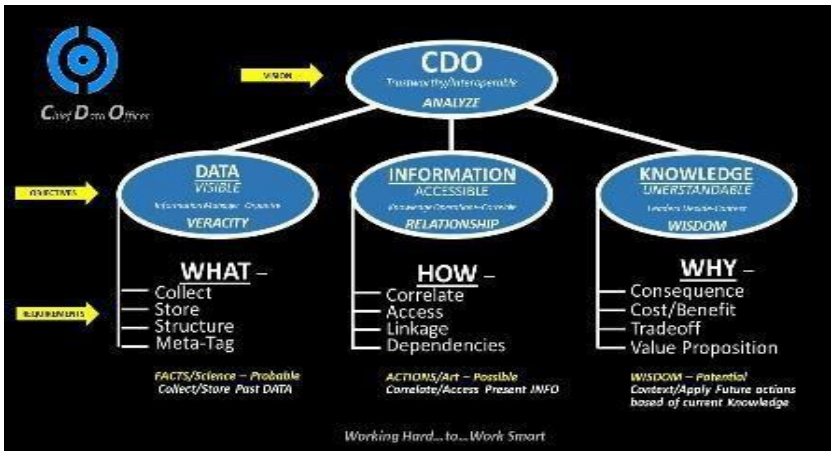
STRATEGY



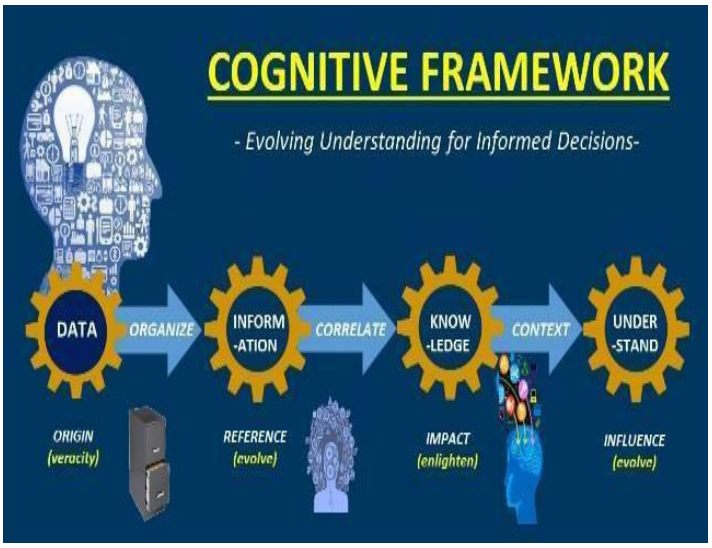
The following framework is intended to establish the building blocks that will help us SEE in order to ACE in this Volatile, Uncertain, Complex and Ambiguous (VUCA) environment. As we explore the scientific approach to improving our understanding of data, it is essential that we learn how it is organized (stored/structured) so we can illustrate our reliance on it (supporting/supported relationships). As information gains context (i.e., alignment and association), it begins to inform wise choices or decisions. Here, we define a*rt* as the creativity that inspires innovation and *science* as the methodical application of effort. It is within this art that perspectives and paradigms are affected, shifts that allow us to learn and evolve, and then take actions that fulfill overarching objectives.

The revolution in information prefaced the upcoming age of knowledge. Considering the magnitude of this change, to remain viable, we must acquire the ability to adapt at the speed of light, which includes near instantaneous coordination and collaboration. To achieve that ability, information must be visible, assessable, understandable and linked, so that it emerges as the right information, at precisely the right place and time, and informs our cognitive process. Clearly, this represents a tremendous challenge given the mass and complexity of establishing an interlinked information environment. To facilitate the process of cognition, data must be managed in ways that ensure its common understanding. Moreover, to be successful in that effort, we must formalize the manner in which data is discovered, interpreted, communicated and analyzed. In short, to ensure that each function receives the necessary attention, organizations must assign responsibility for each of those functions.

The advent of the Chief Data Officer insures that data is assessed and structured, that information is correlated and that knowledge gains context. Thus, it is important to understand the framework that governs the organization of data into information and the correlation of that information into knowledge.



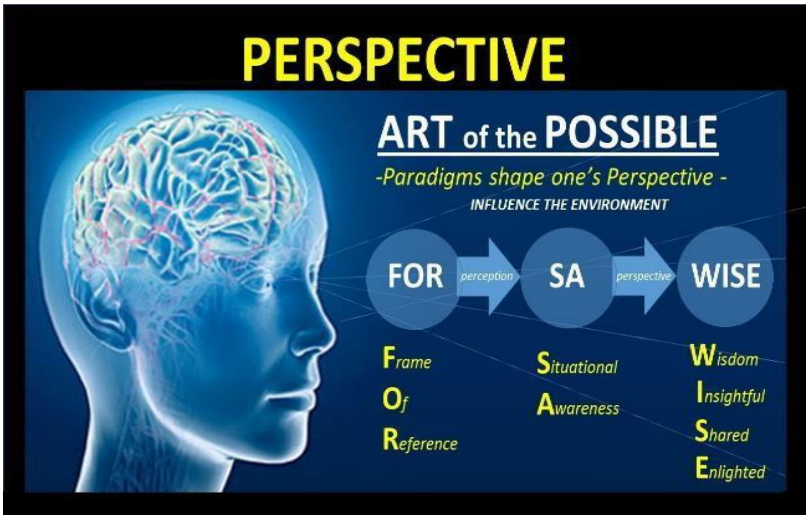
FRAMEWORK



Wisdom is gained through extensive experience, open-minded observation and a desire to understand unknowns. By committing to that process without judgment, one can gain a greater appreciation of people's reactions vis-à-vis environmental influences. According to Plato's admonishment that "Beauty lies in the eyes of the beholder," an individual's experiences or frame of reference (FOR) influence both the way they sees the world and their situational awareness (SA), both of which influence how they reacts to their circumstances.

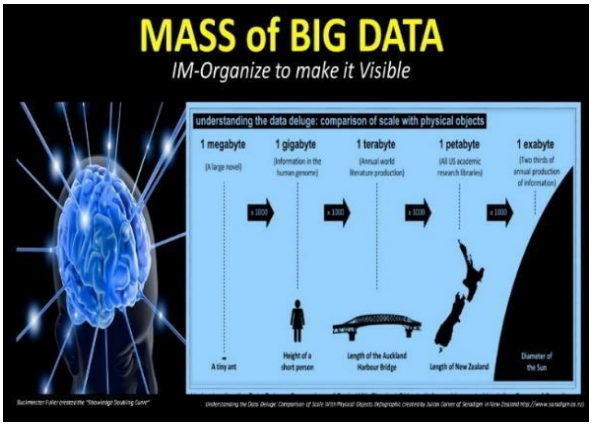
AS OUTLINED IN THE ABOVE DATA MATURATION CHART:

- P1 = **PROCURE**: **OBSERVE-** ***Access***…*Collect- store/structure (meta-tag) data in an organized fashion to make it visible*
  - (PREDICTIVE ANALYTICS for Probabilistic Modeling)
  -
- P2 = **PREDICTIVE**: **ORIENT-** ***Characterize***…*Correlate data into information showing linkage/relationships for accessible*
  - (PREDICTIVE ANALYTICS for DecisionModeling)
- P3 = **PRESCRIPTIVE**: **DECIDE-** ***Empower***/Evolve. . . Context; put information into perspective to inform the cognitive process in an attempt to empower one's understanding of the second and third orders of effect or causality of action to determine outcomes or consequences of actions taken against results to be achieved



Given the diversity of experience and the way it influences our actions, the complexity of this effort is incalculable. Therefore, when one seeks to develop an approach that works in all situations. Thus the necessity to adapt and evolve quickly is essential if we are to gain and maintain our strategic advantage. Therefore a very detailed plan is essential to provide us a point of departure for establishing the point of adaptation from which to evolve. It then becomes evident that while strategy is simple, it is not easy. Similarly, while thinking is easy, it is not always something that we take the time to do.

BIG DATA



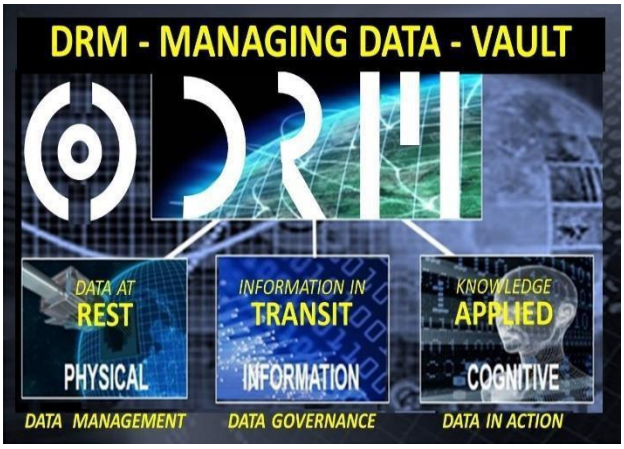
According to estimates, the totality of amassed data will continue to double every two years, and with the advent of the Internet of Things (IOT), that amount is assured to increase exponentially. Some 2.5 quintillion bytes of data are produced daily, and Google (reportedly the largest data company in the world) processes 3.5 billion requests each day. When one considers that the world population is 7.5 billion people, the statistic is astonishing. Further, estimates hold that Google stores 10 *exabytes* of data, but Facebook, Microsoft's Azure cloud solution and Amazon's cloud services are all endeavoring to challenge Google's dominance.

One typically thinks of libraries as the source of wisdom and historical context. Since the advent of the internet, however, this traditional data format has taken a backseat to the digital domain. Estimates hold that the sum of all books in every library, school, home and company worldwide represents only six percent of all human data. Assuming that all data in human existence has been created within the last two years alone, compared to 500 exabytes in 2012, it is anticipated that 40 zettabytes of data will exist by 2020.

Considering the amalgam of available information, it is surprising that people fail to heed the available data and thus make decisions based on less than 5% of information. The answer to our most perplexing problem, which is there for the asking, demands that we learn immediately what to do, how to do it, and when and where we should perform those functions. At this point, analytics starts to ACE our efforts to work smarter rather than harder. Specifically, the reliability of high quality data and the predictability of actions taken against results to be achieved is dependent on the knowledge imparted by that data. Given the tools at our disposal, it is feasible that all of the information germane to pending decisions can be made available, which would increase the likelihood of making wise choices while reducing risk.

To realize the value of data and unleash the power of information, data must be organized, structured and managed. Considering the staggering accumulation and increasingly complex nature of data, Data Resource Management (DRM) is quickly gaining importance, as it improves business leaders' understanding of what their data is telling them. As data is assessed using an approach intended to organize the more than 80% of the world's unstructured data, the criticality of a well-developed DRM program cannot be overstated. Similarly, to ensure the viability of data, a central organization (like that of a CDO) will make it Visible, Accessible, Understandable, Linked and Trustworthy (VAULT) for the organization. With increased efforts to put this information into context in order to understand the relational reliance's, the resulting mathematical and computational models fail to fully present a holistic picture as to understand the potential consequences from actions taken against desired results to be achieved.

- ***Data Management:*** *a program for the implementation and performance of data management functions, such as metadata management and more*
- ***Data Governance****: business functions that develop and execute plans, policies, data quality, data standards, data operation practices and projects that acquire, control, protect, deliver and enhance the value of data*
- ***Data in Action:*** *A framework that facilitates the application of best practices in establishing, building, sustaining and optimizing data management throughout the data lifecycle*



Implementing DRM ensures that organizations use data effectively, which adds to their potential for success. DRM aligns data assets with those imperatives, identifies potential interoperability conflicts and establishes the basis for effective, cross-organizational discussions, all of which is intended to facilitate informed decisions through sound governance program informed by effective data services.

Organizations committed to a coordinated implementation of DRM are likely to see improvement in their effectiveness due to the following advantages:

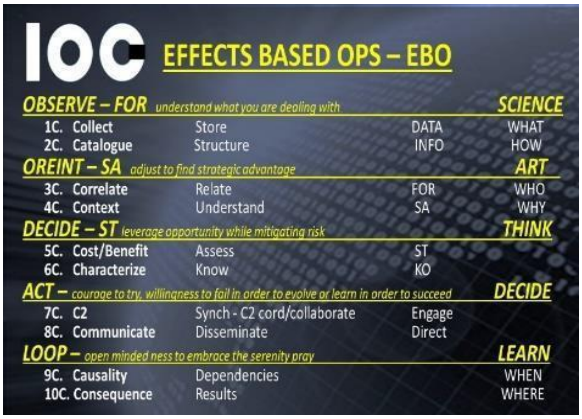
- *Better insight into challenging problems associated with improving processes, productivity and performance*
- *Increased and streamlined efficiencies to realize cost savings and effective resource allocation*
- *Ability to evaluate predictions accurately, develop plans and produce forecasts to increase mission assurance/reliability/effectiveness*
- Improved data transparency and availability to facilitate sound organizational decision making
- Support regulatory compliance in the use of data to improve operations

Continued efforts to establish frameworks upon which to access, characterize and evolve opportunities to advance SA in ongoing efforts should be linked to the application of computational and temporal assessments, such as prescriptive analytics. This process helps management ascertain the value proposition, in order to identify the organization's strategic tradeoffs.

As data dependencies continue to increase, the value implicit in such data is unquestioned. Therefore, it is necessary to safeguard the use of that data by ensuring that prudent, effective actions be taken to prevent unauthorized access and distribution, particularly in the areas of Personally Identifiable Information (PII), Health Information Portability and Accountability Act (HIPA) and the congressionally mandated need to disclose – Privacy Act of 1979. The White House is leading the way in this effort with its Open Data Transparency initiatives, Open Data Innovation Summit and Big Data Privacy Workshop. These initiatives emphasize the importance of not only what must be done, but also how it should be done considering the interests of all U.S. citizens.

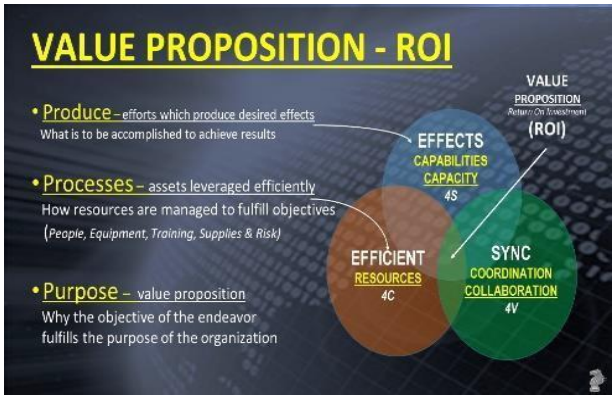
INFORMATION MANAGEMENT

While all of us have faced innumerable decisions, the mass and complexity of information available today to inform our cognitive processes demands that we capitalize on the technological tools at our disposal to assess the probability that the decisions we make are both timely and relevant. Many people wrongly believe that artificial intelligence is sufficient to power this decision-making process. In reality, the only intelligence capable of making such decisions is human. Yet technology can help collect, correlate and add context to these strategic choices, and it can serve as the framework for understanding the cost/risk and benefit/opportunity associated with each decision.



The adaptive process, coupled with the temporal analysis of today's efforts in machine learning, represent the means to simulate and assess the probable and potential outcomes of actions taken vis-à-vis desired goals and objectives. Here, technology can advance the process of ACE-ing information to facilitate the decision-making process. The importance of this approach is evident given industry's rapid development of the 10C; collect, catalog, correlate, context, cost/benefit, characterize, coordinate and collaborate, communicate, causality and consequence.

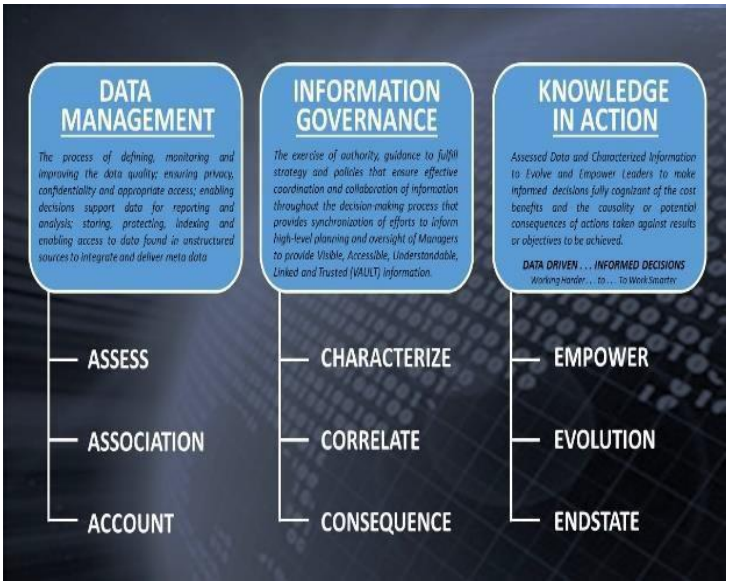
The maturation processes involved in turning data into information produce knowledge that facilitates understanding. Decision support tTools afford the means to align the three circles of capabilities/capacity, resources and timing/synchronization. These efforts identify thos strategic tradeoffs that maximize return on investment, as they align resources according to priority to deliver the capabilities that facilitate mission success.



Decisions must be informed by prescriptive analytics or mathematical and computational models. We must become aware of the effects our actions have on the environment. The veracity of data, our dependencies on information and the context in which we interpret things improve as our understanding improves affording us to make smart choices. Yet each of these actions are predicated on the 10C building blocks to make information visible, accessible, linked trustworthy and imperative that we learn to THINK, as doing so will obviate the need to work harder.

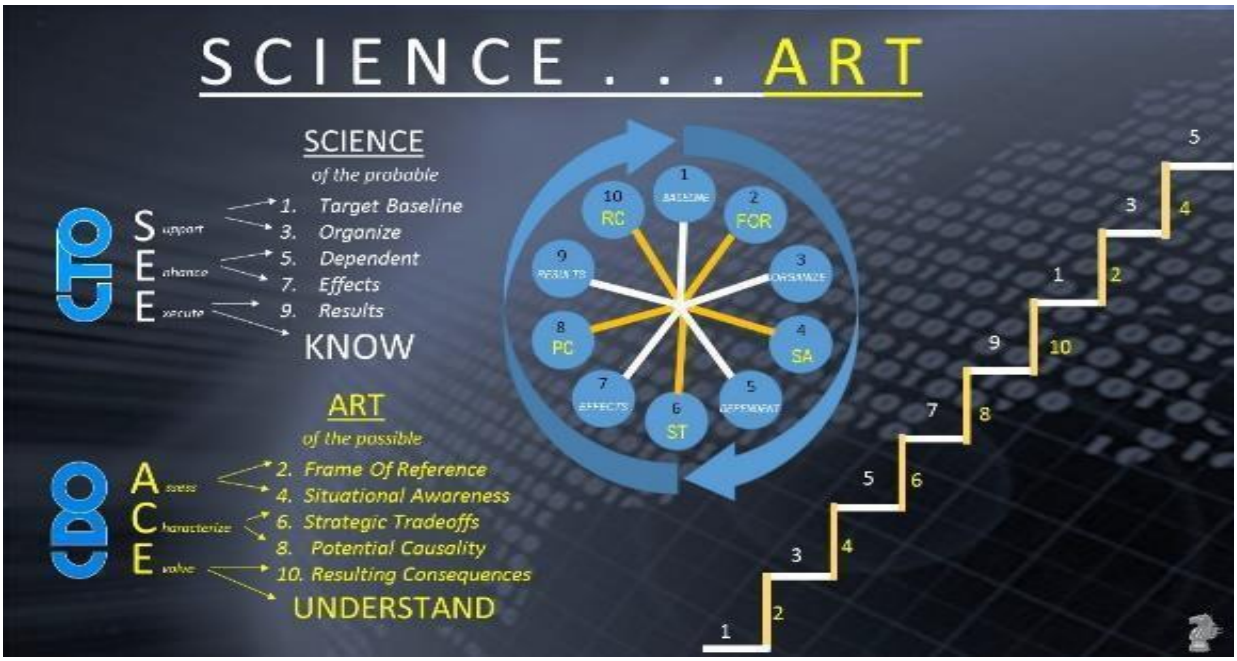
KNOWLEDGE OPERATIONS

Early efforts made to store and structure the incredible volume and variety of data produced the term "big data." As organizations struggled to store these massive data sets—but found it difficult to do so considering the complexity involved—they realized the commensurate limitations in querying, accessing, transferring, visualizing and analyzing that data. Given the increasing reliance on, and growing demand for information to mitigate risk and identify opportunities, organizations have become acutely aware of the critical need to make decisions informed by data, as doing so helps them manage risk and take strategic advantage of opportunities.



Of course, such opportunities must be seized at just the right time to produce beneficial results in today's VUCA environment. The framework (at left) illustrates the dependencies and interrelationships of these concepts in a sequential process that affords the means to mature, evolve and adapt via the OODA loop, the concepts presented. The illustration summarizes the actions that must be taken to capitalize on efforts to create the effects we desire.

Here, it is important to recognize the science of the probable, the art of the possible and the interrelationship they share as they manage expectations and consequences, respectively. Also illustrated is the progressive approach they take to build upon themselves to achieve the succeeding level of cognition. In short, the process validates knowns and describes and explores the unknowns in an iterative approach that approximates the OODA loop.



Considering the steadily increasing demand to be informed coupled with a decreased tolerance for mistakes, users today rely on timely and relevant information that minimizes risk and maintains productivity. To that end, they develop Dashboards, Alerts, Sensors and Analytics to evolve SA and inform the cognitive process:

Dashboard — Provides the means to elevate awareness, synchronize efforts and communicate and coordinate ongoing actions. These tools enable data to talk to those involved in a relationally contextual manner.

Alerts — A mechanism to identify when things are outside predetermined thresholds. Left unaddressed, such elements could be disastrous. In the context of net-centric operations, those in charge determine risk tolerability and then implement the management conditions necessary to ensure it remains within prescribed parameters.

Sensors — Observe, collect and make data visible and accessible to ensure the timely inputs inform and evolve knowledge.

Analytics — the new "be-all and end-all" of things. Analytics determine what something is and how it can be accomplished using an iterative approach that informs the cognitive process at all stages. This is accomplished in the four steps described below:

- **Batch Analytics**— process the data in large groupings. This is done when the container is full and does not always provide timely results.

- **Interactive Analytics** —an interactive deluge of ad hoc queries with a feedback mechanism for human guidance. This can be likened to a conversation between people and their data.

- **Real-time Analytics**— used to detect something quickly (from a few milliseconds to a few seconds). Real-time analytics are very powerful in detecting conditions overtime).

- **Predictive Analytics** — provides example-based solutions. Problems are solved by citing myriad examples and through behavioral dynamics, self-learning systems and temporal analysis to calculate and predict future outcomes given past performance or the FOR, SA and those influencers that effect vector and velocity trajectories.

ANALYTICS

What Analytics Is:

In today's fast-paced and rapidly evolving information environment, having the right information at the right place and right time is critical to deriving strategic advantage. The employment of analytics enhances awareness by providing trustworthy data that can unlock the power of information. By utilizing effective analytics, opportunities can be identified and compared to the associated risk associated with determining the course of action best suited to achieve the organization's strategic objectives.

Whether leveraged to assure good strategy, improve effectiveness or ensure efficient allocation of scarce resources, the ability to unlock data's inherent value will have a direct impact on our ability to model success probability and potential options, both of which are particularly important in today's VUCA environment. The following are examples of the effect informed knowledge has on fueling the cognitive process by applying organized data that has been correlated into context:

- *Insight into difficult problems*
- *Improved processes, productivity and performance*
- *Cost savings and effective resource allocation*
- *Scope options and opportunities*
- *Accurate predictions, plans and forecasts*
- *Increased mission assurance/reliability/effectiveness*
- *Increased efficiencies and streamlined processes*
- *Superior return on investment (ROI)*

The Analytics Value Proposition:

Chief among the deliverables associated with implementation of the CDO concept are data that have been structured and organized to demonstrate its veracity and information that has been correlated to establish a context. These outcomes enable data to be modeled and assessed in a manner that informs the cognitive process. The analytics that illustrate probable and potential consequences capable of managing expectations and illustrating potential outcomes vis-à-vis the organization's strategic objectives are as follows:

- **Big data** *Finding hidden clues to improve mission capabilities and capacity*
- **Business insight** *Providing quantitative and operational insight into complex problems*
- **Business performance** *Improving mission performance by embedding intelligence into an organization's information systems to improve decision making*
- **Cost reduction** *Finding new opportunities to decrease cost or resource allocation*
- **Decision making** *Assessing the likely outcomes of decisions and determining better alternatives*
- **Efficiency** *Increasing ROI*
- **Forecasting** *Providing the basis for increasingly accurate forecasting and planning*
- **Improved scheduling** *Efficient synchronization of staff, equipment, events and activities*
- **Planning** *Applying quantitative techniques to support operational objectives and tactical engagements that fulfill strategic intent*
- **Productivity** *Helping to determine ways to improve the productivity and efficiency of processes*
- **Quality** *Improving quality while quantifying and balancing qualitative considerations*
- **Resources** *Achieving greater utilization rates despite limited equipment, money and personnel*
- **Risk** *Measuring threats quantitatively/identifying factors to improve management/reduce risk*
- **Throughput** *Increasing speed or throughput with a focus on decreasing disruptive delays*

Answering the challenges, you face today:

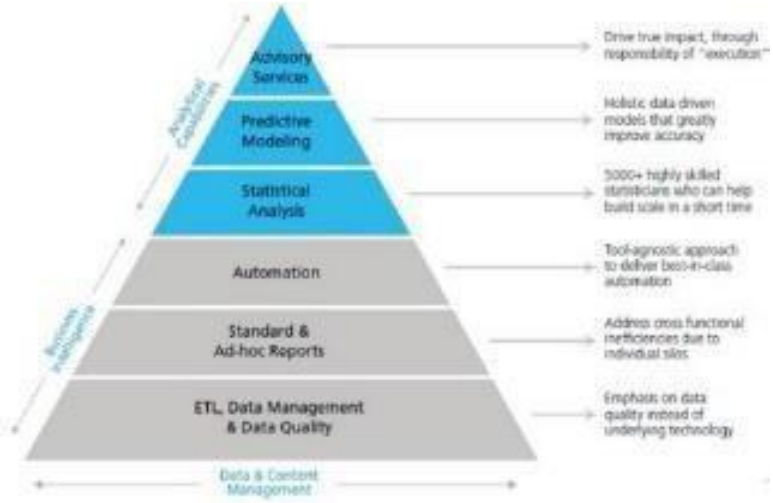
Given the increasing number of decisions, the complexity of options and the implications or consequences of mission success, senior leaders need timely indicators and capable modeling systems that identify opportunity and risk as they ascertain the probability for mission success. Compounded by the vast amount of information being generated by massive amounts of data, coupled with the persistent risk that is a characteristic of this VUCA environment, the opportunity to make fact-based decisions focused on assuring mission success is critical. Analytics can help today's organizations with many of the specific challenges they face, including:

CDO goals and objectives:

This exploratory process helps illustrate both opportunities and risks in an effort to advance the cognitive process and thus make informed decisions. To that end, it is imperative that the CDO's Data Directorate organize and structure data to assess it veracity. The Information Directorate will correlate that information to illustrate links to supporting supported relations to information and put into context that affords understanding. Then, the Knowledge Directorate will model that data using a cost benefit analysis. This will quantify the probable and potential strategic tradeoffs and resulting consequences of actions taken compared to results to be achieved in order to determine the value proposition that identifies potential ROI:

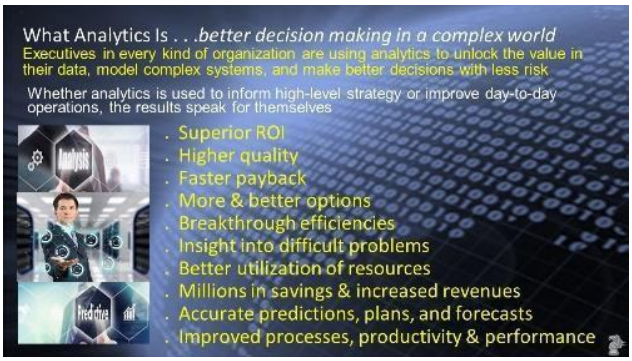
The following describes the roles and functions of the three constituent areas of data, information and knowledge:

- **Data Scientist** – unifies data management, through governance, to integrate and quantify data quality in an effort to add structure via metadata structure. Ultimately, analytics establish the relative veracity and ***reliability*** one can reasonably have of the data.
- **Information Managers** – identify the links that create dependencies within the resulting supported relationship according to the use of, and reliance on data during its operationalization as information. Ultimately, analytics determine the ***reliance*** one can reasonably place on information**.**
- **Knowledge Operators –** determine the causality of actions taken by modeling them against resulting consequences. This action is taken to ascertain potential outcomes and management approaches to enlighten the cognitive process of making sound and informed decisions. Ultimately, analytics determine the ***results*** one can reasonably expect from knowledge that they possess.



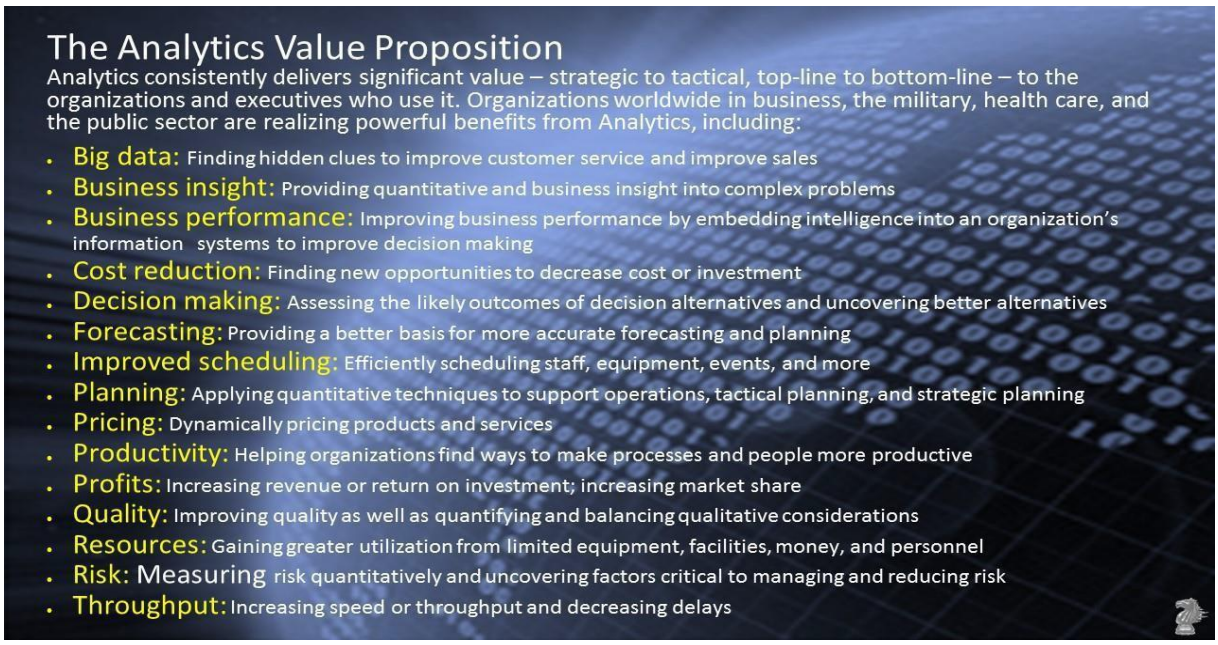
By applying the process, organizations can organize and structure their data and correlate the resulting information to enhance knowledge in an effort to make better decisions. As with building a house, however, the better the foundation, the more capable the resultant structure will be in terms of helping the organization achieve its goals.

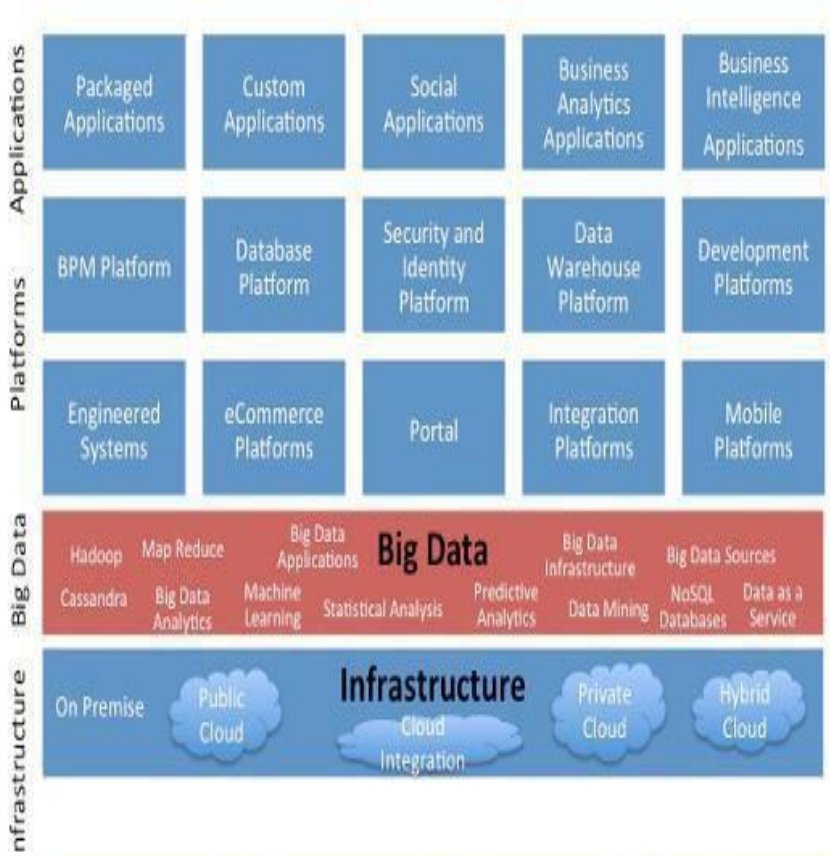
As illustrated in the aforementioned diagram, organizational value proposition that results from good DRM, Information Management (IM) and Knowledge Operations (KO) facilitates several data analysis features. Analytics delivers quantifiable results and can assess opportune cost benefits to maximize the organization's ROI for information analysis.



Assuming the analysis is conducted properly, it should indicate that the needs of the organization are being met through elevated knowledge. Ongoing assessment via SMART measurable will illustrate the ROI and the resulting value to the organization.

Today, most organizations realize that traditional approaches are of little use in terms of remaining competitive on the interlinked world stage. Those same organizations understand the necessity to both outthink and outpace their competition. To do so, they built comprehensive data strategies that enable them to collect, correlate and analyze data from a multitude of sources effectively and efficiently. These approaches have been integrated into the frameworks they use to store, access and unleash the power of information. To that end, they have built massive infrastructures to store/structure data, platforms that make it accessible and applications that analyze it.





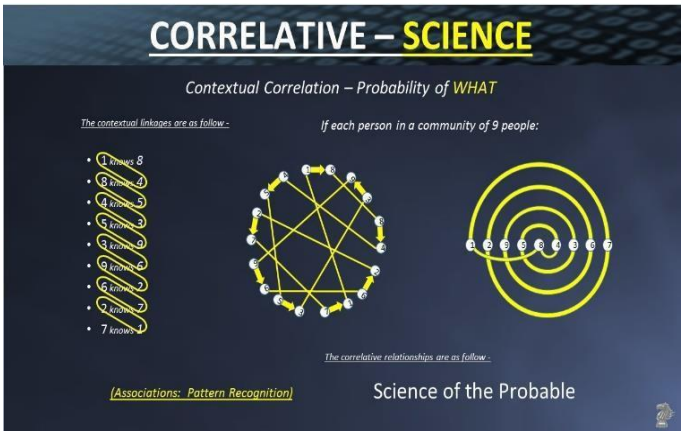
In today's fast-paced, dynamic environment, however, organizations must courageously THINK BIG, cautiously START SMALL and adapt to, and overcome obstacles by SCALING QUICKLY. Stated otherwise, a nimble, highly adaptive environment is essential. In flat organizations with the authority to meet an objective rather than fulfill a requirement, the "team of teams" approach is imperative. Through this approach, leaders are committed to inspiring innovation while maintaining a focus on transformation.

P0 = PROCURE: OBSERVE…Collect – store and organize

-

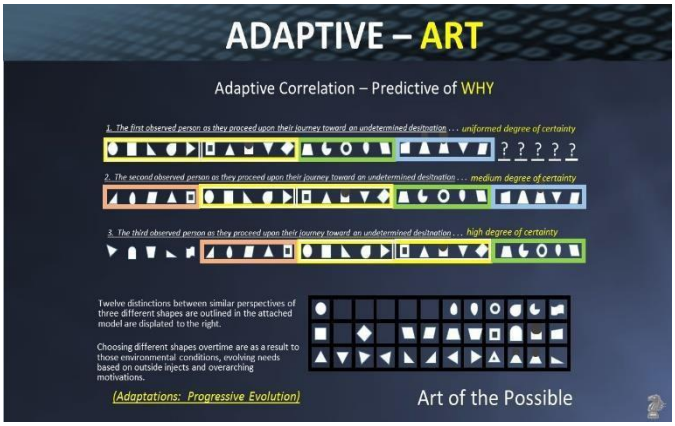
P1 = PROBABLE: ORIENT…Contextual – informs one's awareness as to where they are

- *Generalized Linear Modeling (Probit, Logit, Multinomial Logit/Probit, Count, Cox Proportional Hazard models)*
- *Applied Multivariate Statistical Analysis (Clustering, Principal Components, Discriminant Analysis)*
- *Computer Usage and Programming Skills (SPSS Modeler, SAS Enterprise Miner, Matlab, Mathematica, R, STATA, EVIEWS)*



P2 = PREDICTIVE: ORIENT . . . Adaptive/Behavioral/Evolution – enlightens one as to where they are going

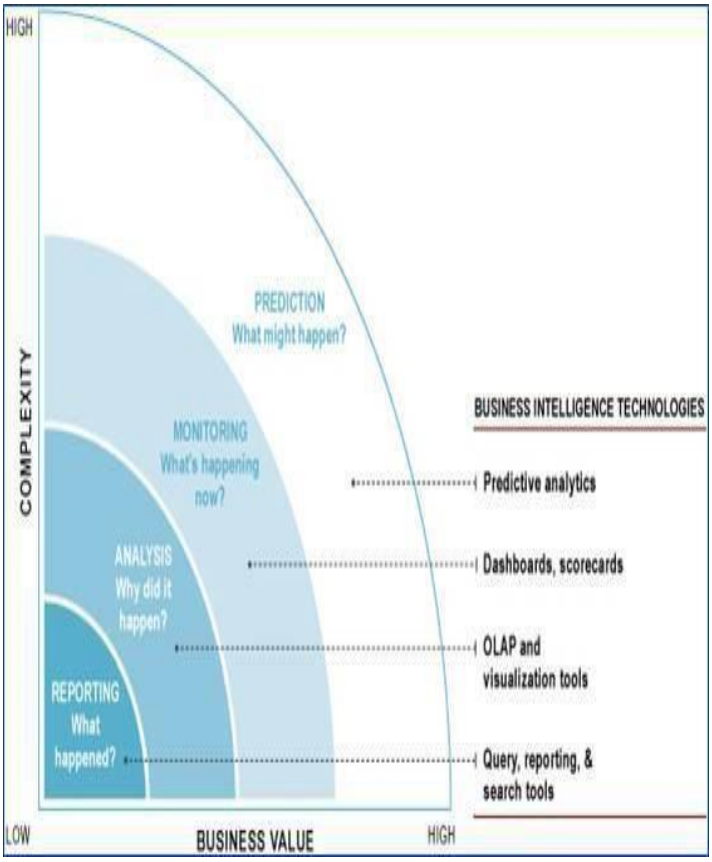
- *Multiple Linear Regression (OLS, WLS, Time Series Regressions)*
- *Time Series Modeling Expertise (Seasonal Adjustment, Box-Jenkins, Exponential Smoothing, Vector Auto regressions)*
- *Training in Machine Learning Tools (CART, CHAID, SVM, ANN, K-Nearest-Neighbors, Association Rules)*



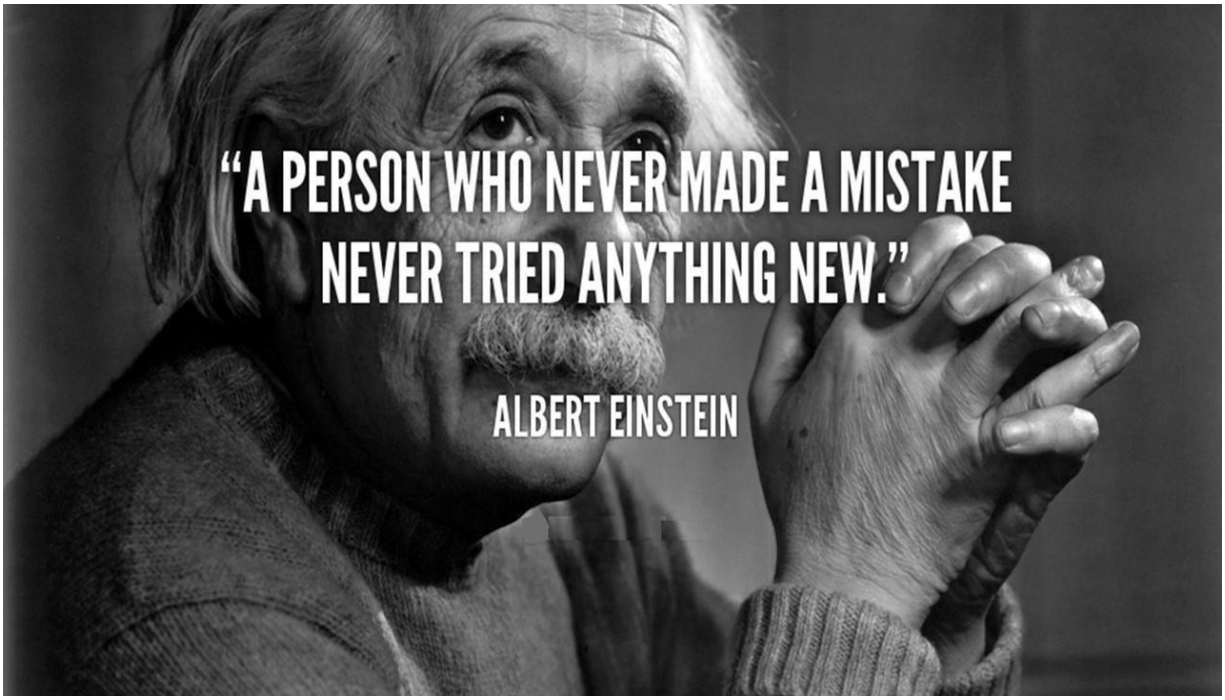
P3 = PRESCRIPTIVE: DECIDE…Prescriptive analytics is Business Intelligence (Strategic Tradeoffs and Consequence Management)

P4 = EFFECT: ACT…Modeling or Predictive Analytics presupposes potentiality given the vector (direction) and velocity (timing) to ascertain likely outcomes or consequence management.

SUMMARY



As we begin to leverage behavior dynamics to understand the causality of human interaction, and, in time, develop the ability to predict more accurately the influences people have on their environment, we will gain a better understanding of the interactions that occur within this complex system. Moreover, temporal analysis will yield a better appreciation of event synchronization and allow us to predict events with greater reliability. These tools will facilitate the necessary progress from a reactionary perspective to one capable of commanding the environment thanks to having a better understanding of it—referred to by some as *wisdom*. This approach to business intelligence will illustrate the benefits of thinking, adapting, and understanding the right answer to our problems is by learning how to ask the right question. This is done by the aforementioned process of ACE-ing the Information Environment in order to effectively SEE within the Cyber domain.



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TAB 12

Chief Information Officer

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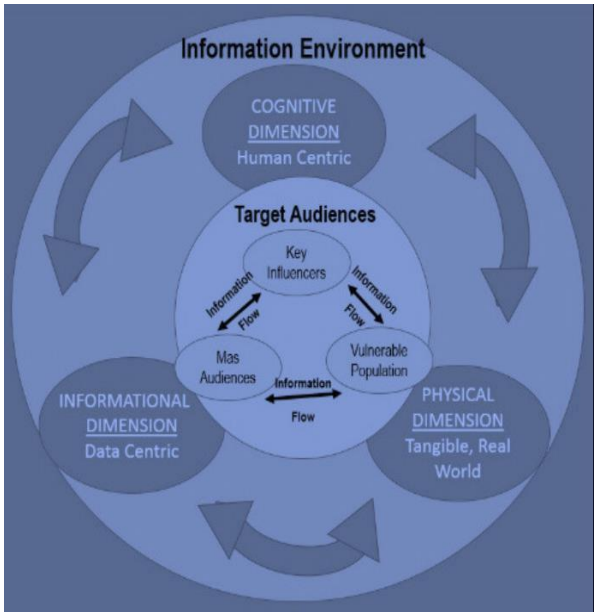
Roles and Responsibilities

ORGANIZATIONAL CONTEXT

The CIO's position has recently evolved from its traditional support role. In 2013, at the time of writing this paper, this new job change comes the necessity to transform the organizational into one with an operational mindset. With this, comes the need to establish and impart a vision that leverages the evolving domain of cyber. In this new capacity, it will be the responsibility of the Chief Information Officer (CIO) to ensure the asymmetric advantage afforded by information is fully leveraged on the field of battle.

Given the infancy of Cyber, and with continued development of its definition and framework there are currently endeavors a foot to formalize a strategic plan and roadmap forward. In this plan, the CIO will define their view of the Information Environment and their future role in Cyber Operations. Given recent efforts to empower the CIO, much effort and resources have been expended toward developing this strategic road-map to evolve and transform the operational capacity of cyber operations.

PURPOSE



(Diagram depicted from Joint Staff, figure I-1 p. I-3)

Today's CIO must transition their organizations from their historic supporting role and transform their outlook and perspective into an operational mindset. Given their enduring background and embedded paradigms it will require a strong transformational leader to guide them through this process. For it is reasonable to expect long term staff will naturally feel uncomfortable as the organization establishes a new baseline from which to operate. Therefore, it is essential that a succinct mission statement be established with a clear vision that must be adopted throughout the organization. This will be the stage-setter to open minds and realign perspectives.

The first step in this process has been accomplished with the most recent efforts to provide advocacy from above to commit to and support this effort. Second, the CIO must establish a vision to serve as a catalyst to empowering the organization to leverage current technologies for future mission objectives. Then they must align their structure to assure it is prepared to meet those prescribed goals and objectives as set forth in this plan. Currently, the organization is endeavoring to develop a strategy that successfully operationalize the cross-cutting nature of cyber throughout all phases of warfare. Throughout this process, they must be encouraged to be courageous and be mindful of the sage advice offered from Clausewitz, "Everything in strategy is very simple, but that does not mean that everything is very easy." (Clausewitz, 1997)

Change is never easy, but is bearable when approached from a top-down strategic approach aligning goals and objectives to fulfill those specified mission statements, vision and a desired end. Establishing a new base line upon which to assess and matrix future performance is a daunting task. Political push-back will likely exist, but a recent change-over of staff could prove to be both a positive and negative consequence of loss of congruency offset by a new open perspective. Compounded by current fiscal constraints and demands to support ongoing deployments requires leadership to make hard choices to ensure mission success. Given the effects of sequestration and the impact of overwhelming resource limitations they must be innovative in their approach to embrace uncertainty and overcome today's daunting challenges.

This strategic plan will endeavor to provide a prioritized strategic focus and an operational framework for a logical progressive roadmap to transition the organization from their familiar support role to the world of strategic trade-offs. Ultimately, they must matrix objectives that provide the means to assess success at this critical venture. Above actual cost benefit analysis, they must consider and assess quality of performance focused measured against a value assessment which include opportune cost and actualized benefits if they are to realize the second and third order of effects as they step into the operational world.

For their past focus on compliance is insufficient for it is an effort to manage expectations from a reactionary position which does not prepare them for the road ahead. They must be proactive and embrace an adaptive approach to plan for their future and to bravely step out and commit to those actions in order to investment in it. Clausewitz aptly advises us to "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 hours, retains some glimmerings of the inner light which leads to truth; and second, the courage to follow this faint light wherever it may lead."

SETTING STRATEGIC DIRECTION

Today's CIO is challenged to provide a vision that is a catalyst to adapt and empower the organization to embrace change and utilize the technological tools at their disposal to evolve and empower the accomplishment of future mission objectives. Once they successfully leverage those technologies, they will be able to master the daunting task and garner dominance in the information environment. Careful consideration must be made to understand how best to align the organization's priorities to fulfill organizational objectives. Thus, the CIO is charged with harvesting the power of information in a way that maximizes yield in their effort to support, enhance and execute (SEE) their responsibilities to dominate the information environment.

In this new operational role, the CIO must establish goals and objectives that inform and influence the information environment at the cognitive level. Throughout their assessment of the confidentiality, integrity, and available of data, they must remain cognizant of the purpose of these endeavors. To these ends, the manner in which data is collected and organized into information is critical as it is correlated into knowledge which informs and enlightens the cognitive process. It is this process that is at the heart of implementing cyber operation's ability to influence the information environment and should not be overlooked. For as Sir Basil Liddell Hart on his thoughts on war illustrates, "The real target in war is the mind of the enemy commander, not the bodies of his troops." (Hart, 2013)

JP 3-13 provides a framework to focus the ends, ways and means that support objectives and will in-turn influence the information environment to affect the enemy's perspective:

ENDS: *"A consequence of the way of applying IRCs"* *(Chairman of the Joint Chiefs, p. I-4)*

WAYS: *"How means can be applied, to achieve a desired end(s). They can be characterized as persuasive or coercive"* *(Chairman of the Joint Chiefs, p. I-4)*

MEANS: *"The resources available to a national government, non-nation actor, or in pursuit of its end(s). These resources include, but are not limited to, public & private-sector enterprise assets or entities."* *(Chairman Joint Chiefs, p. I-4)*

Hence, we must look at data as a national asset and effectively leverage it to master the information environment. Our success will be depending upon how we ensure that "information is collected, processed, stored, disseminated, and protected. It is the dimension where the C2 of military forces is exercised and where the commander's intent is conveyed." (Chairman of the Joint Chiefs, p. vii)

CIO's Vision, Mission & Goals:

MISSION

TRANSFORMING INFORMATION INTO GAME CHANGING EFFECTS

The first iteration of the mission statement serves to transform paradigms and encourage the organization to embrace its new operational role. As this mission statement evolves, it would be helpful to ensure it is measurable, provides specifity and a focus to ascertain what results are to be achieved and the resulting value to be added. They should further delineate the bounds of the organization and establish a framework upon which to invest their efforts to accomplish their organizational objectives which serve their goals and fulfil their ends.

VISION

DEVELOP STRATEGIES THAT MATURE INFORMATION INTO CONTEXT

As the Mission Statement continues to evolve the organization must develop a new operational identity and needs to focus upon their five Areas of Interest (AOI):

1. Cyber Operations
2. Knowledge Operations
3. Cyberspace Operations
4. Warfighting Integration
5. Cyberspace Governance

Additional clarity as to who they are, where they are looking to go, and what their end state looks like will prove critical to the maturation of their vision. With this aggressive breadth of focus, the one common denominator is the need for training. For it is in well qualified and competent personnel that they will be prepared to successfully face the magnitude of the challenges before them. Ultimately, this effort will certainly help prepare, inspire, energize and harvest the motivation of Cyber operators throughout the organization. It is essential that these goals focus and prioritize efforts to Support, Enhance, and Execute (SEE) the organization effort to ensure mission success.

Following are the three GOALS and proposed initiatives to fulfill them:

1. Actualize the value of Cyber to Support, Enhance & Execute operations
2. Provide the organization trusted information where & when they need it
3. Strengthen mission assurance through resilient freedom of maneuver
4. Organize, train & educate cyber operators to be experts in cyberspace

From these three goals the following are presented for consideration in an effort to garner action toward their fulfilment:

1. Assess current Capabilities and identify current and future gaps
2. Build a Roadmap for current and future mission requirements
3. Identify competencies necessary for mission success
4. Develop curriculum/certification standards to identified competencies
5. Implement training programs to grow the future force
6. Assess whether training meets mission requirements bi-annually
7. Certify existing force on competencies
8. Increase certification
9. Identify & fund traditional & computer based initial & ongoing training
10. Reduce training time and increase training availability

The resulting matrix will establish indicators to balance operational focus of what must be accomplished to succeed in cyber operations. Assessments will be made to outline transitions that are necessary to leverage technology in such a way as to serve and support organizational objectives. The aforementioned efforts will ensure collaborative progressive toward objectives and mitigation of counter-productive endeavors that waste scarce resource and distract from a team focused effort.

However, as with any transition, politics will undoubtedly plague the organization's ability to mature into their new role. Lack of clarity and differing points of view along with instability associated with change and the typical power struggles that people find themselves in as they look for upward mobility must not be allowed to divert focus. It is through a well outlined plan of action and a strategic roadmap that highlights the actions necessary for success that will guide the organization to accomplish those tasks that fulfill the objectives critical to goal attainment. The need to provide strong leadership to transform the culture is critical if the organization is to remain competitive. Thus, authorities as outlined in the Klinger Cohen act will provide the necessary statures to align advocacy and outline authorities to complete those actions essential to maturing cyber operations.

WHY IS IT IMPORTANT TO ASSESS ORGANIZATIONAL PERFORMANCE:

During any transition, it is critical to provide feedback to ensure that requirements are properly linked to those objectives that fulfill organizational goals. This will provide a baseline upon which to build an organization to focus on the future. Without said assessment, risk becomes pervasive and is counterproductive to endeavors to find solutions as opposed to living in problems. This will result in the organization living in fear as opposed to actualizing their hope for a brighter tomorrow. The result will be to waste scarce resource and impede the motivation critical to success at this vital juncture in the organization's transformation.

This will permeate the organization at large given their reliance on the capabilities offered in and through cyberspace. For the strategic advantage afforded the cross-cutting nature and inherent critical reliance upon this medium is paramount to mission success. This is evident in the necessity to synchronize activities throughout the organization to derive the synergistic effect of collaborative team focus efforts. For cyber influence in this area provides the catalyst too timely, assessable, and relevant information to decision makers to inform the cognitive process. For the criticality to evolve and develop and leverage the cognitive capacity of information is essential to the organization's ability to gain and maintain a strategic advantage within the rapidly evolving information environment.

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TAB 13

Operationalizing Cyber

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Vision and Strategic Way Forward to Operationalize Cyber

In view of the dramatic changes to the age-old paradigms that govern combat, we are now faced with the responsibility to alter our communications processes, which range from exerting command and control to engaging in cyber warfare and unleashing the heretofore-unimaginable power of information. Our modern global society depends not only on the tools that allow us to engage in cyberspace, but also on the information necessary to make sound decisions. Ultimately, our ability to understand this new environment faster and more effectively than our adversaries will help ensure our victory on the physical battlefield and in the court of world opinion.

The world has indeed graduated from the industrial to the information age, and its thirst for data knows no bounds. These unending streams of data enable us to improve our global understanding and shape the environments in ways never imaginable. It allows us to operate with forethought of understanding through informed decisions that drive to increased effectiveness at all levels of operations. Therefore, it is critical that we gain and maintain a commanding knowledge of the environment in which this seemingly limitless data exists.

Establishing the veracity of data should be the ultimate focus of our efforts. Thus, before anything else, we must develop metrics that help us determine data accuracy. To establish the confidence of COCOM commanders who rely on information to make informed decisions, Information Managers must be held to account for the manner in which data is organized and meta-tagged. Thus, Knowledge Operators are essential to ensure that the information is correlated in such a manner as to establish its interdependent relationships to improving the awareness and contextual understanding of our senior leaders.

As the world becomes increasingly interlinked, the actions of one person can and does have a direct and immediate effect on many. The flexibility and adaptability necessary for victory on the battlefield ascribes to the imperative nature of establishing a credible, reliable and timely means of exchanging information that informs the cognitive process. Therefore, it is essential to develop a common method of presenting that information to operational commanders, so that they can efficiently weigh the cost-risk and benefits-opportunities in pursuit of their respective wartime objectives.

This new information age is a catalyst to change within this new environment and requires us to adapt at the speed of light. There is clearly a need to improve Command and Control (C2) effectiveness, as such "enlightened" C2 can help ensure strategic synchronization while remaining aware of the inherent risks faced by operational commanders. Regardless of the path we ultimately take, enhanced security and controlled access to information should not impede our ability to understand the associations between operational benefits, their associated cost and the time they consume. Understanding the tradeoffs and finding balance amongst the overriding concerns and consequences faced in the decision process, is essential to leveraging the strategic advantage that heightened awareness affords. Thus, the effective organization of data into information that informs knowledge which must then be evolved into contextual understanding in order to achieve the level of wisdom essential to make informed decisions is a crucial element for mission success.

Overall, we must begin efforts of determining cyber's operational makeup and assess the impending impact it has on our environment immediately. In its nascent phase, cyberspace was simply a means with which to further distribute the overall communications process. Over time, however, it has developed the ability to transform our environment by influencing that processes. As a result of this transformation, there is a critical need to harness this capability to ensure that we gain and maintain its asymmetric advantages that afford the advancement and protection US vital national interests.

Therefore, it is incumbent upon information operations to provide timely, accurate and secure information to the operational commanders. The result of these efforts will afford a strategic advantage of informed decision. Thus, by leveraging the technological capabilities to gain and maintain information superiority and dominate the information environment the resulting asymmetric advantage of operationalizing the cyber domain will unleash the inherent power resident within information.

TAB 14

Future of

Technological Leadership

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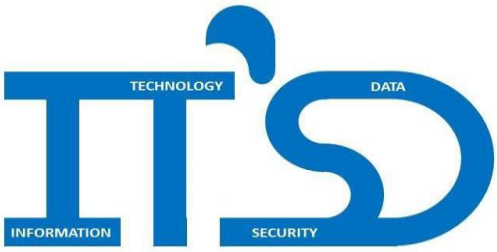
The Future of Technology Leadership



(It's all about leveraging data to ensures mission success.)

Not very long ago, technology was struggling for acceptance in the public and private sectors, largely in an administrative role. In the military, tech was being adapted and implemented in an operational support capacity. But times have certainly changed. Indeed, with the emergence of steadily advanced weapon systems such as the F-35—currently "armed" with millions of lines of code—one must wonder if it's an airplane equipped with a computer or a computer that can fly. In view of our quickly increasing reliance on technology, it has clearly emerged as the critical element in mission success. Yet, similar to the advent of fifth generation aircraft, the volatile, uncertain, complex and ambiguous environment in which we operate, coupled with the opportunities and threats that permeate that VUCA atmosphere, is far more challenging than at any other time in history. Fortunately, those challenges can be mitigated by enhancing the capabilities of critical staff members including the chief security officer (CSO), who both manages and leverages risk; the chief technology officer (CTO), who drives innovation; the chief data officer (CDO), who enhances situational awareness and the chief information officer (CIO), who leads the staff and galvanizes efforts to not only fulfill the specified vision, but also to accomplish the mission.

Due to our critical dependence on technology and cyber operations to communicate, manage and operationalize mission systems, we must reconsider the approaches we are taking to capitalize on and protect the capabilities afforded by technology in order to maintain our strategic competitive advantage. To begin that process, today's CIO must employ proven as well as evolving CSO/CISO techniques to assess and manage risk. Likewise, the CTO must have both the ability and ingenuity to utilize current and developing technologies to fulfill mission objectives. Further, the CDO must always be prepared to unleash the power of information to gain strategic advantage, as doing so will ensure the organization remains capable of evolving in today's highly competitive and rapidly changing information environment. Whether for business systems, weapon systems or to inform strategic endeavors, the CIO must have the ability to exploit technology to

overcome challenges and to seize unseen and unrecognized opportunities. Ultimately, the leadership, expertise and experience of these essential staff members will assure our ability to understand and utilize technology to the greatest extent conceivable.

Despite a competent staff, however, increasing costs, dwindling resources and the constraints imposed by Moore's Law require us to engage in collaborative partnerships with industry. By doing so, for example, the CTO will hone the ability to apply technology to achieve a degree of operational effectiveness that is at once coordinated, unified and unobstructed. By synchronizing those efforts with the actions being taken by the CSO, we can have greater certainty about our operational environment, as we can be assured that operant risk factors are being managed effectively. Further, the CDO will define the analytical context that will allow us to assess, characterize and evolve despite the unpredictable VUCA environment. Ultimately, the CIO will be responsible for the direction and application of these vital resources, and for providing the support necessary to coordinate their efforts, inspiring them to augment mission-related capabilities and imparting the vision that will enable the organization to meet current and future objectives. Based on the foregoing, we propose a multifaceted action intended to imbue critical staff members with greater authority. In short, that effort will yield a single point of convergence that will simplify the supervision and management of technological capabilities, whether for business systems, administrative support, weapon systems or analytical systems.

TAB 15

Data Value Proposition

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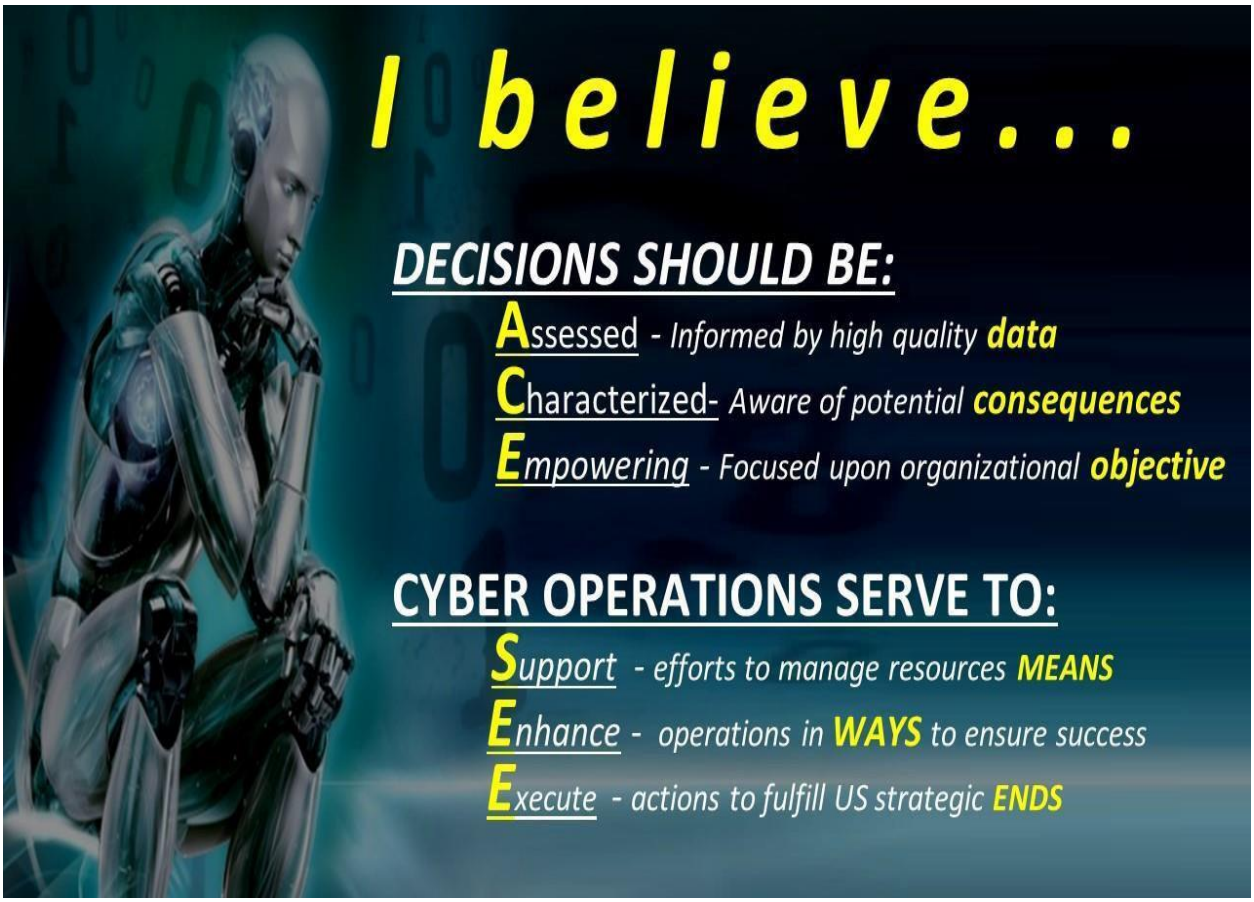
VALUE PROPOSITION
of a
DATA/INFO/KNOWLEDGE

CDO Putting Data into Action Data Driven Organization



What Analytics Is:

In today's high paced and rapidly evolving information environment, having the right information at the right place and right time is critical to derive strategic advantage in a highly competitive interconnected world. To accomplish this, analytics provides enlightened awareness informed by trustworthy data to unlock the power of information. Through effective analytics the CDO affords the identification of opportunities against the assessment of risk to determine the best course of action in order to achieve organizational strategic objectives.

Whether leveraged to assure good strategy, improve effectiveness, or ensure efficient allocation of scarce resource, unlocking the inherent value of data ensures enlightened understanding of the probability of success and potential options through modeling in today's volatile, uncertain, complex and ambiguous environment. The following are just a few of the values that organized data which is correlated into context of informed knowledge fuels the cognitive process:

- **Insight into difficult problems**
- **Improved processes, productivity, and performance**
- **Cost savings and effective resource allocation**
- **Scope options and opportunities**
- **Accurate predictions, plans, and forecasts**
- **Increased mission assurance/reliability/effectiveness**
- **Increased efficiencies and streamlined process**
- **Superior Return On Investment - ROI**

The Analytics Value Proposition:

The deliverables of a CDO should be data structured and organized to establish its veracity and information correlated to establish the context so that it can be modeled and assessed in a manner that informs the cognitive process. The result of which is analytics that illustrates probable and potential consequences in order to manage expectation and illustrate potential outcomes against organization's strategic objectives:

- **Big data Finding hidden clues to improve mission capabilities/capacity**
- **Business insight to quantitative & operational complex problems Business Performance Improving mission performance through assessment, characterization and analytics within an organization's information systems to improve decision making**
- **Cost reduction efforts to decrease cost or resource allocation**
- **Assessing likely outcomes of decision to discover better alternatives**
- **Efficiency Increasing return on investment**
- **Forecasting to determine the strategic choices that meet org objectives**
- **Improved scheduling to synchronize staff, equipment, & activities**
- **Planning to leverage quantitative techniques to support operational objective and tactical engagements that fulfill strategic intent**
- **Processes to increase efficiency & effectiveness for high productivity**
- **Utilize Risk Mgt Framework (RMF) to mitigate cost & maximize benefits**

Answering the Challenges, you Face Today:

Given the increasing number of decisions, complexity of the options and the implications or consequences to their organization, senior leaders require timely indicators and enlightened modeling systems to identify opportunities and overcome ever present challenges. Through an effective Risk Management Framework (RMF) they are able to make enlightened decisions which provide the greatest probability for mission success.

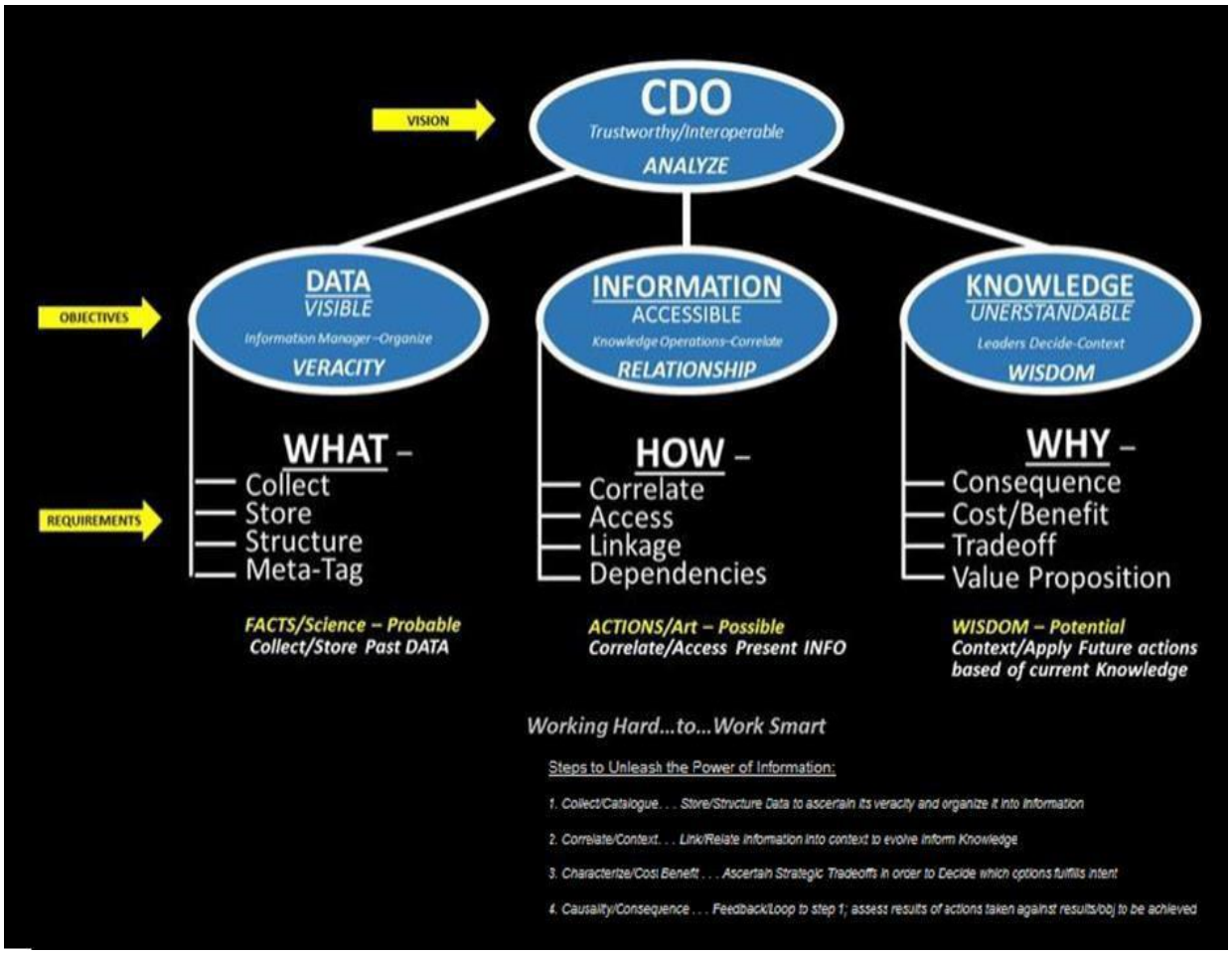
Today's information society is bombarded with the mass amount of data that is currently doubling every two years. As such the vast amount of information that is being generated and the resulting complexity of collecting, correlating and putting it into context (C4) creates a daunting challenge. This combined with the ever present persistent threats make it imperative to make fact based decision to assure mission success in this rapidly evolving information environment. As a result, analytics can help today's executives with many of the specific challenges they face, such as:

- **Deciding where to invest capital in order to grow**
- **Getting more value out of ERP, CRM & other software systems**
- **Figuring out the best way to inform a logical approach forward**
- **Solving complex scheduling problems**
- **Getting more cycles out of the ATO**
- **Optimizing a portfolio of investments**
- **Speeding up response time**

Goals and Objectives the CDO:

The creation of the CDO office within organization is a recent phenomenon. Leading edge companies see the necessity to effectively manage data as an asset and have capitalized upon the resulting strategic advantage of aligning those C4 efforts to unleashing the power of information. To that end, they have charged their CDO's to manage data, correlate information and provide the necessary knowledge upon which to garner a competitive advantage on the world stage.

Organizations have benefited from this exploratory process which illuminates opportunities and effectively manages risk in a way that elevates their situational awareness and enlightens the cognitive process to make informed decisions. To that end it is imperative that the CDO's DATA Directorate organize and structure data to assess it veracity. The INFORMATION Directorate correlates information to illustrate linkages of their supporting supported relations in order to put it into context. Then the KNOWLEDGE Directorate models it through a cost benefit analysis to quantify the probable and potential Strategic Tradeoffs and resulting consequences of actions taken against resulted to be achieved. The results of which afford a good assessment and characterization of the information environment in order to maximize yield and minimize risk. This evolutionary process insures a continual and iterative focus upon the goals and objectives of the organization. In the end, it is within the aforementioned framework that the organization actualizes their Value Proposition and garner their full Return on Investment (ROI):



TAB 16

Data: Strategic Msn Asset

D-SAMS / Maturation

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D-SAMS

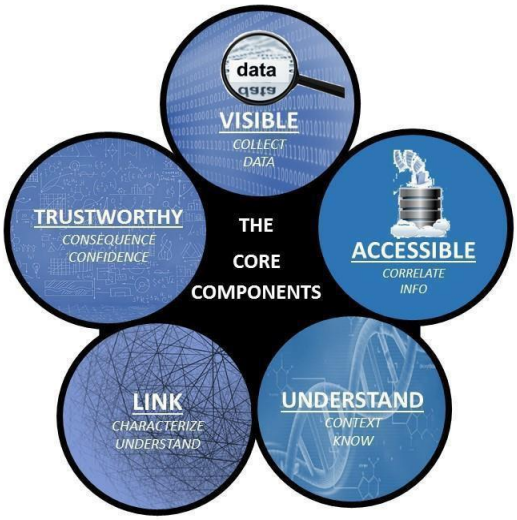
DATA: Strategic Asset for Mission Success

PROBLEM STATEMENT

In the early days of IT, most application systems were built as independent data processing engines. Essentially, they performed their assigned duties while sequestered from the rest of the enterprise. However, as organizations entered the knowledge age, dependencies within such systems also demanded that to gain and maintain their strategic advantage, they had to be adapted for use in today's interlinked information environment. As technological tools became increasingly interwoven in a team of team's approach, periodic interference also required an integrative process able to keep pace with the speed at which high performing organizations were continuing to transform. Since very little complex thought had been given to sharing data across applications, it became imperative to link the interdependencies present throughout the organization. Without such links, data sharing often became an impediment to effective, efficient operations.

To remain competitive, many organizations chose to focus on faster, stronger and more efficient processes, a strategy that has proven to be highly ineffective in the rapidly evolving world market. Thus, a revolutionary approach to achieving transformation among organizations depends on them thinking big, starting small and scaling quickly. Moreover, an interconnected environment that includes a dynamic feedback loop must be instituted. The intent behind such a system would be to put data into action so that it boosts the awareness of those within the organization about extant interdependencies. That increased mindfulness would enable key personnel to manage overlapping efforts and costs while coordinating activities to ensure they are both more collaborative and cohesive.

As data is collected and stored, it must be organized for convenient use by applications that work to unleash the inherent value of information. Traditionally, data has been perceived as just another aspect of a technology project. As a result, its potential has not yet been fully appreciated or utilized in an effort to ensure the organization achieves the maximum return on its investments. While previously held views of application and database planning efforts were sufficient to address ongoing issues, there is today an almost insatiable appetite for making fact-based decisions and far less tolerance for risk which directs stewards, information managers, and analytical assessments to seek to identify and solve organizations' most perplexing challenges as opposed to seeking opportunities.



To manage this rapidly growing and complex environment, the core components of a formalized program must be instituted to identify, store, provide for, integrate with and govern data as an organizational asset. Accordingly, it is essential to establish a well-considered strategy capable of addressing the need to collect, correlate, contextualize and identify the potential consequences of actions taken versus the results to be achieved. Clearly, as the value of data continues to evolve, we must improve the way we capture, share and manage this vital strategic asset.

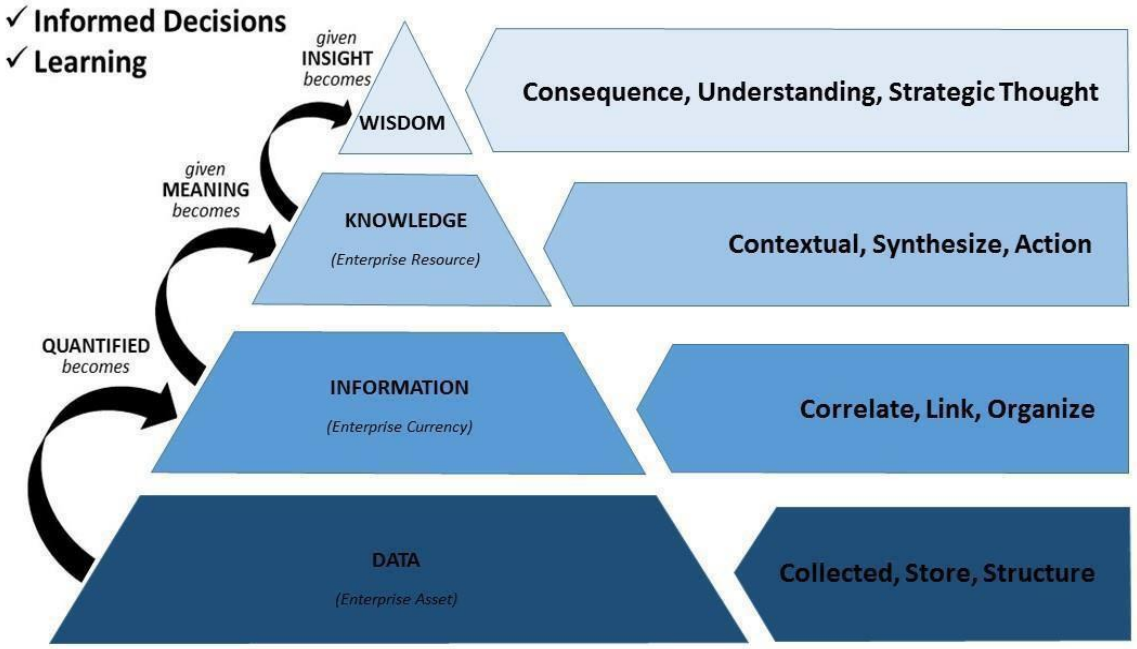
OVERARCHING OBJECTIVES

Organizations typically have three assets: people, money and data. The people and money aspects are well organized and fall generally under the aegis of a Chief Human Capital Officer and/or Chief Financial Officer. In the last 20 years, however, the value of data as a strategic asset has increased markedly as volume has grown and analytical tools have gained sophistication. Demonstrably, today's fast-paced, interlinked and rapidly evolving information environment demands a structured approach that will provide the right information to the right place at the right time to gain and maintain strategicadvantage.

Government agencies have long since recognized that data is critical to accomplishing their prescribed missions, and that ultimately, data has emerged as a vital strategic asset. By making data visible, accessible, understandable, linked and trustworthy (VAULT), effective data management and stewardship will ensure that it is fit for its intended purpose. This process ensures that we can identify risks while highlighting each opportunity to achieve the organization's strategic objectives.

Data-driven analysis can help attain the outcomes mentioned above To realize the value of data, it must be structured, organized, and managed for it to be usable. Considering the staggering accumulation and increasingly complex nature of data, resource management (DRM) is quickly gaining importance, as it improves business leaders' understanding of what their data is tellingthem.

As it becomes increasingly necessary to appreciate the value of data assets and deliver data as a service, the establishment of an effective data governance program represents an essential early step. Beyond helping business leaders, data governance enhances data quality, provides operational excellence, and enables business intelligence with a focus upon extracting more value from organizational data. Hence an effective DRM effort facilitates the use of effectively and efficiently utilizing data assets to accomplish organizational goals and objectives by integrating data governance, management and data in a concerted action.

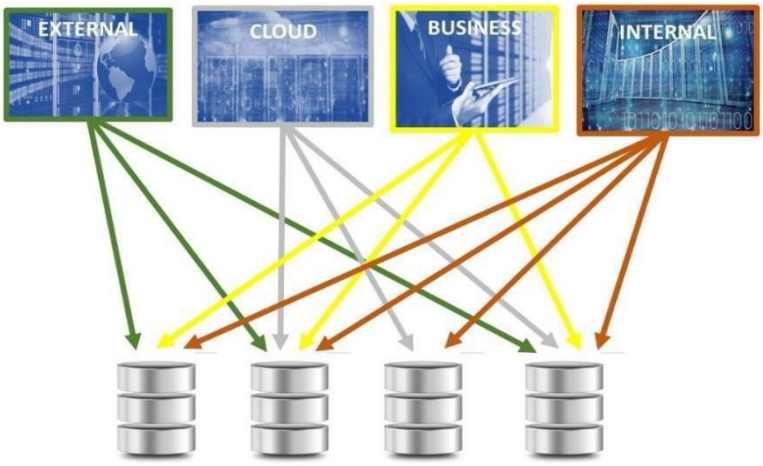


A good data strategy facilitates good decision making

WAY FORWARD

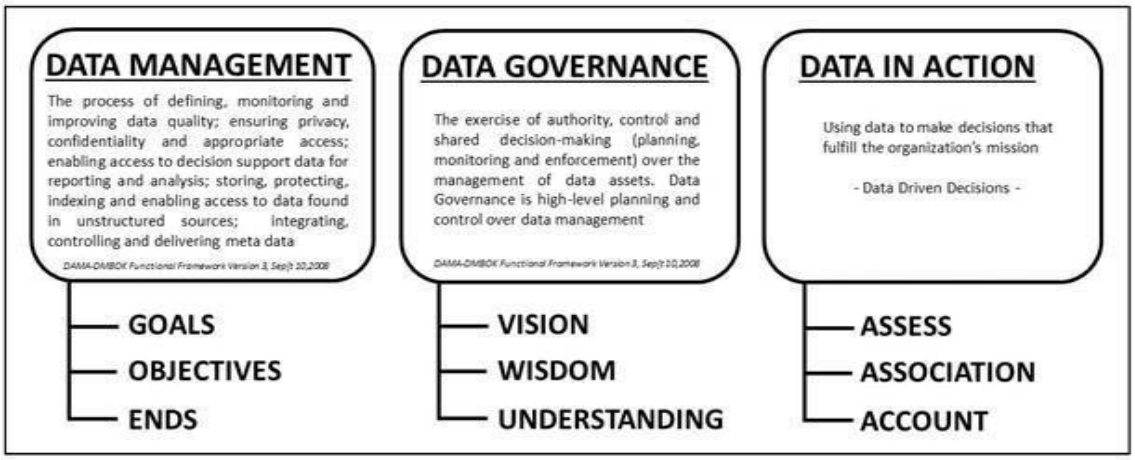
To ensure the greatest propensity for mission success, a data strategy must also encompass the development of a plan to improve the many ways in which one acquires, stores, manages, shares and uses data. To ensure data quality, informed decisions made in full consideration of cost benefit analysis will lead organizations to the right solutions to the problems they face. To that end, organizations must:

- *Assess their DEPENDENCY upon DATA: it must be made visible by collecting, storing and structuring data even as we measure its veracity ortrustworthiness*
- *Characterize our RELIANCE upon INFORMATION: it must be correlated, related and linked to identify its dependencies as well as ensuring itsaccessibility*
- *Evolve from sound ANALYTICS: analyze the cost/benefit of current and future opportunities to fulfill the organization's objectives*



With the foregoing in mind, we must create a road map to help us align efforts across each data management discipline, as it will ensure that we capitalize on data, manage information and inform our analytics. Thus, it is imperative that data is made available to reference and analyze pertinent facts upon which decisions are made. Significant effort is made to store and secure data without consideration ofits use. Whether dealing with transactional processing applications, analytical systems or essential dissemination of information pertinent to daily coordination and collaboration within the organization, thought must be given to those dependencies and interdependencies during all phases of operation.

- **Data** *storage is the first and most basic capability in a company's technology portfolio. It represents the foundation upon which fact-based decisions are made.*
- **Information** *is currently controlled and siloed in today's geographically dispersed organizations. The option for central storage repositories is unfeasible. Antithetical to its effective management, information must be interlinked to help create a collaborative environment. This will ensure that VAULT data informs and improves situational awareness.*
- **Analytics** *harvest the inherent value in information, manage expectations and predicts consequences. It is therefore essential to capitalizing in the inherent value of data and leverage it as a resource. Only then will enough capabilities be produced to meetmission objectives.*

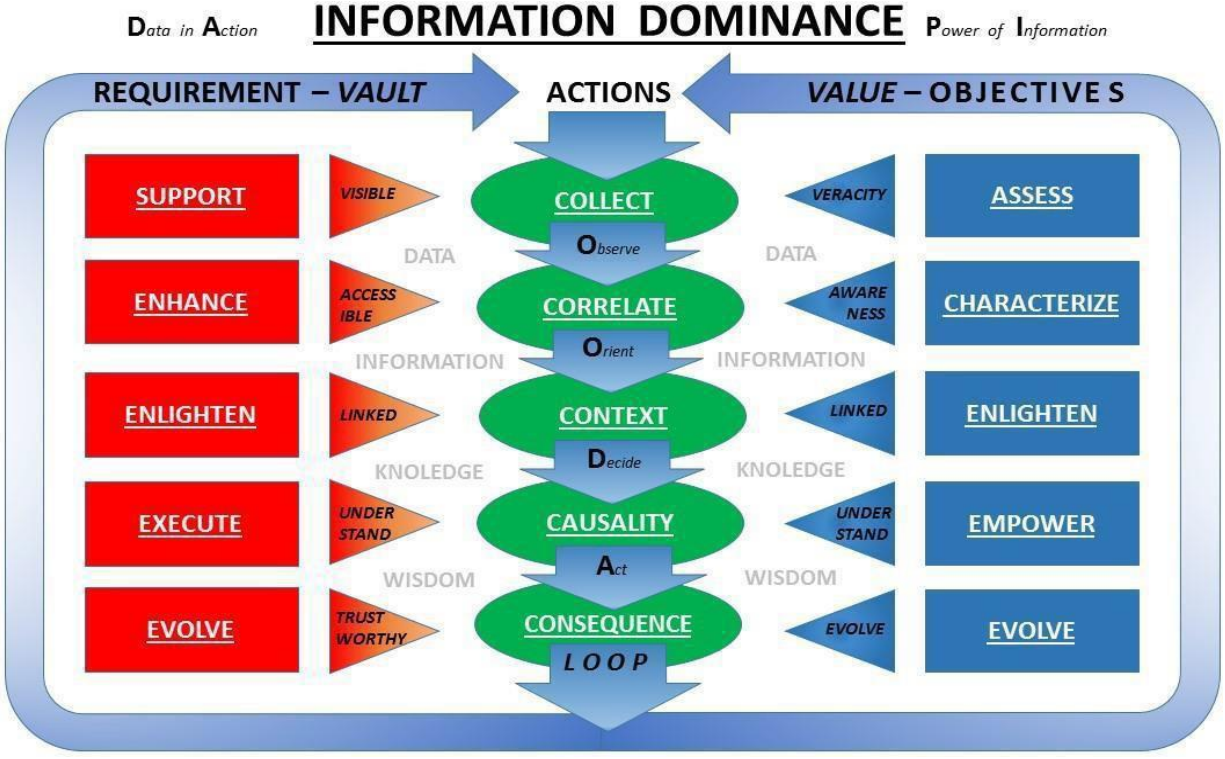


CURRENT CHALLENGES

Today's organizations need to integrate the growing number of siloed systems, which are not only costly, but also instill operational risks. The absence of a thoughtful approach to collecting and storing data and managing and integrating contextually relevant information that will help produce knowledge that truly enhances understanding means that it will remain almost impossible to make informed decisions that fulfil organizational objectives and address mission-related imperatives. This lack of integration logic will continue to decrease exponentially as the number and volume of data sources expand. Accordingly, if data is indeed being managed as an organizational asset, it must be viewed and accepted as a core component that is a prerequisite to mission success.

Since the volume of data doubles every two years and the associated complexity of day-to-day interdependencies increases at a similar rate, it is little wonder that integration-related advantages and disadvantages demand that organizations institute holistic, enterprise-level governance to ensure data's VAULT properties throughout the organization. To achieve these objectives, data must be stored and structured in a manner that ensures it is accessible. It is imperative that information is linked to ensure it provides a complete picture that will both inform and enlighten the human cognitive process. Properly accomplished, knowledge professionals will conduct the analysis necessary to inform the decision-making processes that reveal those opportunities critical to mission success.

Since integration initiatives are often spread across multiple organizations, the challenges to establishing logical linkages across disparate systems, particularly in terms of complexity and cost, are significant. Today, the critical need to coordinate and collaborate at the operational level necessitates availability of information that provides decision makers with factual, linked information that illustrates and informs the contextual picture of current expectations versus future consequences. 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 derives from data in action that is *VAULT informed by the power of information to ensure* VALUE proposition that assures mission success.



Before the enduring perspective that data is a byproduct of application processes can be changed, a data professional must be incorporated. Such an individual will ensure the accomplishment of the following three objectives: (1) assess the veracity of data, (2) manage information linkages to ensure transparency and (3) analyze strategic tradeoffs via the cognitive process. By suitably applying data resources through sound governance processes, we can benefit tremendously from fact-based decisions informed by analyses conducted by dedicated professionals. Such a situation will help establish a coordinated and collaborative effort that ensures the achievement of organizational goals and objectives by leveraging enterprise data as an asset effectively and efficiently throughout all phases of its application of and use.

Clearly, a formalized structure must be instituted that addresses data accuracy, information linkages and analytics, all of which will yield solutions to many of today's most perplexing problems. Such a structure will facilitate informed solutions to problems including the growing need within organizations to induce a "work smarter, not harder" mind-set. This innovative approach would help propel the organizational culture to act proactively by focusing on opportunities rather than retain the extant reactive, risk-avoidance nature. The ensuing *think big, start small and scale quickly* philosophy will become a driver for organizational transformation vis-à-vis our rapidly changing world.

PROPOSED SOLUTION

The challenge faced initially by this organization will be the establishment of a collaborative environment that ensures:

- The crosscutting nature of data utilization becomes less restrictive through an open and transparent shared environment that knows the veracity of data, understands the relationship of information and develops a contextual picture as to illustrate these interdependencies in a way that effectively manages expectations as it assesses current and future consequences. Siloed and disjointed data often distorts, rather than clarifies understanding, particularly when decisions must be made in the face of:
    - *Data that lacks structure and precludes accurate assessment of its veracity/quality*
    - *Information linkages to illustrate operational dependencies*
    - *Analytics manage current expectations and future consequences and provide solutions/opportunities to adapt to and overcome current/future challenges/problems*
- VAULT data will ensure decision makers have all of the information necessary to make wise decisions. A lack of data sharing, data reuse and economies of scale introduce unnecessary costs associated with data movement and development. These will have short-, mid- and long-term effects on our ability to fulfill mission imperatives.
- Today's interlinked, dynamic and *volatile, uncertain, complex and ambiguous* information environment becomes even more inconstant when data perishability is introduced as a factor. Thus, the timeliness of data and the effects it has on informed decision-making require a new approach that focuses on resilience over reliability. This will ensure the degree of flexibility necessary to facilitate continued evolution within the information environment—one that continues to evolve at a dizzying speed. Thus, the need to understand linkages within this environment requires a well-defined governance process that embodies a management framework that facilitates collaboration.

Without validation, there can be no confidence in the data presented. The growing demand for data and increasingly complex information require a structured approach that will assess and manage this vital strategic resource effectively. To date, no formal process exists to develop data quality and information linkages throughout the organization and among its mission partners. Thus, the need to plan for, develop and source such an analyst is paramount to future accomplishment of those organizational goals and objectives that fulfill the mission.

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TAB 17

Chief Data Officer

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DEVELOPING A DATA DRIVEN ORGANIZATION

To ensure that we remain capable of accomplishing our mission, it is imperative that we can make informed decisions. Today, the incredible rate at which data is amassing exceeds our current ability to collect, correlate and add the context necessary for such data to serve both mission and business imperatives. Therefore, we must advance three fundamental and enterprise wide endeavors intended to preserve our ability to fly, fight, and win our nation's wars.

From a data perspective, the greatest challenge we face today is data disparity, disaggregated information, and disassociated knowledge. These factors not only influence the quality, informational reliability, and contextual reference of that data, but they also affect our understanding of existing circumstances as well as the results of the actions we take vis-à-vis the results we desire. It is therefore critical that we identify the Authoritative Data Sources (ADS), associated information, and distributed knowledge that will allow us to advance our overall understanding. Factors that influence data:

- **Quality**
  - *WHAT data is available (ADS)?*
  - *WHO is responsible for it (data stewards)?*
- **Informational reliability**
  - *WHERE is it?*
  - *HOW can we access it?*
- **Contextual reference**
  - *WHEN do we synchronize?*
  - *WHY is it important?*

While a similar effort failed eight years ago, it did so not because it lacked advocacy or effort, but because the unsound framework for that initiative sought to own and integrate the data. Surveys have concluded that technology and resource challenges are not our biggest dilemma. Instead, the cultural dilemma we face is the biggest impediment to success. The proposal offered today is fueled by the framework developed by the White House/U.S. Data Cabinet. It empowers our organization's data steward and links information, both of which will enable us to ascribe suitable contextual reference to data, which will further inform our decision-making processes.

This collaborative approach to registering data by identifying the data steward's ADS in an Enterprise Data Dictionary, and establishing a reliance upon and operational linkages throughout an Information Asset Catalog. Previous efforts have focused on creating "lakes" of data, but those have always degenerated quickly into data "swamps" that are neither current nor usable. From our perspective, data belongs to the organization, and it is best overseen by those who have the most to gain by relying on it. Essentially, the data stewards who act as the guardians of such data are best suited to caring for, maturing, and developing data, so that it serves mission imperatives.

As our reliance upon information continues to grow, the lack of congruent linkages enable us to manage its mass and complexity overshadowing our ability to improve situational awareness given time constraints associated with a constantly broadening mission spectrum. Confronted with unreliable information that fails to serve the organization's strategic imperatives, our ability to make informed decisions is challenged by insufficient knowledge and the consequences of actions we take to achieve the goals and objectives of our five core mission areas. Given today's interlinked and information-starved society, we must learn to illustrate the dependencies and context necessary for us to visualize the knowledge we need to develop our understanding.

Beyond conducting our own surveys during our investigation of relevant lessons learned from industry and government we learned that implementing the office of the Chief Data Officer (CDO) under that of the Chief Information Officer (CIO) was a useful and rapid way to establish the kind of functionality essential in today's information environment. Current policy, technologies, and enterprise views are best associated with the CIO, Clinger Cohen, and other studies noted that most (over 85%) respondents agreed that the fastest way to establish this capability was by including it with the CIO function. This ensures an enterprise approach to implementing the area-specific functionality necessary to achieve what the JP Morgan's CDO characterizes as, "A little data in the hands of many is better than a lot of data in the hands of few."

Accordingly, we suggest that the best approach we can take to extracting the true value of data on establishing a CDO are the benefits validated by operational and business use cases to build-out capabilities that serve the organization as they validate the proposed roles and responsibilities, hone a data management framework, and develop maturation models. The prescribe autonomous process is intended to establish an operational structure to register, catalog, and visualize data to inform the cognitive process. For while we know the cost associated with bad decisions, we must learn to appreciate the value of wise decisions based on knowledge that surpasses our current understanding. According to IBM's CDO, it is "Important to understand the value proposition to modernize our organization in preparation for the future. Thus, we must create an enterprise cognitive data platform that affords us the means to adapt to and inform decisions for our organization."