Introduction
Mr. Brimley began by noting that it is a great time to be a defense analyst:
- Budgets are tight
- The world order is changing
- New technologies are altering how we engage with each other
For the Seminar he explained that he would give a brief overview of how he currently sees the environment and how emerging technologies may alter defense strategy.

Acknowledgements
Much of this talk is based on a recent CNAS report, *Game Changers: Disruptive Technology and U.S. Defense Strategy* that Mr. Brimley wrote with two other analysts. He also noted his report used a great deal of good work that is being done by analysts such as Under Secretary of the Navy Bob Work, Peter Singer at Brookings, Mike Horowitz at the University of Pennsylvania, and Ben Fitzgerald at CNAS.

Framing the Domestic and International Environments
Domestically, the US is clearly in the midst of a major downturn in defense spending
- More cuts are coming
- While Sequestration as a mechanism needs to go, austerity will remain
- This downturn has been going on for four or five years and is normal
  - Based on history expect it to continue for another five or six years
- Bottom line: The Defense establishment must figure out how to position itself for the eventual upturn by making good choices today
International events are also framing the situation at home

- The end of the war in Iraq and the apparent winding down of the war in Afghanistan are changing perceptions and politics of US foreign policy
- Polarization in DC has shattered the consensus that had gone on through much of the Cold War on foreign policy
  - Example: The breakdown of the consensus within the Republican Party
    - Defense hawks are fading away
    - Fiscal hawks and those who question deep engagement overseas are rising
  - While Democrats have had this sort of tension in their party for years, it is new to the Republicans
    - Has added to the overall polarization and stasis in Washington
  - Such tensions in national debates are natural after wars but are being exacerbated by the push to reduce budgets
- The American people are now more skeptical about how statecraft has been used in the last few years as can be seen in polling
  - Americans no longer rank highly affirmative features of traditional foreign policy such as democracy building and human rights
  - Pew Research surveys have shown that only slightly more than half believe that it is important to maintain military superiority worldwide
- Defense analysts and policy-makers must be ready for even greater skepticism about steady state overseas commitments or large defense investments
  - Example: Combatant Commanders should expect more scrutiny of what they consider requirements – will need to argue much harder for them

World Trends Reshaping the International System
(See Out of the Mountains: The Coming Age of the Urban Guerrilla by David Kilcullen for the details of first three of these trends)

- Urbanization
  - In 1800 only 3% of the world’s population lived in cities of 1 million or more
    - By 2000 it was 47%
    - It is expected to reach 75% by 2050
  - This unprecedented urbanization is mostly in the developing world – especially the low-income areas of Asia, Africa, and Latin America

- Littoralization – most of this migration will occur close to coasts
  - In 2012 80% of the world’s population lives within 60 miles of a coastline
  - Of the 25 largest cities only Moscow, Delhi, Beijing, and Tehran are inland

- Connectedness – Populations are more connected by social media and technologies
  - Think of the success of Twitter and Facebook during the Arab Spring
  - It has been possible to track events with live feeds from the overseas events
  - Activists in Libya uprising were getting real-time Skype battle tactics assistance from supporters in Europe

- Dark Networks – social media and economic arrangements that cannot be easily perceived because often involve largely anonymous entities
  - Examples: the Silk Road Network and Bitcoin
Can only expect the number and complexity to grow

- **Changing energy dynamics** – in the world but especially North America
  - Very possibly North America will be a net energy exporter within the next decade – already creating geo-political ramifications
  - European, Mid-Eastern, and Asian players already considering how this will change things for them

- **Rise of China and India** – likely to be the big story for the first half of the 21st century
  - Ties in with the energy issue
  - How the US responds will be important

- **The rapid diffusion of new technologies**
  - Happening laterally – new technologies are involved in all aspects of our lives
  - Happening vertically – technologies are extended throughout the world from advanced to developing states and on to non-state actors
  - Wave of disruptive technologies are changing how we live our lives, engage in commerce, as well as how we prepare for and prosecute military ops
  - Changes coming from big data analytics, cloud computing, 3-D printing, human enhancement, etc.
  - Now in a period of unprecedented innovation that will have impacts on lives, national security, investments, etc.
  - Unlike in the Cold War when innovations came from the defense industrial complex and moved to commercial use
    - Now commercial/private innovations are being adapted for use in the defense field
    - Today's situation is much like early 20th century era when maturing innovations (telegraph/railroad/etc.) spurred massive social change
    - Made changes in how to think about military forces and how to carry out warfare

**Intersection of Innovative Technology and Defense Strategy**

- In World War II the US military might was founded on its ability to mobilize and produce massive quantities of capabilities
  - There was a technological competition but being able to produce mass for a quantitative advantage was more important in winning the war

- In the Cold War the US laid out a multi-decade strategy to establish technological superiority over the Soviets
  - Had to do this because of the Soviets’ quantitative advantage that threatened US allies in Europe
  - US used a purposeful strategy-driven approach to design a qualitative technological advantage to combat the Soviet quantitative edge
    - Lead to precision, stealth, comms, satellites, computing, etc.
    - Included development of concepts such as Air-Land Battle which obviated the advantage of mass to a degree
  - Done as a series of strategic choices in all administrations from Eisenhower onward
In Post-Cold War era strategists have tended to presume that the US will maintain its monopoly on the technological lead
  - There were lots of innovations to support this view
  - Could take a risk but there really was no near-peer competitor on the strategic horizon
- But now in a different environment
  - China is not now a near-peer competitor but by 2030 at least in the Asia-Pacific region the geo-politics will look very different
  - DoD may not be set-up to operate this sort of world given that it is:
    - Still putting vast amount of funding into legacy systems
    - Choosing systems that cost so much that can only buy a few
    - Clinging to a requirements structure that counters investments in technologies that threaten traditional approaches
  - Much of innovative technology is now happening in the commercial world, not the national security world

Technological dominance is a strategic choice but the problem in a time of austerity is how to reaffirm that choice
- Must keep making decisions to support technological dominance
- Former SECNAV Richard Danzig believes that tech dominance cannot be maintained in today’s environment
  - That may be correct
  - However, the US still must constantly invest in the effort to ensure it can measure the edges of these technologies
- As other powers rise, the US will decline naturally and much of the changes are being driven by commercial considerations
- Bottom line: the US must resist temptations to make big cuts in defense R&D and S&T budgets under austere budgets simply to uphold the legacy structures

Historic background of technological developments in defense
- Up through WWII combat depended on unguided munitions
  - Starting with rocks, combat zone kept growing with newer technologies
  - While range increased in going from arrows to artillery, accuracy decreased from feet to miles This meant that ballistic unguided munitions while having great range, usually missed their targets
    - Result was one had to use massive numbers to overcome the targeting problem
    - Even skilled operators didn’t improve the kill rate that much, if at all
- Then near the end of WWII two alternatives to unguided munitions were developed
  - Nuclear weapons solved the problem by delivering one enormous pulse of destructive power
  - Guided munitions solved the problem of individual aiming errors by homing in on their targets
    - Improved targeting so much that individual munitions could do the job of massive numbers of unguided munitions
With guided munitions only needed enough munitions to make it through defenses and then assumed that any leakers would do the job
- Included Japanese Kamikaze pilots and wake-homing torpedoes

- By Vietnam the importance of precision was very clear
  - Accuracy had become independent of range
  - Maximum effective range and weapon probability of kill were more important than rate of fire or the density of barrages
  - Range was dependent on cost but the results were such that it was worth paying more
  - Operator skill was becoming less important
  - All of this played well with the broader Cold War strategy of finding technological ways to overcome Soviet mass advantages

- All of these improvements taken together showed that US forces would be able to penetrate Soviet defenses and strike deep into their territory
  - By the 1980s the Soviet military leadership fully understood this concept
  - Marshal Ogarkov in 1984: the effects of guided munitions and automated reconnaissance strike complexes could equal those of tactical nuclear weapons
  - Bottom line: the Soviets recognized that “the jig was up” – US qualitative advantage would erode the deterrence power of Soviet forces

- 1993: Mike Vickers published a concept of warfare in 2020
  - Best post-Cold War description of how guided munitions would play in a future war
  - His intent was to describe a world where precision-strike munitions were proliferated among combatants
  - Inspired a series of wargames called 20XX that were played between 1995 and 2000
    - Adversaries had a rough parity with US on guided munitions and battle networks – US no longer had monopoly
    - Conclusions of the wargames:
      - Nuclear weapons would continue to truncate conventional war at a strategic level
      - Offensive capabilities would dominate defensive capabilities
      - Stealth would be central to survival in an increasingly transparent battle space
  - Bottom line: Recent history has largely upheld findings of the wargames but now there is a need for a new look at the situation
    - Is stealth still central?
    - Is offense still dominant?
    - How is the long-range precision strike regime effected by global trends like urbanization / littoralization / diffusion of technologies?

The Current Defense Environment
Broad diffusion of military technologies predicted in the 20XX Wargames is happening probably at a slower rate than some predicted, but trends indicate an accelerating shift
• Access to contested spaces is becoming increasingly more difficult to create and maintain
• Lethality of weapons will continue to increase
  o Any state or non-state actor could have weapons such as guided rockets, missiles, and mortars
• The internal dynamics of the Defense budget complicate the issues
  o Rising personnel costs are starting to crowd out expenditures on modernization and force structure with an impact on combat power

Together these trends will combine to make unmanned systems much more pervasive
• Unmanned platforms and associated systems are really only in their infancy
• Many of tech advances, now actually driven by the commercial sector, will improve unmanned systems and accelerate their acceptance using:
  o Big data and advanced computerization
  o Protected communications
  o Artificial intelligence and robotics
  o Miniaturization and advanced manufacturing
• DoD is being pushed toward a new warfighting regime involving ubiquitous, unmanned, autonomous systems
  o Regime becoming operational at some undetermined date that could be called 20YY
    ▪ Could be 2045 or 2050 – not important but it is coming
  o Regime will be across all domains and involve:
    ▪ long-range precision strike & ISR platforms
    ▪ advanced sensors
    ▪ protected comms and battle networks
    ▪ swarms
    ▪ system logic and comms backbones
• These new technologies will have relatively significant impacts on defense strategies including relation between offense and defense
  o Long-range strike regimes have been weighted toward offense
  o New sensors that eliminate stealth advantages and directed energy weapons might shift the balance back toward defense
    ▪ That could have an impact on strategies
• World now is relying on range, precision and stealth but that could change with new technologies
  o Systems that provide approximate parity in long-range strike capability
  o Capability to mass produce cheap, expendable swarms of unmanned systems
• Then the quantitative aspects of warfare will become more important
  o Unclear what impact that would have on legacy force structure
  o Would probably force the US to do things differently

**Relationship between technology, crisis stability and escalation dynamics**
How will these new technologies affect the action of actors during crises?
• Example: China recently sent a military drone toward the contested Senkaku Islands and Japan immediately scrambled F-15 jets
  ○ Both sides followed up with bellicose pronouncements
  ○ Worrisome for future relations in that region and elsewhere
• Bottom line: Other countries besides the US will start using these new systems and they may have very different ideas on the use of force and escalation

Human control over technology
• Although the Cold War tested some of these concepts, it is a growing concern
• New technologies compress the time that leaders have to make decisions
  ○ See this a lot in the cyber security world and expanding to other areas
  ○ Often discussion of perceived advantages of taking humans out of the decision-making loop
• Brimley wants to resist the notion that because things happen quickly that it is necessary to get humans to make choices quickly
  ○ Glad to see the DoD directive on autonomy from last year stating that there needs to be a human decision in any use of lethal force
  ○ Expect to see this as an issue over the next 5-10 years as new technologies come on line
• Recommendation: Develop series of scenario based table top exercises in which senior policy-makers go through the decision-making process involving these technologies
  ○ A lot of time was spent on such exercises in the Cold War about command and control and decision-making architecture
  ○ Coming to a period when need the same sort of effort for the national command authority to think through using new technologies

Recommendations
• Congress should assume an important role on the subject despite some objections
  ○ Congress needs to make sure, especially in the austere environment, that DoD keeps track of its S&T and R&D investments
    • Might even need a new formal or informal sub-committee structure to watch DoD’s spending on new technology development
  ○ Not just how much is being spent but how and whether there is a strategy to support the spending
  ○ Would be helpful for DoD to have something like the Congressional Military Reform efforts of the 1970s
• Ensure that there is some form of government-wide overview of the introduction of new technologies
  ○ Don’t want to build another IPC structure but it is important when bringing in commercial technologies to ensure that there is oversight of all players
  ○ Might need to be at the White House so all instruments of national power collaborate to track spending on all agencies’ R&D efforts
• Since so much of new technologies are coming from the commercial sector, it is important that public-private relationships and collaborations be encouraged
Next Deputy Secretary of Defense needs to do a focused look into how new technology is being affected by the current environment
  - Ensure that plausible upcoming technologies are aggressively inserted into proposed scenarios
Develop wargames in the Office Net Assessment or elsewhere that look at the impact of technology in general and on specific regional military competitions
  - Could include studies on technology and decision-making during crises
Chairman of the Joint Chiefs of Staff should be encouraging combat commanders and the services to find ways to leverage new technologies in exercises, experiments, etc.
The analytic and research community should have a role in considering how a 20YY situation will have an impact on
  - Strategy and force posture
  - How to build alliances especially in regions such as the Asia-Pacific
  - What theater warfare will look like (air dominance and sea control)
A lot being done in classified realm but more should be done at the unclassified level
Need to look at the impediments to transition to new technologies
  - Unmanned aircraft on carriers versus the future of manned aircraft
    - See story of X-47B with both positive and negative aspects
  - Some encouraging efforts going on to integrate a manned and unmanned mix
Need to look at legal issues given the complications of autonomous systems and ubiquitous unmanned surveillance

Final Thoughts
- The US military technical advantage is not an inherent right
  - Must constantly choose to retain dominance or superiority
- Disruptive technologies are constantly changing the security environment
- All branches of the government have roles to play
- R&D and S&T should not be the bill-payers
- Must identify the type of future that will dominate – long-range precision strike or the more likely world of ubiquitous advanced weapon systems
- Need to focus on connecting technology and policy-making
- Probably only have two-three years to make good decisions about strategy-driven investments so the US will be ready for the next big crisis

Topics for further discussion
- What sign posts will identify whether or not the US is on the right path?
- What capabilities are the crown jewels in the new environment?
- Which tribes in DoD understand how to leverage disruptive technologies and which ones don’t?
- What should we watch for in the QDR and FY2015 budget that indicate that OSD and the services are ready to move in this new environment and make hard choices?
- Which technologies will be the most disruptive?
How can the defense analysis community push DoD to adapt more rapidly to secure the future?
QUESTION AND ANSWER SESSION

Re: Using S&T as the bill-payer
Mr. Brimley is concerned that a strategic surprise could occur
- Given the Sequestration situation, this could be a readiness failure
- Concepts such as R&D, modernization, and readiness do not resonate beyond the national security community
  - Analysts from outside the government need to push harder on these topics
  - Recently Mr. Brimley and other “think-tank nerds” signed an open letter on the need to think about military compensation
    - Group included those from both the Right and Left
    - Had a big event on Capitol Hill to push this concept and something similar needs to be done with protecting S&T funding
- Bottom line: Expect more consideration of the concept of maintaining S&T spending in upcoming DoD efforts but need Congress to be involved

Re: Swarming, unmanned, other technologies facing non-American cultural norms
Future potential adversaries may not share American concerns about the use of these new technologies
- Such as the need for affirmative human decision-making in a crisis
- This has happened before – the submarine community was trained on how to operate in a denied communications environment
  - Sub commanders were given kill boxes
- Protected communications will be very important especially for the next five years or so as transition to more advanced technological systems
  - Important for service cultural and civilian control reasons
  - Will want to maintain ability to communicate with these systems
  - Once we get out to 2030-2040-2045, we will see a change over time
  - In the near term, strong communications connections will be needed

Re: Costs of personnel productivity
Looking at the work of Peter Singer at Brookings about the composition of the all-volunteer military in today's technological environment
- It may no longer make sense to have the same physical fitness standards across the whole force given:
  - The required skills of future soldiers using technology
  - The types of useful experience potential recruits have had while mostly sitting in front of PlayStations and X-Boxes
- Composition of the force will change over time especially in the next 10-15 years
  - The all-volunteer force will likely do more to differentiate required skills sets
- Must recognize that bureaucracies always have difficulties making changes
- In the near term the Army will need to think creatively about using the National Guard and Reserve
  - Will need to integrate these elements more in ways that the Army does not find comfortable
Many efficiencies and other positives could come from integrating the reserve components more completely
Could think of using reserve components in more of the high technology areas that the Army needs to expand into

**Re: Pushing the DoD bureaucracy to handle the new threats and technological needs**
- A lot will depend on the personality of the Secretary of Defense and the priorities chosen by future secretaries
- Optimistic that a lot of interest is already moving in that direction
  - Unclear whether there is enough interest to actually change the force structure
- Budget reductions will also force big changes in the overall structure – a silver lining
  - Service chiefs need to find a way to address issues such as the rising military health care and personnel costs
  - Those savings could be used to help fund the tech requirements
- There is already a lot of interest in doing something on Capitol Hill and among some DoD insiders
  - A lot could be accomplished if the right people worked together on this
  - A study of the Nunn-Cohen reforms that created SOCOM showed that there were only a few people involved
    - A couple of people from the Hill, some Special Forces veterans, some key DoD insiders, and a couple of think-tankers
    - The network was no more than 25 people but it had enough of all the right experience sets
    - Managed to create a structure to allow SOCOM to get through all sorts of bureaucratic restraints from various DoD cultures
    - SOCOM was then able to have its own funding program line item and go out and buy what it needed off the shelf
- Bottom line: With the right networking and the right long-term approach DoD can make progress
  - This is why the 20YY concept is useful
  - Need to have ways to talk about these changes so that they resonate beyond a Rethinking Seminar audience
  - Then can be ready to take on this more technologically stressing future or expect someone else to take advantage of it

**Re: What goes into the making of strategic choice**
- Looking at the problem tactically, there are a couple of major decisions that are coming up in the near term that will have major impacts on the far term
  - Future of the Global Hawk Block 30 versus the U-2
  - UCAS-D versus other options
  - Another 10-12 decisions that need to be made over the next couple of years that would lay down markers indicating which path DoD was going
  - Expect to see some mixed results along the way
• In the Asia-Pacific region consider how allies there reacting to US rebalancing such as
  o The military investments they are making
  o Japan’s consideration of changing its constitution
  o Bottom line: The US will need to be very actively focused on these changes
• Not really calling this RMA – a Revolution in Military Affairs
  o Technological advances are happening organically in ground combat theaters
    ▪ Unmanned systems and ISR architectures have profoundly changed situations for the Marines and Army
  o Bottom line: Need to select the best of these new technology lessons and extend them into other areas

Re: Responding to disruptive technologies quickly enough
DARPA is tasked with some of this response and they seem to be trying to make commercial cases for the systems that they are now developing
• As a “policy guy” Brimley can only call for some affirmative statements to get things done in this field
• Expect the next QDR to provide some high-level statements supporting such efforts
  o Language about the environment we are moving into
  o Affirmative statements about the role that the public sector plays in providing required technologies
  o Difference between the now and the Cold War – the commercial world is now “in” and the military-industrial complex is “out”
  o Such a document could then be used as a cudgel
    ▪ Provides SECDEF and staff maneuver room on Capitol Hill
• Probably will take a generation to fix the problem

Re: Human capital
China and India are investing a great deal on a national level to improve their human capital in S&T as a strategic choice
• How to respond is really a US national, not just a DoD question
• Certainly an issue that needs to be tracked
• May need something like the Cold War-era National Security scholarships or fellowships that included Russian language learning
  o It is unlikely that funding will be found in the Executive Branch given the current budget situation
• Bottom line: Will need some sort of a public-private coalition to support useful programs
  o Might be as simple as easy ways for people from the outside to gain government experience
    ▪ Allow best and brightest from Silicon Valley to do a year in the Pentagon or elsewhere and then return to their past organizations
  o Back in 2009 there were still lots of ways for academics and other outsiders to get useful DoD experience with counter-terrorism efforts
    ▪ That has dried up
Now only Presidential Management Fellowship program available and even those opportunities are drying up
Not just S&T – losing across all areas of human talent
  - Bottom line: The US will likely pay for this problem in the future

Re: Leveraging commercial-off-the-shelf technology
  - The SOCOM example cited above shows what can be done when the right kind of authority is given to an aggressive network for innovation
    - It is unlikely that the bureaucracy will do that sort of innovation on its own
    - Need to identify successful instances such as this and expand on them
  - A lot of this type of innovation took place in Iraq and Afghanistan
    - It is disconcerting that this type of innovation will get lost

Re: Cyber domain
One of the concepts that got into the 2010 QDR and has survived in the National Security Strategy (NSS) documents is the Global Commons
  - In DoD's war and contingency planning review process, cyber was not really considered organically – it was always an appendix
    - Question was finally asked: What would happen if we lost space capabilities for a day?
    - Finally started to think about the consequences and began integrating cyber into the plans
    - Shows how domains (air, sea, space, cyber, etc.) are treated very separately
  - Using the term Global Commons in the QDR and NSS should help press the concept of more closely integrating the various domains
  - Could think about cyber now as the equivalent of the thinking about airspace in the post-WWII period
    - Then countries developed international civil aviation rules and global common standards
  - Part of global commons concept in the Cold War was to restrain the Soviet Union
    - Started with the concept that the world needs to build and maintain a healthy international order
    - Such an order would have certain characteristics like open travel and robust economic activity – would be good for US national security
    - The secondary reason was the impact it would have on the Soviet Union with its very different approach to world order
  - Bottom line: US national interest in the cyber domain is intimately bound up with the broader international order
    - Can be seen much like maritime law
    - Gets more interesting with the rise of China and India
      - India has very different ideas about sovereignty and what constitutes the global commons
      - Expect to see the narrative change over the next 50 years as countries with different ideas rise