Chapter 8
Conclusion

There is a tide in the affairs of men,
Which, taken at the flood, leads on to fortune;
Omitted, all the voyage of their life
Is bound in shallows and in miseries.
On such a full sea are we now afloat;
And we must take the current when it serves,
Or lose our ventures—(Shakespeare, 1919).”

At this point the authors would like to wrap up with a neat package of recommended actions, based on data and analyses, that addresses each component of the problem, their interactions, and the emergent features that together make up the situation. That is the wrong approach. The conflicts we face are too diverse and changing too rapidly for simple algorithmic solutions. We contend that cognitive superiority is the means to the solutions. We must be algorithmically armed but not algorithmic ridden.

In this chapter we offer a synopsis of current conflicts, warfare in a information age, and propose requirements for achieving ongoing cognitive superiority.

The War

We are engaged in warfare the unlike any before. Instability increases, change accelerates in the technium and the noosphere, strategic spaces expand, and many battles don’t have a physical battlefield. The cycle time is both faster and slower. The time scale has expanded and now ranges from milliseconds to the 100-year marathon (Pillsbury, 2015). This warfare is occidental and oriental and exploits our increasing understanding of human vulnerabilities and potentials. Some combatants are familiar,
some new and they are many. Bits and atoms—digital and kinetic conflict—are utterly intertwined. AI/ML and the panopticon, augmented by experiments performed on unsuspecting internet users, provide adaptive predictive analytics for use by captology, narratology and shi. We encounter surrogation, bot armies, proxies, information arbitrage markets, and merchants of information and attention using persuasion science for micro-targeting and massive interpersonal persuasion (MIP), strategic deception and confusion strategies. We have near peers who seek our total domination and fight with “10,000 means” where the only rule is that there are no rules (Chinese Academy of Military Science, 2018; Qiao & Wang, 1999). The old paradigms are replaced by the new (Table 8.1). Just as in Darwinian survival of the fittest, “If environmental conditions change, the struggle begins anew (Max, 2003).”

We are at war, a multi-agent, multi-pronged attack (Fig. 8.1). This is partially a metaphorical war, as when advertisers work with addictive technology to persuade us to buy their product or change our political views. However, this is also a literal war, a life-and-death struggle for existence, with kinetic, economic, information, and diplomatic operations. This war affects more people, more severely, more quickly, and more certainly than climate change. We have seen many discussions about coping with the attacks, but few about winning the war. This may not be a short war, but we can win it.

We have a limited history to draw from because of the brevity of experience with the digital world, its accelerating rate of change, and the preference for secrecy concerning adverse experiences with the digital world. We have repeatedly been unprepared when facing wars that threatened our survival and only after significant

Table 8.1  Toward new paradigms

| The central axis of our time is accelerating change |
|-----------------------------------------------------|
| The sum of human knowledge is increasing exponentially |
| The motif is connectivity |
| Increasingly cognitively enabled machines and the drop in the learning barriers between expert knowledge and end-user is changing us and the matrix of our age (Susskind & Susskind, 2017). |
| New knowledge of man, including our vulnerabilities and potentials and advances in persuasion science, are increasing the effectiveness of persuasion |
| We have a surveilled world with experimentation amidst a vast infrastructure of knowledge access. |
| Tracking is ubiquitous; knowledge brokers abound. |
| Sensing is fused with computation and communication. |
| Information is ascendant in power, favored information access, and analytics and superior learning speed are critical. |
| Three clusters of emergence are preeminent. |
| Cognition: AI (AI supremacy will determine who decides the rules of the future), big data analytics, “software is eating the world,” etc. |
| Biology has advanced genetic engineering and synthetic biology. |
| “Reality” is increasingly represented by immersive technologies: xR, VR, AR, 360° video, and mixed reality, often scripted with persuasion science and metanarratives. |
delays did we adapt to defend against and defeat the enemy. A massive digital “attack” would be at the speed of the electron. Our fate could be determined in nanoseconds after a clandestine polythetic prologue. Kinetic superiority is no longer a certain guarantor. “For the first time since World War II, an adversary managed to knock a U.S. Navy aircraft carrier out of service. Only this time the enemy was a virus, not a nation-state (Koblentz, 2020).” Now with multiple weapons and layers hidden by method and problematic attribution, augmented with features unique to the digital world, we must have cognitive superiority.

**Accelerating Change**

The changes are in the technium (our technology), the noosphere (the sum of our knowledge), and in man and our knowledge of man. The motif of that change is connectivity with increase in the complexity of the complex adaptive systems that constitute our world.

Advances in AI, the biological sciences, cognitive science, computer science, data science, the learning sciences, information science, network science, neuroscience, psychology, and social psychology are salient. Complexity science fosters...
the understanding of transdisciplinary knowledge and creativity. Major advances in monitoring, measurement (e.g., single photon detection (Migdall, Polyakov, Fan, & Bienfang 2013)) and experimentation (e.g., high-throughput experimentation with automation and robotization (Peplow, 2019)) bring new optics for thought. Extended reality (xR) is already selectively useful and advanced genetic engineering, nootropics (drugs that enhance or modify mental functioning), and synthetic biology are extant. A future of accelerating change (Fig. 8.2) causes a remixing of these topics: quantum computing will boost AI and AI is prepared to boost all fields. As always these are constrained by our bounded reality—limited by our preconceptions, cognitive capacity, biases, fixity, and predictable systematically irrational aspects—however, we should work to enlarge our views of reality, and expand the bounds.

Figure 8.2 suffers from limitations: the arrow of change and the axes give the impression of smooth change. However, the content in Chaps. 2, 3, and 4 belies this. The changes in humans, the noosphere and the technium are expected to be anything but smooth. There will be increasing change in each, with increases in the number and types of categories in each. These axes each therefore represent a multiplicity of dimensions. The arrow of change will actually be a jagged path through multiple dimensions.

![Fig. 8.2 Accelerating change affects everything](image-url)
**Its from Bits (The Age of Cognification)**

Although information is orthogonal to matter and energy, information relates to and can represent matter and energy \( F = MA, E = MC^2 \), etc.). John A. Wheeler, the physicist who popularized the term “black hole,” suggested that each thing in the universe, starting with the basic particles derives its existence from information—bits (Wheeler, 1989).

Information in the eye of the beholder and the hands of the user, can be the ingredients for the acquisition of knowledge for

- the sake of learning or advancement of man,
- property in the ideas industry (Drezner, 2017),
- profit for the arbitrage of ideas market (Aspesi & Brand, 2020),
- weapons for cyber warfare
- in the event of kinetic war, to assure our kill chain is combined well (CAS integrated) with superior speed (Brose, 2020b), or
- for cognitive superiority, and thus all of the above.

Evolution is the competition and cooperation of information. There is no love, peace, war, or meaning without information. Knowledge is the coin of the realm in our information age and it is increasing exponentially. Data can bring information, which can bring knowledge, which can bring wisdom; but wisdom comes in very small packages. As the radius of our knowledge increases, the circumference of our ignorance increases six-fold.

LTG Michael Flynn said, “Publicly available information is now probably the greatest means of intelligence we could bring to bear (Singer & Brooking, 2018).” This new aspect of the taxonomy of intelligence is obviously relevant to all learning ecosystems including education and propaganda. Controlling the morphing misinformation processes can be accomplished only with knowledge of authors, articles, rumors, images, the publishers and platforms. There is too much information and diversity for a single person or a standard team.

We are complex adaptive systems living in complex adaptive systems that are becoming more information-dense, more complex. Cognitive superiority, the cognitive domination of one side over others illustrated in Fig. 8.3, is now essential in war and necessary to flourish in peace.

**Humanity and Its Matrix**

Man is an emergent bio-psycho-socio-techno-info being. We are in an age when the very nature of cognition is morphing with AI/ML, the cognification of objects, processes, environments, and the cognitive augmentation of man.
We have predictably systematically irrational aspects with manifold vulnerabilities and potentials. The new science of persuasion, armed with new knowledge of man’s irrationalities and vulnerabilities, using big data analytics from new surveilled mobile biometrics and sociometrics, allows targeted direction of attention and induction of doubt with probabilistic persuasive control. Warfare and peace are not exempt.

The conflicts that permeate our environment utilize the panopticon, open or hidden. Deception can be simple or as complex as part of shi. The participants, means, and memes, are utterly intertwined. Narrative warfare is joined by computational propaganda, election tampering, and stealing intellectual secrets. Fake news can use AI-augmented sociometrics and biometrics to direct attention and micro-target or expand for mass interpersonal persuasion (MIP), employing computer assisted persuasion (captology). Persuasion art/science should be understood as combining the oriental and occidental traditions, brought into the twenty-first century. Sun-Tsu, Aristotle, Cicero, Cialdini, Centola, Fogg, Maan, Sapolsky, Sunstein and Thaler, and Martin and Marks are central in this community of knowledge of persuasion.

Drawing from Fig. 8.1, we see that among the myriad persuasive competitors, there are national attacks whose fundamental long-term grand strategy is a zero-sum game for domination. There are also attacks with economic gain as the motive. There are attacks designed to influence opinions and behaviors. There are attacks based on philosophical and purely malicious motives. There are personal attacks and demands on our cognitive capacities by our cognified “servants.” The targets include the operations of physical systems and human cognition.
The Imperative—Cognitive Superiority

**Prerequisite:** Executive level vision, with announced political/power buy-in; a Manhattan Project level of funding and empowerment; and a senior leader with recognized expertise in science and technology management and experience in dealing with government (for example, Vannevar Bush, during World War II (Dyson, 2012)).

There is a complementarity about cognitive superiority: it is both an emergent sixth domain and part of the other five domains, for as the Chinese said, we are in a new world of cognification (Chinese Academy of Military Science, 2018) and “the winner is the one who combined well (Qiao & Wang, 1999).” We must combine well to support the imperative of Cognitive Superiority.

**Requirements**

Table 8.2 lists the requirements for cognitive superiority. Each is described in the text following the table.

1. An executive and bipartisan supported **vision and grand strategy** to address the enlarging arc of cognitive conflict is required. The arc of the conflict includes competition for superior information access, cyber war, economic warfare, “lawfare,” narrative warfare, and conventional military warfare. The pressures arrayed against us are generated simultaneously by multiple actors with different agendas. The means include diplomacy, meme and media conflict, network dynamics, persuasion science, and warfare for supremacy in the emergent new forms of cognition. All of these must be coordinated and interoperable across hierarchical levels of abstraction, vision, policy, strategy, operations and tactics in a world of

| Table 8.2  Requirements for achieving cognitive superiority |
|-----------------------------------------------------------|
| 1. An executive, bipartisan supported vision and grand strategy for a Manhattan Project level of national commitment to Cognitive Superiority, including AI and quantum superiority |
| 2. Talent, the best and brightest |
| 3. Education, lifelong for all, with superior learning speed |
| 4. Favored information access both for the individual and on a systems level to the frontier of science and technology |
| 5. Persuasion science superiority |
| 6. Superior cyber-sensing security resilience and capacity for our global networks; |
| 7. Cognitive augmentation for individuals and groups |
| 8. All of the above “combined well.” |
unending paradigm shifting disruptive change (Kelly, 2016; McFate, 2019; Maan, 2018). Central to the vision is a Manhattan Project level of national commitment to Cognitive Superiority is required, including:

(a) **AI/ML superiority**, with third J-wave AI/ML (DARPA, 2019) (within five years the country with the superior military AI may determine the rules of the future), **quantum superiority**, and cognified objects and systems (IoT) on earth and in space;

(b) **Recognition of and formal Establishment** of the *de facto*, extant, Cognitive (Sixth) Domain of Warfare;

(c) **Talent**: The best and brightest talent: recruited, recognized, and remunerated;

(d) **Persuasion science**: Persuasion and influence superiority, both for external use and internal use in recruitment and management;

(e) **Major cognitive augmentation systems**: With superior analytic information access, a dedicated Eratosthenes affiliation, PAALS, and removing barriers to information access;

(f) **Process**: Operations using flexible multidisciplinary approaches, resilient cyber security, embedded lifelong education both for the team and throughout the nation, and favored access to the frontiers of science and technology; and

(g) **Adaptive integration**: Policy, diplomacy, strategy, and tactics, with the motif of connectivity for the vision.

2. **Talent**: The best and brightest, “smart creatives (Schmidt & Rosenberg, 2017),” must be recruited (see the subsection on talent recruitment in Chap. 7 and the section on talent below), recognized with emoluments, ranked, and offered selected relationship flexibility across multiple significant domains of knowledge. It will be critical to craft the metanarrative and persuasion arguments to recruit Silicon Valley’s A-team for America’s military AI superiority.

3. **Education** as a national priority should be understood as extending from womb to tomb. Teaching should be a more honored profession. Education involves filling the bucket of knowledge, lighting the fire of the “demanding festival” of lifelong learning and preparing the mind to meet the unexpected. This cognitive adaptation for today’s matrix of accelerating change and exponential increase in the sum of human knowledge (with new forms of cognition) is for intellectual enrichment and increasingly sequential employment, but now necessary for national defense. (For more on education, see the education section in Chap. 7.

(a) **Liberal arts** and **STEM** education are required, as is training in the trades. The evidence for the benefit of choice in education is overwhelming. The goal of a “liberal arts education” is to teach critical thinking, analytical problem solving, and understanding of humanity. This goal is impeded by politics, political correctness, greed and fixity, which must be called out and overcome. STEM support must include statistical literacy and advanced placement computer science courses in all U.S. high schools and later work-life adult education support for reskilling and upskilling for fundamental skills, craft, and theory. The current 40% of post high school
students attending college, as currently constructed, should be re-thought. A large percentage of these students should be offered training for likely employment skills and then at the time when creative destruction causes that job to disappear, be offered reskilling or upskilling. Minds must be prepared to meet the unexpected (see the subsection on serendipity and sagacity in Chap. 3).

(b) **Life-long learning** is required. This includes transdisciplinary reskilling and upskilling as we face the automating workplace. Our technical and scientific expertise are becoming obsolete ever more quickly. The pedagogy should be optimally matched to the student’s individual learning style, the topic and matrix. Urgently needed adult education must be expanded. It should encompass all workers, from the factory floor through “white collar” jobs to academia, with easy logistical and financial availability. Post-doctoral students and faculty need education in new trans-domain fields and access to monitoring and use of ultra-expensive technology and methods only available in the private sector. This requires bipartisan political will with public-private partnerships supporting lifelong learning, using interoperable, learning networked, modern personalized pedagogy-driven learning technology, a foundational educational path that is a hierarchically selective system.

(c) **Learning speed superiority** is critical, as we experience accelerating change, both in the civilian and military world (this may be our only long-term adaptive advantage) (Anderson, 2019).

(d) **Meta-learning skills** are needed for defense, security and beyond to hone personalized adult adaptive learning systems to optimize the incoming information and support tacit knowledge transfer. These skills include learning, knowing how to learn, understanding the sources of invention and discovery (Polya, 1945), and content expertise.

4. **Favored information access including access to the frontier of science and technology**—both for the individual and on a systems level are obligatory. (The items are amplified in the section on cognitive enhancement below.)

(a) The system needs an **Eratosthenes Affiliation** for cognitive augmentation that will harvest, winnow down and make convenient salient knowledge from the expanding frontier of science and technology for system-wide use by defense and security. Besides providing cognitive enhancement, this will serve as an enticement for talent recruitment.

(b) Personnel should be taught to develop personalized adult adaptive learning systems (**PAALS**) to optimize their lifelong learning including use of their collective learning opportunities and optimized use of the available cognitive artifacts (computer search expertise, MOOCS, MOOSECS, etc.). They should understand the power of collecting and nurturing mentorships, hone the skills of problem solving taught by Polya, and understand the complexity of tacit knowledge transfer.
(c) It will be necessary to remove barriers to the improvement of research reporting and deal with information access portals and tolls.

5. **Persuasion science superiority** is required a priori to bring this vision of the urgent necessity for cognitive superiority to those in power, then to establish meta-narratives in international relations, for recruitment of previously reluctant AI/ML expertise, and for the cognitive superiority agenda, including the military.

6. **Superior cyber-sensing security resilience and capacity**: David Sanger’s prescriptions for cyber security are relevant (see Table 6.3 in Chap. 6). We certainly need defenses of various types; however, we also require resilience to bounce back from successful attacks. This will require superior knowledge management, including security, robustness, resilience and provenance of data, selected modularity, capacity for dynamic reorganization, facility for cooperation, and access control (Rothrock, 2018; Zolli & Healy, 2012).

7. **Cognition augmentation for individuals and groups**: Cognified, individual and networked digital augmentation across domains is advised. Intelligence amplification or augmentation (IA), ambient, processes, group and individual are part of this. It will be necessary to minimize neurotoxicants (substances capable of causing adverse effects in the nervous system and sense organs) in our exposome (the environment, that is, non-genetic drivers of health and disease) (Vermeulen, Schymanski, Barabasi, & Miller, 2020). Attention must be paid to the manifold factors that optimize cognition, including nutrition, sleep hygiene, exercise, and psychosocial health. Where possible, we should optimize our integrated stress response (ISR) (Costa-Mattioli & Walter, 2020).

8. All of the above “combined well” (Qiao & Wang, 1999).”

Cognitive superiority will require our A-Team talent and should be envisioned as continuous, lifelong learning, optimizing information access and learning speed, possessing superior AI (necessary for continued freedom) and intelligence augmentation (IA). Requirements #3, #4, and #7 above can all be advanced with individuals having their own personal training/education accounts, funded by the government, their company, or by themselves, to provide for upskilling or reskilling as needed. “Due to the acceleration of technology, people are losing around 40% of their skills every three years (Michaels 2020a).” Why would we not do this?

Numbered among the impediments will lurk limited knowledge or vision, aversion to feedback, fixity and bureaucracy, and self-interest of many stripes, political, hubristic or greed.

### Organizational Implementation: What’s Different Now?

Winning this war will not be simple. The diversity of means, targets, protagonists, and motives guarantees this. We need an ensemble of solutions that can address all aspects of the “war.”
The art and science of management has changed in the twenty-first century. Empowered by information and technology, individuals and small teams can have enormous impact, far greater than ever before (Schmidt & Rosenberg, 2017). Figure 8.4 begins the description of the ensemble. The ensemble is adapted from the requirements for an agile organization of Fig. 7.2 in Chap. 7. It can be envisioned as having six parts: structure, management, sufficient operational freedom, talent, cognitive augmentation, and an Eratosthenes affiliation. We have added individual cognitive enhancement to the agile organization requirements to take advantage of the human cognitive enhancements that are becoming part of the cognitive landscape. An Eratosthenes affiliation expands the cognitive enhancement from the individual to the organization.

**Structure**

Organizational structure has at its center trust and candor. It is dedicated to multidisciplinary lifelong learning for all, features connectivity within the team and without. Some connections should be continuous but with the capability for microstates (temporary confluences that inform). With accelerating change, agility is essential. Valuing “adapting to change more than sticking to the plan,” flexible hierarchy with agile teams are probabilistically more productive and work differently from strict “chain of command bureaucracies (Rigby, Sutherland, & Noble, 2018).” A transformational mindset and the capacity for rapid response and quick iterations are essential. AI/ML can now be used to enhance the operations of both the talent and the management (Tarafdar, Beath, & Ross, 2019).

The organization can also be viewed as a team or set of teams. Because the breadth of knowledge required is larger than a single person or small team can be expected to possess, the team must have a network of collaborators (Fig. 8.5). Some of these collaborators will be closely linked to the team (C), as shown by the bold
connections. Some will be only moderately (M) or weakly linked (W), as shown by the light and dashed connectors. Some collaborators will be more distant (D), only linked through the closer collaborators. The team members and collaborators should be augmented with AI/ML and other cognitive artifacts and supported with superior connectivity within the team, to knowledge resources, and to innovation partners (Ancona, 2020). Crowdsourcing will be one useful team adjunct. Brabham defines crowdsourcing as “an online, distributed problem-solving and production model that leverages the collective intelligence of online communities to serve specific organizational goals (Brabham, 2013).”

Work has been done concerning AI assisted teams (see DARPA ASIST (DARPA, 2019)). The team environment can benefit from all forms of intelligence (ambient, traditional, and xR augmented intelligence). Enhancement by collective learning should flow from the team long-term and short-term with microstates, as well as from the network of “consultants,” optimally involving a variety of types of associations from on-call to special projects and lifelong availability of education and upskilling. Ongoing personalized information feeds, both traditional and digital, are needed. A supportive, connected, personalized environment along with the previously mentioned persuasion science change can give great advantage for top talent recruitment.

Each team will need abilities seen in the neurobiology of cognitive science to quickly form microstates with real time recruitment, semi-permeable filtering and rapid analysis, prediction and adaption. In the digital world, “x-teams” “foster speed, innovation, and execution. These teams don’t just collaborate internally; they also link to knowledge resources and innovation partners in the outside world (Ancona, 2020).” No static models, no single model, no silo models will be sufficient.

Figure 8.6 combines Figs. 8.4 and 8.5. The Eratosthenes methodology will detect and send information from the frontiers of science and technology to the team and to the network. Its structure will involve AI/ML-augmented computer and
information scientists, experts from academia, military, industry, and security. It will have the capacity for curation and will look for morphing ontologies and salient single advances.

Now, with the surging power attendant to information and accelerating changes in the noosphere, the technium and cognition, including the network science, translation technology, AI/ML, big data analytics and data science, it is possible and it is also urgently essential to have superior information access. Awareness of the scientific and military advantage of having favored access to the frontier of knowledge has a long, storied history, repeatedly brought to the fore at times of conflict or challenge. It has been mitigated and stymied by entanglement with politics, turf battles, unripe fields of knowledge and inadequate technologies (Burke, 2018).

As in the human brain and human hybrid systems in general, the structure’s outer boundaries should reflect the adaptive advantage seen in Mother Nature’s modular, flexible, hierarchical, cognitively selective semi-permeable membranes. The competing ideals of secrecy and security versus the need for free exchange of information and ideas across traditional and new boundaries to foster creativity and discovery must be addressed. In the past, excessive secrecy, “has retarded development or at least policy integration of digital combat power (Lin & Zegart, 2018).”
Fortunately, many of the modules are ready or nearly ready for collective assembly. It will of necessity have an emergent bio-psycho-socio-techno-info structure. Mother Nature’s combinations of cooperation and selected competitive strategies are advised with affiliation bias in envisioning and with quick alpha versions with early end-user involvement, constructed with relevant subdomains of specific fields of science and technology. In parallel, we must develop modules with sufficient distributed, connected executive expertise. The psycho-social, human aspect will be the most challenging. Expert aggregators and “cheerleaders” will be mandatory. Human hybrid processing of data and metadata, the capacity to winnow down and make potentially salient material usable, and facilitation of microstates using creative management and sociometrics will all be part of this affordance.

Management (Including Recruitment)

Leaders must “promote agility by being agile (Rigby, Sutherland, & Noble, 2018).” “A 2017 survey of leading executives confirmed that their skills were depreciating at twice the rate of only a decade earlier.” “CEOs must rethink their job (Groysberg & Gregg, 2020).” From senior management on down all must be lifelong learners (Ignatius, 2019).

General Management must view talent recruitment and development as key. It must have the technical abilities and social capital to attract talent. Management must subscribe to the vision of accelerating change in the noosphere, the technium, man, and the knowledge of man. Managers should be connectors, not micro-managers, and employ flexible hierarchy to encourage the questioning of default rules within a challenging, clement environment.

“Your Approach to Hiring is all Wrong,” refers to the fact that “the majority of people who took a new job last year weren’t searching for one: someone came and got them (Capelli, 2019).” Talent recruitment-development-retention is a central management responsibility. To attract talent there should be trust and candor, meritocracy, recognition, reward, and career development offerings, opportunity to find meaning in their work, mastery in their field, and sufficient operational freedom (Pink, 2009).

Recruitment must be supported using persuasion art/science and by metanarratives to foster participation in these efforts as opposed to the belief in the counter-narrative of a “virtuous” avoiding of giving aid to DoD and Homeland Security. In the setting of America’s having the best AI/ML companies and the most effective attention and persuasion merchants, there is a dangerous problem with silicon valley’s relationship with Homeland Security and the Department of Defense. The attitude of distrust and disjoint metanarratives and narratives are barriers to the recruitment of talent and a prime example of failure of dealing with complexity and competing ideals. Solving this impasse must be urgently addressed from personal contacts to metanarratives. (See the sections on persuasion, including confronting the established, in Chap. 4 above.)
Talent

Talent is required for multiple traditional and new communities of knowledge. For computer sciences, we must have “smart creatives” with deep technical knowledge, hands-on experience, firehoses of new ideas, curious, driven, unafraid to fail, self-directed, and communicative that freely collaborate (Schmidt & Rosenberg, 2017). For persuasion superiority, rhetoric and narratology (mastery of storytelling) including video and narrative warfare, captology, computational propaganda, psychology, data science, learning science, cognitive science, data science, and human and digital network science are required. The talent should also be hired for grit, “a concept that Angela Duckworth of the University of Pennsylvania describes as perseverance and passion for long-term goals (Robson, 2019).” Talent and management must not only teach new content and traditional “how to learn” skills, but also actively improve practical and creative intelligence (Robson, 2019).

An Eratosthenes enabled team can address the science and technology knowledge explosion and will attract talent in today’s competitive environment for the best and brightest. Favored access to be in the vanguard of the knowledge explosion will entice talented recruits, even in today’s hyper-competitive talent recruitment environment. The opportunity to gain mastery in their fields of knowledge and an opportunity to work with other senior experts will aid motivation and retention. Such a team structure will provide a unique resource that will empower learning and creativity. Providing individual and team multifaceted cognitive enhancement and lifelong transdisciplinary learning will be talent multipliers. Having the talent, connectivity, structure, mentors, and technology to learn, and innovate will capture the creativity of small, smart groups. Utilizing a “stake in the outcome” versus “perks of rank” and an environment where results, not rank, are celebrated and rewarded will produce the desired results (Bahcall, 2019).

Operational Freedom

The operations should be constructed so that the individuals and small teams are entrusted with the optimal operational freedom, the freedom to be original. The organization must be agile because a fixated or slow bureaucracy will kill the capacity to deal with accelerating change, the unexpected.

An environment of collaboration, including collective learning, requires elegant listening, empathy, “making people comfortable with feedback” (“aversion to feedback is common”), teaching people to lead and to follow, clarity of communication, and “training people to have win-win interactions (Gino, 2019).” The difficult problem of dealing with competing ideals of maintaining the core scientific benefits of collaboration (nationally and internationally) and guarding against intellectual espionage will require public-private collective wisdom (Leshner, 2019).
Cognitive Enhancement - Metascience

Cognitive enhancement, including superior information access with analytics, is suggested at three levels: an Eratosthenes Affiliation for favored access to salient information at the systems level; personalized adult adaptive learning systems (PAALS) at the individual level; and removing other barriers. The technology and talent are extant to grasp this set of powerful low-hanging fruit.

There is an exponential increase in the sum of human knowledge. As the radius of our knowledge increases, the circumference of our knowledge (the boundary of our ignorance) increases six-fold. To wit, obsolescence is upon us in an accelerating fashion. John Chambers, former CEO of Cisco Systems, said that without constantly learning the leaders of tech companies are obsolete in three to five years (Groysberg & Gregg, 2020). In medicine, it is estimated that it only takes five years for 50% of treatment algorithms to be out of date. Lifelong efficient learning and superior speed of learning are our only sustainable advantages. It is necessary for cognitive superiority, central to the sixth domain and the maintenance of freedom.

Eratosthenes Affiliation: We are in urgent need of an Eratosthenes Affiliation (named for Eratosthenes, a third century B.C. scientist, mathematician, philosopher, and world-wide information gatherer, arguably the first information scientist).

An Eratosthenes Affiliation requires a multidisciplinary affiliation of library/information scientists, educators, computer scientists, multiple content experts in applicable fields of science and technology, provided with the requisite AI and IA. The purpose is detection and gathering the newest knowledge from the ever-accelerating expansion of the frontier of science and technology for use and empowerment of those in and allied with our security and defense. We now have the requisite technology, talent and metascience for this essential element for enduring cognitive superiority.

The Eratosthenes Affiliation should learn what current systems are extant. There is no excuse for not knowing the current best in class. It will require an organic structure with an agile management team with superior intellectual, emotional and social capital adept at dealing with diverse communities of knowledge. It needs empowered talent to recruit and motivate the recruits to participate in further recruitment. The network will of necessity utilize a variety of types of affiliation, from brief and limited to ongoing. End users should be involved early. Success will entail the proper metanarratives, the use of the art/science of persuasion, and scaling in an incremental fashion. Each of SciFinder (SciFinder, 2019), DataONE (DataONE, 2020), and Google Scholar (Google Scholar, 2019), the national labs, DARPA, IARPA, NASA, commercial and independent labs, knowledge brokers, consultants, academia, library and information science may be parts of the affiliation.

At least one near peer is pursuing its version of an Eratosthenes Affiliation - China (Chinese Academy of Military Science, 2018) and possibly Russia (Singer & Brooking, 2018).

PAALS: Personalized Adult Adaptive Learning Systems are individual systems to aid in learning. They address cumulative education and education at the time of need (with the locus of our maximum density of learning moments). Such a system
involves aids in how to learn—heuristics meta-learning, includes guides concerning mentors—how to seek, appreciate, and nurture them and how to locate and transfer tacit knowledge. The system also aids in participating in collective learning, such as groups, microstates, and list serves, and in finding and using cognitive artifacts, traditional, digital and hybrids, such as MOOCs, MOOSECs, Ted talks, digital platforms, and search expediters. We are children of the word, the book, the screen, and now also digital intelligence amplification or augmentation (IA). We should choose topics for our focused learning, know how best to assemble our learning structure and reify that system.

**Removing Other Barriers:** The rapidly evolving knowledge infrastructure means we must deal with “information arbitrage markets” with portals and “augmented discovery services through artificial intelligence (AI)-powered mining and analysis of full-text (Aspesi & Brand, 2020).”

Another claim is that there are other chronic and current addressable delays in harvesting advances from the frontier of science and technology for deployment and use. The period of delay is less, but present, even when there is obvious advantage to those with vast financial resources, as when the advance is deemed essential for national defense (to be addressed by the Eratosthenes Affiliation) or very lucrative for commerce. There is a yawning gap of delay outside these two areas where, though currently not judged salient to either of those two areas, the discovery may, with time, yield emergent, manifold, national advantage, including defense or commerce. This issue is discussed more fully in the section on Validation and Accessibility in Chap. 3. Table 3.10 in that section lists remedies.

Part of the delay in knowledge transfer from the frontier is because of an accepted practice by even the most prestigious academic journals of allowing publication without sufficient transparency of procedures, data collection, and description of metrics to be readily reproduced for validation. Examples of this can be seen in the short, discovery-announcing articles found in the journals *Science* and *Nature*. This can be remedied by a policy of not publishing without transparency and detail commensurable with reproducibility. (The publisher Wiley and the software firm Scite are teaming up to use the software Scite.ai to use AI to help determine which articles are reproducible (Brainard, 2020). This may be a step in the right direction.) This could be strengthened by an independent certifying body attesting that the article provided sufficient information for reproducibility. Successful pressure for journal article method transparency would speed the path from print to use. Pre-registration of hypothesis (*ex ante predictum*) would also improve the advancement of science (DellaVigna, Pope, & Vivalt, 2019).

These meta-scientific, normative and structural changes can bring great cognitive advantages to those who employ their bounty. We now have the technology, metaknowledge and many of the unassembled subsystems to bring an Eratosthenes Affiliation to life.
Rationale for a Manhattan Project to Achieve Cognitive Superiority

The sum of human knowledge is increasing exponentially. The disruptive impact of technology and new knowledge is felt across the matrix of man (Schmidt & Rosenberg, 2017). Knowledge infrastructure and thought leadership are new battlefields. We have near peers in the conventional land, sea and air domains. We have near peers in the newer space and cyber domains. Some are near peers in only one or two domains. Russia and China are near peers in all five domains. Nation-state power is challenged by new capacities for reach and scale in our ever more connected and complex world, as evidenced by Al Qaeda, ISIS and COVID-19. Power has shifted to include large international corporations, swarms and even individuals who are billionaires.

Technology follows from and abets knowledge. The power of information is mounting. Technology, knowledge and skills are becoming obsolete more rapidly. AI is on track to be the most transformative technology in human history and military AI superiority may determine who writes the rules of the future (Karp, 2020). However, there are and will be newer technologies (e.g., quantum technologies), further accelerating change. By numbers of graduates, China leads in science, technology, mathematics, and engineering (McCarthy, 2017). Our ability to learn faster may be our only sustainable advantage.

However, the nature of power, of warfare, and how and by whom it is waged has changed, continues to change, and the change is accelerating. Kinetic power alone is no longer sufficient to guarantee dominance or even freedom (Brose, 2020a). Low barriers to entry, ease of scaling effects, and the potential of problematic attribution guarantee more combatants. This is particularly true in cognitive conflict writ large, in biosecurity and in cyberwar.

We are engaged in ongoing conflicts involving atoms (kinetics) and bits (information). The persuasion wars require the talent to recognize fleeting moments of potential massive influence, digital and otherwise. Persuasion science/art can make the resolute sequacious. This conflict is polythetic, multi-pronged, and pursued by multiple agents with multiple motives for multiple ends. If we fail to see its entirety, but try to address the conflict piecemeal, we will ultimately fail.

The future “dogs of war” will include bits and orbits, atoms, memes and meta-narrative meaning, genes and germs. It’s different now.

Cognitive superiority is the basis for information superiority, technical superiority, economic superiority, diplomatic superiority, and military superiority. The future of conflict is lies in the pursuit for cognitive superiority. Achieving and maintaining cognitive superiority will require a massive and coordinated effort—a Manhattan Project level effort.
"The old order changeth, yielding place to the new (Tennyson, 1842)," and the pace of change accelerates. We change in information infrastructure, technology, affiliation, and biology. Even "reality" and cognition have ever new and more complex forms.

We face an existential threat, challenged like never before. We must define cognitive superiority as the grand central mission. The requisite executive challenge is political system buy-in to this reality for focus and funding. We need a Cognitive Superiority Manhattan Project with a scientific advisory mechanism. We have the people, the technology and many of the subsystems. We executed the original Manhattan Project, the Moonshot, and have organized a whole-of-America response to COVID-19. We are "shovel ready." With an empowered IARPA, with DoD, DARPA, the 17 national labs, proper funding, public-private partnerships, in concert with technology push and demand pull it will be transformative not only for defense, security and freedom, but for vast new wealth that has repeatedly come from technology and information paradigm shifts (Margonelli, 2020).

The proper grand strategy must deal with ten thousand methods from milliseconds to marathon, provide totally integrated superior kill chain dynamics, have talent with the sagacity to deal with the unexpected and possess flexible adaptive management. A lifelong commitment to learning must be algorithmically enabled, not algorithmically ridden. All "combined well" for cognitive superiority.

Most of the knowledge needed to realize this vision is extant but spread across multiple domains of knowledge and unassembled. The alliance would include empowered superior senior management, graybeards, and content experts from multiple domains. Truth and need must prevail over political correctness. Need and commitment to results should trump short-term ego, career advancement and turf wars. Management will need to be connectors between, above—to address politics and power, within—to orchestrate, and without—to foster a variety of consultant relationships.

The first step can be top down or bottom up. Top down might entail a conference with powerful agents: NSA, DOD, Homeland Security, commercial knowledge brokers, senior advisers and graybeards, etc. for buy-in of the vision, its creation and support. Alternatively, one agency could be the genesis to connect and combine wide and well. Such a complex adaptive system of necessity will become a public/private partnership with trans domain talent and include aggregators and persuaders and sufficient authority for the enduring conflict.

These proposals will foster advances in basic research, while solving immediate real-world needs for security, defense and beyond (Pasteur’s Quadrant in Fig. 7.1). The weaponization of a forme fruste of a cognitive domain is extant but distributed and accelerating in potential province and power. It can be assembled and will be by some, to influence and potentially control any level of oppositional power from National Destiny, Grand Strategy, command and control down to the individual combatant and citizen. It will seek and feed upon the opponent’s limited executive vision, poor knowledge management, fixity, insufficient agility, and suboptimal cognitive capital across all domains and hierarchies of warfare.
It’s Different Now

“The central axis of our time is unending accelerating change (Kelly, 2016).” The motif is connectivity. The sum of human knowledge is increasing exponentially. There is a new ecology of information access, analytics, and management. The new and unfolding knowledge of man’s vulnerabilities and potentials is crucial. We must possess favored information access, superior learning speed, the sagacity to wisely address the unexpected and develop and deploy emerging technology and knowledge. Information ascends in power. There are even emergent new forms of cognition. For continued freedom, cognitive superiority is the central imperative.

If not us, who? If not now, when?