AIR SPACE CYBERSPACE

ON LEARNING: THE FUTURE OF AIR FORCE EDUCATION AND TRAINING

Air Education and Training Command

30 January 2008

AMERICA'S AIR FORCE

"Develop America's Airmen today... for tomorrow."

FOREWORD

To maintain our position as the world's most respected and feared Air Force, we must carefully consider the future. Technological change is accelerating. To accomplish the Air Force mission in an environment of accelerating change, we will need to recruit, train and educate Airmen with agile minds and cutting edge skills; Airmen able to counter future adversaries who seek out new technologies searching for an asymmetric warfighting advantage.

An additional future challenge will be to recruit the best and brightest young Americans to become the Airmen of the future. The young men and women who will lead our Air Force in the future have been living in a digital world their entire lives and are better prepared than any other generation to operate in this environment. It is imperative their needs and expectations inform our approach to education and training as we develop an enterprise-wide infrastructure that fosters learning and captures their most critical asset--knowledge. To become an agile organization comfortable with continuous change improvement, the greatest hope for the Air Force is to educate and train Airmen to be comfortable with continuous and collaborative learning.

This White Paper was written to articulate the concepts the Air Force must adopt to train and educate Airmen in the future. We expect to pay the greatest dividends in defining future concepts for learning. This White Paper sets out the concepts we must exploit if we are to meet these new challenges. It provides a roadmap to progress towards a strategic learning end state and serves to ensure we will always meet our vision and obligation of "Delivering unrivaled air, space, and cyberspace education and training."

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On Learning: The Future of Air Force Education and Training

Introduction

> ***"Man's flight through life is sustained by the power of his knowledge."***
> ***- Eagle and Fledgling Statue, United States Air Force Academy***

> ***"In Counter Insurgency Operations, the side that learns faster wins." - Nagle***

This White Paper presents concepts that are essential to meet the needs of the future Air Force and defines one approach to the future of education and training. Acknowledging dramatic world-wide changes in the future, these concepts provide the foundation for the Air Force to become a new learning organization – an organization referred to as Air Force 2.0. The three concepts integral to the vision for the future of education and training are:

1. **Knowledge Management**
2. **Continuous Learning**
3. **Precision Learning**

When co-evolved, these concepts, enabled by an integrated capabilities management system, will transform the Air Force into a learning organization of knowledge-enabled Airmen. In his White Paper, General Moseley states, "We must develop and field systems that are not just network-centric, but knowledge-centric." Airmen of the future will be able to share their gained knowledge with others, to collaborate, and to operate successfully in and dominate the domains of air, space, and cyberspace. If the Air Force of the 21st century is to be an agile, adaptive, learning organization, it must embrace change, accept risk, cope with reverses, and learn to reinvent itself – constantly. These concepts are discussed in greater detail in the Air Force 2.0 section.

This White Paper is intended to not only present concepts for accomplishing the mission, but also to suggest bold ideas that will challenge us to consider new approaches to learning.

Within the paper, the Introduction presents AETC's mission and vision, White Paper assumptions, imperatives and learning considerations used as a basis for development of the concepts. Next, The Future section addresses key planning considerations, to include future learners, knowledge content, technological change and geopolitical factors. The Air Force 2.0: The New Learning Organization section presents three concepts that will power future learning. Next, the MyBase: The Future Learning Environment section explores leveraging technology to create virtual worlds and immersive environments that can enhance current education and training. A Capabilities Management section discusses transforming Air Force learning management systems. Finally, the Recommendations and Conclusion sections provide a suggested way ahead for developing future education and training capabilities.

Mission and Vision

The mission of Air Education and Training Command (AETC) is to "Develop America's Airman today…for tomorrow." In support of this mission, AETC's vision is to "Deliver unrivaled air, space and cyberspace education

and training." In pursuit of these endeavors, AETC provides basic military training, initial and advanced technical training, flying training, and degree-granting professional military education.

The Airmen of tomorrow will have to be more creative and innovative and will require greater access to knowledge. In the newly released Chief of Staff White Paper entitled "The Nation's Guardians: America's 21st Century Air Force," Gen T. Michael Moseley states, "We must prepare our Airmen for a future fraught with challenges, fostering their intellectual curiosity and ability to learn, anticipate and adapt." To ensure future success, the Air Force must transform its existing education and training systems to build a future learning organization employing new learning concepts and leveraging new technology – an organization referred to as **Air Force 2.0.**

AETC's strategic intent is a commitment to support the Air Force, its leaders and Airmen in their development and lifelong learning needs. One aspect of this strategy for future Airman learning includes development of a virtual learning environment interface known as **MyBase**. MyBase provides a virtual, exploratory and interactive environment in support of continuous lifelong learning. The enablers for MyBase discussed in this paper include technological, informational, organizational, pedagogical, social, and related capabilities.

To succeed in its mission, the Air Force must enhance and add to its traditional live training as Airmen strive to develop the mission essential competencies necessary for future success. AETC will search for the right mix of live, virtual and constructive courseware delivery methods as the Command continually assesses and addresses the needs of the Air Force and transforms education and training to meet the Air Force mission to defend the nation and its interests in the global environment.

Assumptions

This White Paper is based on the following assumptions:

1. The Air Force will innovate and change its approach to education and training in order to effectively prepare future Airmen to perform successfully.

2. New approaches to education and training will account for how future Airmen learn, changes in technology, and the future environment in which Airmen operate.

3. Future enterprise-wide learning systems will access comprehensive, authoritative data and information and will be widely accessible, highly reliable, and robustly protected.

4. An integrated and systematic approach to improving the quality and delivery of the learning experience will focus and leverage current and future education and training initiatives.

5. To lead-turn adversary learning, the Air Force will be an early tester and adopter of new, innovative learning approaches and technologies or risk falling behind.

6. Knowledge-enabled Airmen will continue to be the key to flexibility and the Air Force's asymmetric military advantage in air, space and cyberspace.

Imperatives

The Air Force is responsible for educating and training over 700,000 military and civilian members. To ensure future Airmen are prepared to meet future challenges, the Air Force must transform how it educates and trains. To meet the vision of this paper, it is imperative the Air Force achieve the following:

1. A **common vision** for the future of education and training.

2. A **strategic implementation plan** to achieve the vision.

3. A **systematic approach** for inserting and integrating technology into education and training.

4. An **enterprise-wide architecture** for education and training.

5. An **investment strategy** for resourcing education and training transformation.

6. Closer **integration** of training and operations.

7. A **commitment to start now**.

The Air Force needs a **common vision** for the future of education and training supported at all levels. This vision and its details must be shared across the Air Force and used as the basis for transforming learning capabilities.

An initial parametric estimate of investments to support the vision is required and a **strategic implementation plan** must be developed to inform Air Force leadership on the future education and training needs of our Air Force.

The Air Force requires a **systematic approach** for inserting and integrating technology into education and training. A new approach must provide more diverse training delivery methods that are available to Airmen anywhere, anytime through a robust integration of technology. This plan should include the ability to react quickly and insert breakthrough technologies that have proven effective.

An **enterprise-wide architecture** for education and training is necessary to provide common standards and compliance for the communities within the Air Force and interoperability with DoD standards. Such an approach, guided by a Chief Learning Officer, is essential for success.

The Air Force needs an **investment strategy** for transforming education and training and developing the future capabilities required to deliver unrivaled learning. Focusing guidance through a common strategy will serve to move functional training across the Air Force in a common direction. This strategy must be closely aligned with Air Force Smart Operations 21 (AFSO21).

Future Air Force education and training efforts must strive for closer **integration** of training and operations to meet the needs of our operational Air Force. Knowledge must be available and learned when and where needed to support operations. The changing dynamics of warfare and the need for an increased pace of doctrinal and operational change will also require closer integration of training and education with lessons learned.

Finally, the Air Force needs to make a broad commitment to **start now**. This commitment needs to begin with a common understanding of the vision and endstate for training and education and be communicated across the Air Force and to the public. Starting now will ensure our personnel are provided the best education and training possible to meet the challenges of the 21st century. Delay is unacceptable and puts our air, space and cyberspace power at risk.

Learning Considerations

A widely accepted educational model, Bloom's Taxonomy defines three domains of learning – affective, psychomotor and cognitive. Air Force learning must account for each of these domains and ensure education and training that accounts for the emotional, physical, and mental aspects of learning.

The nature of Air Force education and training dictates live training in many venues and courses. However, the Air Force must undergo a major effort to astutely identify the right mix of live, virtual and constructive education and training. This mix should optimize content delivery and leverage the use of new technologies to supplement and, where appropriate, replace "hands on" training. However, certain aspects of military training cannot be performed virtually. Military training and its concomitant values training, involves the affective domain and often requires face-to-face training.

As the Air Force transitions to a more effective learning environment, it can never lose its ability to instill a warrior ethos in Airmen. To continue to accomplish this, a significant amount of training must remain in the live and physical realm.

This White Paper explores new concepts on how the Air Force will educate and train America's Airmen in 2008 and beyond as it changes focus from "education and training" to "learning." The Air Force should use the concepts presented in this paper to seize the initiative and gain cognitive speed and agility which will enable dominant operations in the warfighting domains of air, land, sea, space, and cyberspace. Air Force 2.0 embodies these concepts and the vision for the future Air Force as a learning organization.

The Future

"Let our advance worrying become advance thinking and planning."
– Winston Churchill.

The United States Air Force was born of innovation, driven by the need for a capability not yet existent – warfare waged, controlled, and won from the air. Just a few years before the Wright Brothers' successful powered flight, the scientific community held the belief that such an achievement would be decades in the future. Wilbur Wright himself admitted in 1908: "I confess that in 1901, I said to my brother Orville that man would not fly for fifty years." Powered flight did not just change minds, it made the world seem smaller and more closely knit. The introduction and exponential expansion of the Internet and its powerful knowledge search engines has tightened the weave considerably. The future of learning will be affected by shifting paradigms in the following four areas – learners, content, technology, and the geopolitical environment.

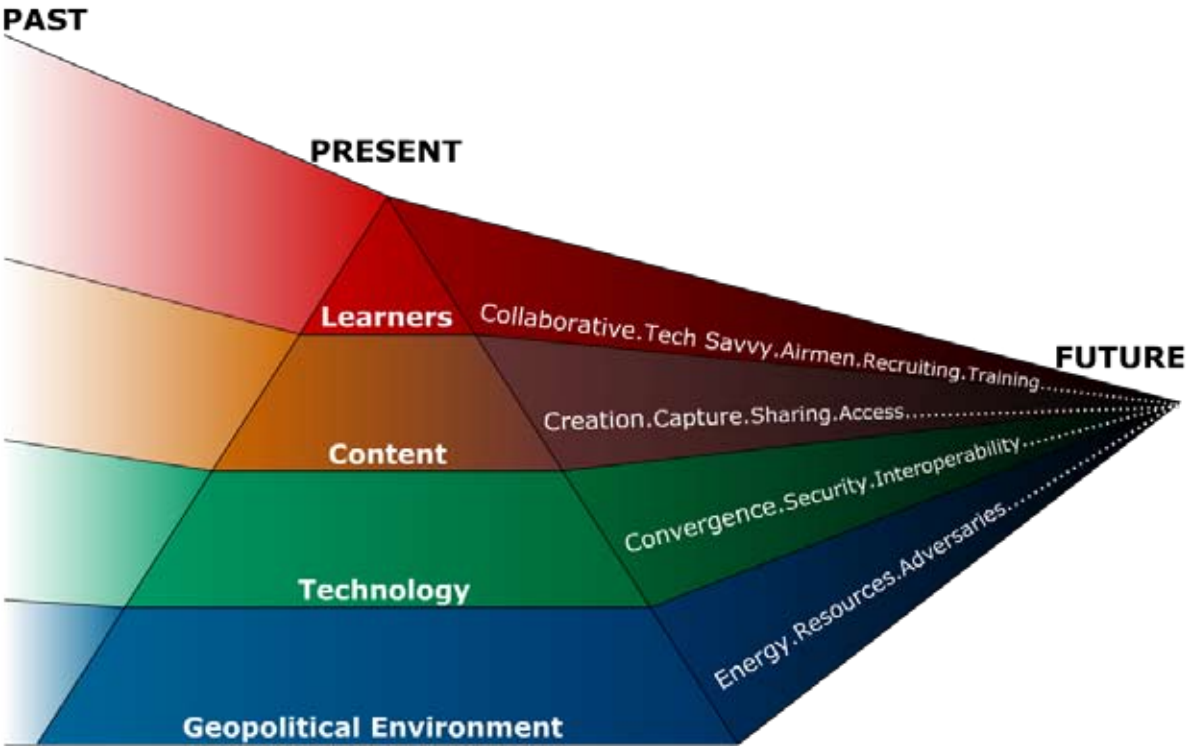


Figure 1. Changing Future Environment

Learners

Who are the Airmen of Air Force 2.0? The next 20 years will likely see a continued world population explosion: from 6.6 billion today to 8.2 billion by 2030. According to Mar Prensky's, *On the Horizon*, the ushering in of *The Millennial Generation*, will require a novel approach to how the Air Force recruits and develops its future Airmen. Who is the Millenial Generation and how do they compare to today's Airmen? Here is a description of generational differences.

Baby Boomer (Group I)

- Born from 1946 to 1954
- Key characteristics: experimental, individualism, free spirited, social cause oriented

Baby Boomer (Group II)

- Born from 1955 to 1964
- Key characteristics: less optimistic, distrust of government, general cynicism
- Digital Immigrants

Generation X

- Born from 1965 to 1979
- Key characteristics: quest for emotional security, independent, informality, entrepreneurial
- Digital Immigrants

Millenial (Generation Y)

- Born from 1980 to 2001
- Key characteristics: quest for physical security and safety, patriotism, heightened fears, acceptance of change, technically-savvy, environmental issues
- Digital Natives

The implications for recruitment, both of warriors and people to care for them, could be stark. Maintaining an all volunteer force means a greater competition for the skilled labor required to meet the Air Force's accession requirements. Currently only 27% of today's American youth qualify for Air Force duty – the latest data point on a long term declining trend line. To recruit from this small pool of eligible candidates, the Air Force must be able to understand the Millennial generation and provide a training and education infrastructure that leverages their life long exposure and aptitude with technology. As learning changes, so must our education and training approaches.

Content

Along with the exponentially expanding internet comes a corresponding explosion in the creation and accumulation of knowledge. This is a concern for militaries because of improved search capabilities and increased access to knowledge around the world. Throughout time there have always been advances in understanding, but today's pace of scientific breakthroughs dwarf previous generations. It has been said that the sum of all that is known doubles every seven years. Many believe this cycle of scientific advancement and its corresponding knowledge creation is accelerating with the increased access to existing knowledge by the addition of hundreds of millions of users to the internet.

The challenge of this content explosion for the Air Force is to keep pace. Militaries and governments directed and dominated technological research in the post-World War II era. Today, industry world-wide is creating new technology and internet users are leveraging information technology to collaborate and create knowledge at an ever increasing pace. This trend provides opportunities to leverage new knowledge while creating challenges to protect it.

As the Air Force pursues the concepts in this White Paper, it will need to ensure authoritative data is the norm. "Gatekeepers" will ensure the validity of data. The same gatekeepers will be responsible for inserting newly created knowledge into academic content as fast as possible. Air Force learning will have to keep pace with the knowledge explosion through rapid and continuous updates to courseware. Refresh rates for educational materials must decrease from rates currently measured in years to near-continuous.

To set the conditions for success, the Air Force will need to ensure increased transparency and access to all courseware by all Airmen. The Air Force will need a knowledge management system enabled by powerful search engines and a structured approach to organizing knowledge. Stated differently, the Air Force will need a way to organize, and ensure the greatest access to, the expanding knowledge of the Air Force. Recruits from the Millenial generation will require convenient and immediate access to knowledge. This expectation will be deeply ingrained long before entering the Air Force.

Technology

The pace of technological improvements will continue to accelerate. Exponential change will be the norm. Increases in computing power (quantum computers), graphics, and bandwidth will lead to advancements in visualization, modeling, simulation, and animation that are unimaginable today. While the Air Force is a leader in modeling and simulation, much work will be required to keep pace. Modeling and simulation is a key area where operations and training will need to be more closely integrated in the future. The concepts presented will enable this closer integration. Updating teaching skills will be as important as updating hardware. The need to update personal knowledge will be continuous and accelerating and increasingly rely on technology.

Collaboration tools will continue to improve and will be critical for communication and knowledge creation. Airmen must learn both the power and the techniques of wiki-style collaboration across a network of users, practitioners, scientists, teachers, and other unimagined information sources. When asked what they thought learning would look like in the future, Millennials envisioned teaching "pods" with holographic environments and direct bio-electronic interfaces to facilitate ultra-high speed information access.

Continued rapid advances in communication technology will further revolutionize how Airmen access and share knowledge. Computational power and bandwidth continue to grow exponentially. Web 2.0 tools such as blogs, podcasts, and wikis combine with the proliferation of smart phones, MP3 players, and other portable devices to expand the opportunities for accessing knowledge at the right place and time.

How will new technology enable the Air Force develop Airmen who are mentally flexible, agile, and capable of harnessing the intellectual capital of other Airmen? Are our established methods of training and educating adequate to maintain superiority with the accelerating pace of change? How do we educate and train a force of future warriors to out-think, out-maneuver, and out-fight numerically superior and intellectually equal future opponents, at a cost the country can afford to sustain? How will the military cope with this environment of accelerating change and the need for constant reinvention and continuous learning?

The Air Force will do this by recruiting and developing Airmen with agile minds, capable of leveraging Air Force knowledge to accomplish the mission. They will provide a hedge against the vagaries of an uncertain and rapidly changing future threat environment. The Air Force needs to dramatically improve its ability to operate in the cognitive domain and increasing the intellectual capital of Airmen will be critical to the effort.

Geopolitical Environment

The world is changing at an unprecedented and accelerating rate. We must invest today in order to secure the future advantage of our Forces to meet terrorist threats and adversarial expansion. Our adversaries are creative and adept at developing learning through the use of current and emerging technologies. The following trends provide a snapshot and context for understanding. These trends demand a sense of urgency to make critical choices and investments that transform Air Force learning to meet the mission requirements of the future Air Force.

Expanding world population and economic activity will inflate the costs of raw materials, energy, capital and skilled labor as these commodities increase in scarcity and value. Concomitant growth in mandatory Federal entitlement spending (for Social Security, Medicare, Medicaid and other programs) will further constrain discretionary spending on defense. These constant, parallel and interrelated competitions for available resources will compel continuous improvement in the effectiveness and efficiency of Air Force Education and Training – a quintessential application of AFSO21 processes and principles.

> *Хакер is a very dangerous man, he is unique - a cyber warrior trained in the art of military planning. Trained in the Soviet military as a young man, Хакер, which translates to "Hacker" in English, worked for three years, planning simultaneous physical and cyber attacks on a highly classified U.S. government site.*
>
> *- Vignette 3*

The sheer size of potential future adversaries is a concern for the U.S. military. When a population is measured in billions and their political will is unrestrained, it becomes possible to build an entire military establishment larger than the combined arms of the United States from the physical and intellectual top two-tenths of one percent of their population. They will have increased capacity to create, disseminate and apply knowledge.
The Chief of Staff's White Paper makes predictions about adversaries of the future, "Airpower's unprecedented lethality and effectiveness deter opponents from massing on the battlefield, driving them to adopt distributed and dispersed operations. They find maneuver space and sanctuary in dense urban areas, ungoverned hinterlands and loosely regulated information and social networks. These enemies pose a significant challenge to our freedom of action and threaten our interests at home and abroad."

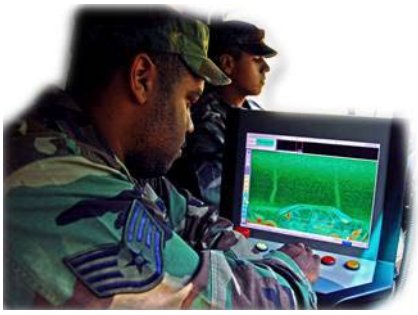
In this world of expanding knowledge access and cyberspace capabilities, adversaries are clearly Internet and technology empowered. Our adversaries have access to the same technologies we have and will continue to engage us across the spectrum of warfare. They will be knowledge-enabled through networks of "Digital Warriors" who are highly educated and capable of leveraging our open information architecture. They will make every attempt to capture or destroy our information networks and thereby our knowledge.

Our education and training must prepare Airmen to understand scenarios such as -- regional engagement, humanitarian operations, influence operations, counter-insurgencies, and conventional warfare from the perspective of our adversaries. We must be prepared to engage adversaries strategically as well as tactically. We must think globally and be prepared to counter adversaries in all of the warfighting domains. Questions to answer relative to our future adversaries include:

- How will adversaries be knowledge-enabled?
- How will they learn and how fast?
- What asymmetric opportunities will they leverage?
- How will the concepts presented here help prepare us for this future environment?
- How can we better defend our knowledge content and distribution?

Achieving and maintaining the capacity to seek, identify, track, target, and ultimately influence or neutralize adversary capabilities will require investments. It will take new weapon systems, the latest hardware and software, and more importantly, a new learning environment that teaches our Airmen critical thinking, creative problem solving and mission critical skills.

Air Force 2.0: The New Learning Organization



> ***We have all heard the phrase 'flexibility is the key to airpower.' I would like to add that Knowledge-Enabled Airmen are the key to flexibility.***
>
> ***- Michael W. Wynne, Secretary of the Air Force***

The future Air Force must successfully operate in and dominate not only the domains of air, space, and cyberspace, but the cognitive domain as well. To produce knowledge-enabled Airmen, learning will become more learner-centric and will focus on the continuous and life-long development of cognitive, affective and psychomotor knowledge and skills.

The cognitive domain exists in the human mind and involves information processing. As an example, strategic communication – the capability to inform and appropriately influence audience perceptions, decisions, and behavior – focuses on the cognitive domain. Influencing the will of an adversary requires highly skilled and creative thinking, coupled with synthesis and application of information in a timely manner. Following Bloom's Taxonomy, the Air Force will create learning experiences in which Airmen gain and apply knowledge, and then analyze their corresponding comprehension and synthesis of information.

The Air Force must focus its transformation efforts to achieve superiority in the cognitive domain. Successful operations in this and all warfighting domains require the adept leveraging of **knowledge management**, force development through **continuous learning**, and providing Airmen with the right skills and the knowledge to generate the right effect through **precision learning** delivery to prepare Airmen for the future. In the future environment, new Air Force learning capabilities management approaches will be required to capitalize on these concepts and leverage the new skills and abilities of knowledge-enabled Airmen

To achieve cognitive and learning superiority, the Air Force must develop a new learning organization culture. Learning will also focus on the affective domain by developing intellectual skills, knowledge, and attitudes that embrace the Air Force's warrior ethos and core values. Knowledge is power and learning is the means by which we put this knowledge in the hands of Airmen.

Figure 2: Future Learning

Knowledge Management:

Lt Maria Stringer was flying her avatar in the Air Force virtual world -- MyBase. She was concerned about some infor mation she just heard in a briefing by the A6 in HQ AF/Africa. She looked down at the Mentoring Center. Noticing the lights were on, she decided it was worth the time to see if "he" was in today.

- Vignette 3

Knowledge management is the end-to-end continuous process that describes the systematic creation, acquisition, integration, distribution, application and archiving of knowledge to drive behavior and actions which support organizational objectives and mission accomplishment. Knowledge management captures both existing and newly created information and knowledge, stores it in an enterprise knowledge base through which information can be distributed, shared and accessed by Airmen to support both learning when and where needed and the application of knowledge and skills to perform assigned tasks and solve problems.

An enterprise-wide knowledge base provides access to content that is the foundation for all training and education. A dynamic knowledge repository managed by subject matter experts and knowledge gatekeepers can ensure current and authoritative data is available whenever and wherever needed to support training, education and operations. Rapid access to knowledge at the right place, at the right time, and in the right format is also critical to future operations. The key elements of collaboration, coordination, and communication are essential to effective knowledge management.

Airmen need to be more creative and innovative to solve tomorrow's problems. Access to a dynamic knowledge base will provide closer integration between training and operations. Greater value will be placed on knowledge creation, acquisition, capture, and archiving so that knowledge can be rapidly disseminated and applied. Knowledge management systems will make information universally available. Collaboration tools will enhance information aggregation and speed up "connecting the dots." Social networking and emerging computing applications will permit development of countless communities of practice that support collaboration and the development of expert knowledge.

Embracing knowledge management and becoming a learning organization requires a culture change across the Air Force. The Air Force's knowledge management system will be revolutionary, leveraging existing efforts and rapid technological advancements. It will enable a greater convergence of operations and training. Not only will we train the way we fight, but we'll fight the way we train using the same knowledge databases, networks, and technologies.

With development of the af.edu domain, the Air Force has a unique opportunity to leverage new technologies to advance the knowledge management concept. In addition to the .mil domain, af.edu will serve as a potential platform for the delivery of services supporting future learning systems and the distribution and application of knowledge. It will also provide a unique and more flexible yet secure learning domain separate from the rigid security and procedural requirements of the .mil domain.

Instructors and course developers must keep in mind entire student training pipelines and how they can be optimized. Instructors are an integral part of the learning environment and will be called upon to continuously improve the process. In each effort, information technology can be used to strengthen the learner's experience and increase the learner's access to information, knowledge, and lessons learned. All Airmen will be knowledge content creators, producing content using course development tools, and consumers of knowledge who take advantage of courses, programs, and expert systems.

The Air Force's drive to master the cognitive domain and institute knowledge management begins with becoming a learning organization and instituting a culture of learning. Critical resourcing decisions and cost benefit analyses must be made to ensure sound investments keep the Air Force at the leading edge of meeting its worldwide commitments. To become an agile organization comfortable with continuous improvement and change, the greatest hope for the Air Force is to educate and train Airmen comfortable with continuous and collaborative learning. The skills required for future Airmen to succeed necessitate a transformational shift from *education and training* to a focus on *learning and the learner*.

Continuous Learning:

At any time of night or day, Airmen could enter MyBase and choose from an extensive list of speeches being given by America's leaders, take part in academics at any Air Force or civilian college, or meet and speak with participating senior mentors. The learning opportunities seemed endless yet continued to expand.

- Vignette 2

Highly skilled and educated Airmen are essential to Air Force success. The key to personal and organizational growth in the Air Force, and development of valued Airmen capable of dealing with complex missions operating in air, space, and cyberspace is continuous learning.

Continuous learning focuses on the development of Airmen from before accession through retirement or separation and beyond. This concept is consistent with the Continuum of Learning and views Airman learning as a continuous and life-long process of training, education, and experiential learning that has as its outcome the development of Airmen who can individually recognize the right skills, knowledge, and aptitude they need to accomplish assigned tasks and missions.

A systematic and holistic approach is necessary to provide the right education, training and experiences at the right time, to enable this outcome. Learning is life-long and can be driven by either Air Force requirements (operational or force development) or individual learner needs and desires. Formal and informal learning can be tailored to each Airman and delivered through precision learning means when, where and how required.
Basic principles embodied in continuous learning include:

- Recruit the best and brightest candidates who can learn and operate in the future Air Force
- Offer effects-based learning opportunities based on learning objectives and outcomes. These opportunities must be provided continuously to the Airman – before, during, and after service
- Provide career-long progression through deliberate education, training, and experiential opportunities to enable Airmen to reach their full potential
- Present learning opportunities on demand – the right information at the right time – and assess its effectiveness in achieving the defined learning outcomes
- Provide a push and pull system to make learning opportunities available when and where appropriate to enable a sustainable military advantage
- Leverage operational competence and tactical expertise through timely education, training, and experience
- Development supported by leaders who internalize and visibly espouse the vision, values, climate, motivation and behaviors that constitute the new learning environment

Training, education, and experiential learning power continuous learning. Whether through formal or informal methods, the Air Force must use these means to develop the appropriate combination of specialists and generalists to meet mission requirements. Developing uninterrupted access to Air Force knowledge for all Airmen will be the final ingredient to effective continuous learning.

Airmen have a great heritage and are well known for their desire to continuously improve and their ability to continuously find a better way to accomplish the mission. Continuous learning requires a systematic approach to putting the most current tactics, techniques, and procedures based on lessons learned rapidly into the hands of learning Airmen. A collaborative environment that shares best practices, innovations, lessons learned, and other learning opportunities for a shared vision will be needed.

Future Airmen will develop multi-disciplinary skills and become "multi-specialists." Airmen will perform a wider range of functions, enabled by new technologies, new learning paradigms, and robust knowledge management systems. Technical skills may now be acquired and maintained through various media. Core technical skills will be available on demand through a distributed network. As most technical skills are perishable, the virtual and constructive environments offer a good opportunity for Airmen to reduce skill decay, keep skills current, and remain informed of the latest technological changes and developments in the field.

Critical thinking and problem solving skills epitomize the need for continuous learning. No longer will critical thinking education be reserved solely for senior Air Force leaders. Advances in scenario-based virtual learning and decision simulation will mature and refine the learner's innate talents and experiential skill sets, as well as give the learner an appreciation for the limits of software, hardware, and "brainware."

One of the most challenging skills to develop is leadership at the tactical, operational, and strategic levels. Successful application of human judgment to orchestrate mission success requires much more than force of personality. In the future, it will require a greater ability to multi-task, prioritize subordinate actions, and assimilate vast amounts of information while fostering collaboration. Some leadership scenarios must be executed in an atmosphere of maximum situational awareness, while others may impose an information-limited setting. Application of modern leadership will necessitate new methods in the way we train and educate current and future leaders.

All education and training programs, including advanced operational training and Professional Military Education (PME), will adapt to the needs, skills, and learning proclivities of Generation Y - the Millenials. According to Mark Prensky, Millenials are considered Digital Natives because they:

> *"...are all 'native speakers' of the digital language of computers, video games and the Internet. Those of us who were not born into the digital world but have, at some later point in our lives, become fascinated by and adopted many or most aspects of the new technology are Digital Immigrants. Digital Natives are used to receiving information really fast. They like to parallel process and multi-task. They prefer their graphics before their text rather than the opposite. They prefer random access (like hypertext). They function best when networked. They thrive on instant gratification and frequent rewards. They prefer games to 'serious' work."*

To address these needs, courseware that is interactive and multi-media enhanced will be available through a next generation distributed learning system that will offer live, virtual, and constructive scenarios for development of all Airmen. These capabilities will enhance the decision-making, communication, and negotiation skills that are critical for senior leadership. Distance learning will evolve from basic enrollment in computer and web-based courses to virtual learning environments that support online collaboration and classes taught by both live and virtual instructors.

The underpinning of effective skill development is applying learning resources judiciously, adaptively, and continuously. Students, subject matter, and courseware must be matched carefully. Flexible courseware can quickly adapt to mission and situational changes. Learning is a continuous process with contiguous and intersecting elements. Success or failure depends not only on the composition of these elements, but also on their careful orchestration. Arranging these elements to achieve the exact learning needed at the exact moment needed to achieve the optimum effect defines the concept of Precision Learning.

Precision Learning:

His newly uniformed avatar initially issued at BMT was now bearing his proud Airman stripes and participating virtually in his maintenance career field technical training course. After a brief duty stop at Sheppard AFB to learn the basics of Air Force maintenance, Jay was officially enrolled virtually in a class with countless other young airmen from all parts of the globe in the F-35 virtual training program.

- Vignette 1

Precision learning delivers the appropriate education, training, or experience at the right time and place, in the right format, to generate the right effect. Precision learning relies on customized learning, mass collaboration, push and pull learning systems, distributed learning opportunities, increased use of simulated and virtual technology, and enhanced use of visualization technologies. It focuses learning on the learner.

Precision learning provides an enterprise-wide approach for how, when and where Airmen learn. Learning is customized to learner needs and abilities and delivered across a spectrum of live, virtual and constructive means using a variety of multi-media tools and modes. Learning is tailored to learners through live, person-to-person

engagement, or by leveraging technology to deliver knowledge when, where and how needed. Learning is learner-centric and relies on social and professional networks to enable collaboration.

From their first day in the Air Force, Airmen will have unprecedented access to knowledge delivered via the internet to hand-held, mobile devices and organized by advanced knowledge management systems. In technical or basic training scenarios, instructional delivery systems will be designed and built as networks that allow users to proceed at the fastest pace that fits their specific learning ability. Instructional systems will allow students to increase the utility of the network by adding information and ideas that can be utilized by instructors. Reverse mentorship may become possible and real-time changes to tactics, techniques, and procedures will become both necessary and commonplace.

Learning will be tailored in format, time, media, and frequency for each individual Airman. Precision learning has the potential to enrich the learning experience and increase effectiveness while reducing the cost of instruction and increasing efficiency. Provided in interactive modular and short-course formats, Airmen will fit learning sessions into their daily work routines.

Each Airman will receive customized training which may allow moving at the Airman's own pace while maintaining standards. Airmen should receive incentives for working harder and learning faster. Precision learning will tailor courses and instructional delivery systems to adjust course material flow to learners while continuously assessing progress and performance. Open courseware and knowledge management systems will give Airmen access to training courses and educational material when and where required.

Just last week, he participated in a fascinating virtual lecture where historically famous airpower theorists like Billy Mitchell and Sir John Slessor, presented as life-like avatars, explained their ideas. Capt Wilson was amazed that Billy Mitchell's avatar spoke with the same agitated and contentious personality that no doubt made him the infamous maverick of his day.

- Vignette 2

The delivery of training and education must be flexible and permit schedule, delivery, and media formats tailored to individual needs. Courses will combine live, virtual and constructive formats even while being distributed to increase training effectiveness and as well as shift to more cost-effective methods.

Precision learning will deliver customized course material based on each student's ability to learn. Students will enter the Air Force having completed high school and potentially some college courses with increased knowledge and understanding of the Air Force and its culture. Upon entry, most Airmen will be comfortable with and expect the scheduling options, variety of media, and knowledge sources provided through precision learning.

Precision learning will offer a variety of delivery formats such as text, video, audio, interactive courseware, and virtual environments. A new generation Learning Management System (LMS), to meet learner needs and with shareable content objects, will be part of the infrastructure to support precision learning in a secure environment. Assessing individual learning styles will give students the ability to select the best options that will optimize their learning experience. Knowing that certain students learn more effectively by themselves and others in group settings, instructors can develop course delivery options that include providing solitary, group, or virtual group learning opportunities. A systematic approach will be created and evolve to the point where an Airman's learning performance is tracked throughout his or her career with optimal delivery methods identified.

Jay's avatar recruiter cordially introduced himself and immediately complimented him on his impressive high school accomplishments, as his virtual transcripts and resume were readily accessible via his primary social networking account. Within minutes, he was offered at least three guaranteed career fields for which he qualified, complete with available base locations and associated signing bonuses.

- Vignette 1

Precision learners will increasingly access knowledge networks and expert systems to strengthen learning experiences while raising the quality of their knowledge, skills, and ability to accomplish assigned tasks and missions. Precision learning will incorporate network power into the instructional and knowledge delivery system, empowering students in training and operations. Increased learning efficiency and greater power in the hands of Airmen will harness information technology and the intellectual capital of all Airmen, especially subject matter experts.

Precision learning and knowledge management training will teach Airmen to contribute to networks that utilize this intellectual capital. Our future ability to mass fires may come not only from massing sorties but also from massing intellectual capital.

Precision learning relevance translates to Airmen learning skills and having access to cross-functional, interdisciplinary information and knowledge to help them succeed in their mission. Relevance also implies that available information remains current and prioritized so students understand what they need to know, when they need to know it, and where to find it. The ability students possess to accelerate through course material will drive the increased flexibility of precision learning capabilities.

Considering future Airmen and the increasing need to continuously learn throughout a career, Air Force training and education will evolve into a "life cycle" process of learning. Precision learning, like precision weaponry, will become a force multiplier. The application of precision learning capabilities will contribute to optimize learning and enable Airmen to quickly gain the knowledge and skills necessary to operate in the future Air Force. The effectiveness of such a complex learning system requires a significantly greater capability to effectively and systematically manage future training and education delivery.

MyBase: The Future Learning Environment

Jay remembered being awed immediately after entering MyBase, seeing the avatar guard wave him on after a quick check of his IP address credentials. After passing through the visitor's entrance, he found the options endless as he flew his visitor issued avatar around the base.

- Vignette 1

To succeed in its mission, the Air Force must enhance its traditional live training of Airmen. While getting the mix of live, virtual, and constructive delivery methods right is essential, the Air Force must move forward quickly in the development of new virtual and constructive simulation capabilities by leveraging both existing and emerging technology. One such development is the use of virtual worlds and immersive environments to facilitate learning. One possible solution is MyBase, a virtual, exploratory and interactive environment and architecture that supports both continuous and precision learning.

MyBase is a virtual learning environment designed to enhance Air Force recruiting, training, education, and operations. It provides the means for Airmen to rapidly access the knowledge they need to make effective decisions and perform assigned tasks. Designed as a virtual Air Force Base, MyBase can be tailored to recruit the Millennial generation, inform the public, deliver precision learning, provide pre-deployment training or even conduct operational rehearsals.

As a presentation layer, MyBase provides a portal for access to Air Force advanced distributed learning systems, knowledge management systems, communities of practice, and knowledge bases. As depicted in the attached vignettes, MyBase environments will span three separate venues – public, education and training, and operations. MyBase will provide Airmen the means to rapidly and effectively access the knowledge they need.

The MyBase virtual environment will enable the convergence of training courses, educational programs, expert systems, distance learning, communities of practice, distributed mission operations, and other means of sharing, distributing, and applying knowledge to enable the Air Force to become a superior learning organization.

Unlike the two-dimensional environment of the AF Portal and current computer-based training, MyBase provides a virtual three-dimensional world populated with Avatars. With Avatars issued at Basic Military Training and MyBase connected to personnel and learning management systems, Avatars can be updated with new rank upon promotion and an Airman's records can be updated upon completion of education or training courses.

Through an Avatar, Airmen will be afforded opportunities to participate in live, virtual and constructive learning opportunities in online classrooms, receive mentoring or personnel services, attend PME, participate in meetings, access knowledge bases, or collaborate on projects. Upon leaving the Air Force, some Airmen may even remain as valued mentors in the MyBase learning environment.

Using haptic technology, Airmen will be able to manipulate virtual objects and add the sense of touch to the visual cues obtained in virtual environments. From maintenance to medicine to fire fighting and flying, education and training experiences will be enhanced through multi-media and multi-sensory inputs. Virtual training will supplement, or in some cases replace, live skills training when either cognitive or psychomotor

MyBase represents the capabilities that will power greater capability for our Air Force to be an agile and adaptive learning organization. Our future Airmen are comfortable with these technologies and they will enjoy learning and working in these environments. Due to the sophisticated social networking websites in operation today, our newest Airmen will be extremely comfortable networking, collaborating, and learning through MyBase. Through MyBase, these interactions will be possible from any location around the world at any time of night or day.

Precision learning will be best delivered across the Air Force through an integrated, enterprise-wide platform with a common, standardized architecture. This architecture must integrate virtual environments with knowledge bases and learning management systems such as the Defense Integrated Military Human Resource System – Enterprise Learning Management (DIMHRS-ELM), Advanced Distributed Learning System (ADLS), and Technical Training Management System (TTMS). The MyBase environment will also enable a convergence of training courses, educational programs, expert systems and unlock the power of distance learning, communities of practice, and every other means of sharing, distributing, and applying knowledge to empower and enable Airmen to learn and to create an advanced learning organization.

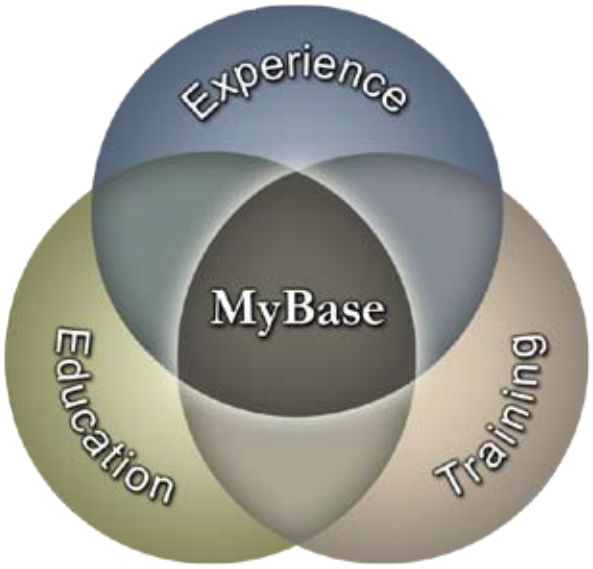


Figure 3: The Future Learning Environment

Capabilities Management:

The systematic management of Air Force education and training capabilities across the entire enterprise is vital to a learning organization. With current systems and procedures effective at producing and developing the world's finest Airmen, the Air Force must transform the management of education and training capabilities. Changes must be implemented consistently and systematically across the Air Force. Management systems and capabilities must extend from recruiting to beyond separation.

The front-end selection of tomorrow's Airmen is critical. Competition for the most qualified young men and women will be intense, especially considering current trends and the fact that 27% of those between the ages of 18 and 24 are even eligible for military service. Competitors for this limited pool of qualified candidates include academia, industry, federal and state agencies, and the other military services.

Air Force systems must support the assessment and selection of the best and brightest to serve as future Airmen. Precise identification of viable recruits using advanced aptitude and skill assessment tools will ensure optimal selection and career field assignment and learning management systems will "push learning to the left." The Airmen of Air Force 2.0 will supply the versatility and agility needed to increase Air Force combat capability in an era of smaller force levels and constrained financial resources to sustain them.

Management of technical training pipelines will change as Airmen complete courses at different times due to the increased opportunities to proficiency advance. Precision learning will enable more efficient training pipelines and require new approaches to managing student flow. Learning management systems will need to effectively administer all aspects of life-long learning and the tracking of all education, training, and experiential learning.

Figure 4: Managing Future Learning

Learning systems must have the capability to manage the development and currency of modular courses, track course content and multi-media objects, flexibly adjust and manage student throughput, and effectively manage training capacity. These systems will help reduce duplicate courseware, eliminate excess capacity, and increase content refresh rates. To accomplish these objectives, it will be necessary to develop and implement an advanced learning management system capable of handling a highly dynamic learning environment. Effective capabilities management is vital to the successful implementation of knowledge management, continuous learning, and precision learning and delivering unrivaled education and training.

Recommendations:

We can achieve this vision. The Air Force must systematically implement these new collaborative efforts into a hierarchical military organization with a strictly defined chain of command and a doctrine of centralized control and decentralized execution. Pursuing this vision requires the Air Force to implement these concepts thoughtfully, methodically, and comprehensively.

To achieve this vision, the Air Force should take the following actions:

- *Strategic Implementation Plan:* Develop a plan to implement the learning concepts described in this paper across the Air Force. Include a strategy, objectives, technologies, capabilities, resource requirements, and milestones.
- *Strategic Communication:* Inform Air Force leadership, Airmen, industry and other key audiences so they embrace this learning concept as a common vision for the future of education and training. Communicate this concept to share understanding among key internal and external audiences and generate support.
- *Functional Area Analysis (FAA):* Conduct an FAA to determine the capabilities required to develop and operate a learning organization using the proposed concepts.
- *Chief Learning Officer (CLO):* Designate an appropriate senior leader to function as the Air Force CLO to lead its transformation to a learning organization. The CLO will be responsible for establishing AF-wide policy and guidance for transforming all education and training.
- *Knowledge Base:* Establish a shared, authoritative and transparent knowledge repository for learning. Adopt an "open courseware" approach to migrate education and training course materials into multi-media and distributed learning formats. Make formal and informal courseware and learning materials available to all Airmen when and where needed.
- *Knowledge Management:* Initiate a formal enterprise-wide knowledge management program that focuses on capturing expert knowledge (recent and career-long); distributing knowledge for education, training and operations; and supporting both continuous and precision learning concepts. This system should provide the foundation for knowledge-enabled Airmen and learning organizations to successfully accomplish assigned tasks and missions.
- *Knowledge Transparency:* Aggressively implement the tenets of the Air Force's Information and Data Management Strategy to achieve the goal of making all learning information available to all authorized users immediately on demand from anywhere.
- *Key Technologies:* Determine which technologies are essential to the implementation of these concepts and the achievement of this learning vision. Enlist the Air Force Research Laboratories (AFRL) and academia to identify key enabling technologies and establish Science and Technology Objectives in the out years. Leverage commercial capabilities to bring these technologies from basic or advanced research to full operational capabilities.
- *Systematic Application of Technology:* Develop an enterprise-wide systematic and integrated process throughout the lifecycle (with emphasis on quick look assessments) for identifying, developing and applying technologies in the learning environment. Evaluate the effectiveness of each learning technology and rapidly transition it to operational capability.
- *Resource Learning Technologies:* Infuse funding and authorize a program for learning research and development, and accelerate the insertion of technologies into training and education programs to support development of a learning organization, knowledge management capabilities and implementation of this concept. Resource Future Learning Systems, the follow-on program to the current Education and Training Technology Application Program (ETTAP), and develop a next generation Advanced Distributed Learning System.

- *MyBase Virtual Air Force Base (vAFB):* Establish and resource a program to create MyBase in support of recruiting, training and educating. Assess the feasibility of developing a "family" of bases (public, training, and operational bases) to facilitate precision learning opportunities for a variety of audiences at various security levels.

- *Cyberspace Pilot Project:* Initiate a project with a series of demonstrations to transform an existing cyberspace course using cutting edge technology into distributed learning course that embodies this concept. Cyberspace education and training provides an ideal launch platform for developing new learning environments and applying new technologies for education and training.

- *Develop af.edu:* Establish and develop the af.edu domain to serve as a potential platform for the delivery of services supporting future learning systems.

- *Concept Studies:* Conduct fast track studies and reports done by Air War College, Air Command and Staff College, the Air Force Institute of Technology, and other organizations and individuals to further refine and explore these concepts and associated capability requirements. Of primary importance are studies that focus on the proper application of a spectrum of media to enhance learning and appropriate use of live, virtual, and constructive environments.

- *Learning Experiments:* Develop tests of various combinations of live, virtual, and constructive training approaches to evaluate optimal mixes of technologies, organizations, and learning concepts. Evaluate the best and right mix of live, virtual and constructive training environments.

- *Force Development:* Integrate these training and education concepts into force development programs, policies, and processes to include the Continuum of Learning. Provide guidance consistent with this concept that informs functional proponents on education and training requirements and methodologies.

- *Requirements and Acquisition Processes:* Integrate this training and education concept into the current and future development of military capabilities and ensure "learning" is a key component and consideration in all acquisition efforts. Acquisition programs should ensure digital product information is obtained to facilitate reproduction and use of objects in virtual environments and in knowledge bases. Take measures to assure that learning methodologies and technologies acquired through such programs are compatible and interoperable with the emerging infrastructure and capabilities of Air Force 2.0.

- *Change Management:* Institute an effective change management program to facilitate the rapid implementation of these learning concepts across the Air Force. Focus efforts to support an Air Force culture change that embraces these learning concepts leading to a high performance learning organization.

- *Right-size Capacity:* Assess Air Force education and training capabilities to ensure steady-state delivery of required throughput and appropriate surge capacity while divesting excess capacities. Increase throughput by shifting to on-line, distributed courses.

- *Evaluation and Assessment:* Continually assess the concepts and create and implement methods to measure learning effectiveness. Update projections and assumptions on an annual basis.

With the right attitude, organizational focus, investment strategy, and policies, the Air Force can start on the road toward enhanced operations in the cognitive domain. The Air Force must start now with comprehensive efforts to embrace these concepts and build our future – Air Force 2.0.

Conclusion:

This White Paper was written to generate a body of thought on the future of education and training and to focus our minds on impeding issues for the Air Force. The paper attempts to educate readers on how we must transform our approach to learning, not only to exploit the unique qualities of today's new recruits, but to ultimately enhance warfighting capability to meet the threats of the future.

Throughout the Air Force, pockets of excellence exist that are speeding toward the inclusion of new technologies to leverage virtual and constructive training environments. However, until the Air Force fully incorporates a systematic approach to technology insertion, such efforts will be isolated and lack the potential synergy that will be achieved through an enterprise-wide solution.

Unfortunately, time is not on our side. We are faced with a global and Information Technology savvy adversary. Demographics point to a reduced recruiting base. We must act now to put in place an infrastructure to recruit, train, educate and retain Airmen to fly, fight and win in the future Air Force.

The Air Force must leverage knowledge management to seize the initiative in the cognitive domain. It is the force multiplier for keeping the competitive advantage in air, space, and cyberspace. Vital is a shift from education and training to a singular focus on learning and knowledge application. Success requires a common vision and support across the Air Force. Investments in this vision are critical to make it a reality. While this White Paper has focused on the Air Force, these concepts apply across the Department of Defense and should include our sister services and foreign partners into an all encompassing learning environment. A Department of Defense that embraces knowledge management, continuous learning, and precision learning is essential.

From its inception, the United States Air Force has relied on innovative brilliance of visionary pioneers, coupled with resourceful practical knowledge, skills, and hard work of every line Airman, to meld new concepts and equipment into capabilities that ultimately triumphed. This must remain constant amidst the massive change facing us now and in the foreseeable future. Our past goals included breaking the speed of sound barrier. Now we must break the barrier of change.

A true learning organization, ceaselessly focused on process improvement, minimizing waste, stressing innovation with successful employment of new technologies, and teaching its people to think critically yet creatively, is what the Air Force must become to continue to fulfill its role as the Nation's farthest reaching and fastest acting defender – its "sword and shield."

We must begin now to make those key investments in learning capabilities and processes that will enable tomorrow's Airmen to effectively deal with any adversary or challenge and preserve in these Airmen their decisive will to win. The faster we commit to achieving this vision, the sooner we can begin to ***"Develop America's Airmen Today … for Tomorrow."***

> *"This White Paper was collaboratively developed using wiki software.*
> *The drive to build Air Force 2.0 has begun!"*

Attachments:

Attachment A: Vignette 1- MyBase Public

The memories of just a few months ago were as vivid as yesterday. On that unforgettable late night, Jay found himself once again sleepless and tapping away at his laptop. As easy as high school had seemed to him, having recently graduated in the top 20% of his highly accredited school, what to do next haunted him. As he was surfing away curiosity got the better of him and he finally clicked on that one link that seemed to appear and reappear endlessly – MyBase: *The United States Air Force Virtual World.* The nation was abuzz with the recent terrorist attack, and Jay, filled with a sense of patriotism, made the fateful click that would forever change his life.

Jay recalled how his confusion had turned to clarity that night. He needed direction, and at 5 AM what could be the harm in at least looking? He remembered being awed immediately after entering MyBase, seeing the avatar guard wave him on after a quick check of his IP address credentials. After passing through the visitor's entrance, he found the options endless as he flew his visitor issued avatar around the base. The overlaying navigational aides directed him to countless areas, to include the latest flight simulator at this virtual AFB. Another option was to visit the potential new recruit orientation room that provided personalized presentations on the various missions awaiting those who chose to enlist, as well as the well-publicized signing and educational benefits.

There was also the *War Room*, where visitors played the highly popular *Air Force Warrior* interactive game. In the simulation, the visiting avatar was given a sequence of missions to accomplish, starting off by executing combat basic skills in defense of the base and culminating with flying an F-22 mission against a hostile enemy attack. The game awarded the player with a virtual rank promotion and updated uniform after completing each mission. The game allowed individuals to have fun while being exposed to a myriad of Air Force missions as it sent Air Force recruiters initial information regarding the aptitude and skills of potential recruits. After fiddling around with the game and completing an in-flight refueling mission, Jay, now a virtual Captain, found himself transfixed on the one building he had not yet entered in MyBase , a simple building in the middle of the virtual base broadcasting a blue lit neon sign that carried with it the weight of a thousand decisions: ***"WARRIORS ENLIST HERE!"***

Jay recalled the surreal feeling that filled him after flying to the building, opening the door, and being immediately met by his avatar recruiter, TSgt Brian Mills. Sgt Mills cordially introduced himself and immediately complimented Jay on his impressive high school accomplishments, as his virtual transcripts and resume were readily accessible via his primary social networking account. Within minutes, Sgt Mills was showing Jay at least three guaranteed career fields for which he qualified, complete with available base locations and associated signing bonuses. Sgt Mills even granted him a guest pass to teleport to any virtual MyBase. Even though Jay would be excluded from the operational areas that were reserved for active duty avatars, he could still fly around and see the base facilities first hand.

In a stroke of fate, Sgt Mills revealed one of the guaranteed fields for which Jay qualified – *Aircraft Maintenance*. Jay had two passions – cars and planes. He loved the challenge found in repairing old vehicles, especially the kind that ran on standard petrol gasoline. The idea that he could follow this passion and work on the most advanced super fighters in the world was humbling. He knew from reading various blog discussions that selection for a career in aircraft maintenance was an honor, as those slots seemed to be reserved for the best and brightest of the new recruits.

After another hour of Q&A with Sgt Mills and a consultation with his parents, Jay decided on the spot to enlist. Following a simple digital signature and sworn oath to defend the Constitution, conveniently done via his high definition webcam in his living room with his proud parents serving as witnesses, he was officially a new Airman recruit.

Before his formal basic military training could begin, TSgt Mills laid out the list of required pre-accession training Jay would have to accomplish prior to arriving at Lackland AFB. TSgt Mills granted Jay access to numerous additional classrooms on the public MyBase to accomplish this training. He was even able to take the qualifying exams virtually using the intelligent tutoring and proctoring system. Passing the exams was the final requirement prior to joining the Air Force. In the end, the Air Force got not only a higher quality recruit, but Jay started his newfound career with nearly 20 college credit hours under his belt.

That was several months ago, and after attending live training in what turned out to be a physically challenging Basic Military Training (BMT) Course, Jay once again found himself in the realm of MyBase. This time he was accessing the site from the dorm of his new permanent assignment at Hill AFB, Utah. His newly uniformed avatar initially issued at BMT was now bearing his proud Airman stripes and participating virtually in his maintenance career field technical training course. After a brief duty stop at Sheppard AFB to learn the basics of Air Force maintenance, Jay was officially enrolled virtually in a class with countless other young airmen from all parts of the globe in the F-35 virtual training program. The program was run by mentors graphically displayed as instructional avatars in the virtual environment, available 24 hours a day, 365 days a year.

Reflecting on his Air Force career so far, Jay realized just how much he enjoyed the time he spent in MyBase. It was a virtual environment like many others where he had spent a great deal of time as a teenager and with which he was very comfortable. He looked forward to the day very soon when he could visit a virtual expeditionary base to prepare for his first Air Expedition Force (AEF) deployment. He was amazed how far along he had come in just a short amount of time and looked forward to all the opportunities to contribute to this new learning environment that awaited him.

Attachment B: Vignette 2- MyBase Education and Training

It was 2000L hours, and Capt Wilson was heading back to his apartment, relieved to finally be done with the duty day. Unfortunately, instead of spending his evening relaxing with his TV, tonight had a more significant activity – virtual Squadron Officer School (vSOS). After enrolling just a few months prior, he was excited to have already passed the halfway mark – he would even admit, if only to himself, that he was actually learning a lot. As a career logistician, he found it refreshing to interactive with other officers and learn about the operational side of the Air Force through virtual SOS.

As he arrived at his apartment, he connected to MyBase on his personal computer using his Government to Personal Computer Interface Device (GPCID) to see what courses were on the agenda for him that week. The GPCID allowed him to effectively and safely conduct duty day activities at home without risk of viruses infecting his home system or corruption to DoD networks.

Overall, Capt Wilson was pleasantly surprised with his vSOS experience. With less heavy emphasis on classic academics than a civilian university, the program focused more on collaborative team efforts and practical exercises. Even the included classic academics kept his interest active. Just last week, he participated in a fascinating virtual lecture where historically famous airpower theorists like Billy Mitchell and Sir John Slessor, presented as life-like avatars, explained their ideas. Capt Wilson was amazed that Billy Mitchell's avatar spoke with the same agitated and contentious personality that no doubt made him the infamous maverick of his day.

What also impressed Capt Wilson about vSOS was the collaborative participation of sister service and civilian academic institutions. A few days prior, during his lunch hour at work, he finished a course elective by attending a guest lecture at The University of Texas virtual lecture hall. He sat in a virtual room hosted by UT's collaborative education center featuring a panel of officers from all three major military educational institutions – Army War College, Air War College, and the Naval Post Graduate School. The civilian educational participation not only gave a wider variety to the courses, but they also provided much broader level of accreditation. Upon completing vSOS, Capt Wilson will have already amassed 10 hours towards his Master's degree, without having to leave base.

Capt Wilson connected his virtual headset and gloves to his computer and teleported his avatar into the seminar room. Today's lesson was of particular excitement: Combined Arms Offensive in a non-contiguous battlefield. The seminar leader announced to the group the assignments for the exercise. Capt Wilson smiled, he would be playing the role of an Army M1A2 platoon officer. Not only was he transcending operational roles of his own service, today he actually got to be part of Big Green and experience the virtual reality of land component combat.

Capt Wilson's avatar, temporarily wearing Army BDUs, 'climbed' into his virtual M1A2 Abrams; he knew the intent of the lesson was to expose him to the other side of air-to-ground coordination. The mission was to establish a forward arming and refueling point (FARP) at Objective Bravo, 30 km to the east of the existing forward line of troops (FLOT). The virtual tank that Capt Wilson was driving was the lead element of a battalion size unit. Participating in the exercise with him were three other students – an actual armor captain from Fort Riley, Kansas, who was assigned the role of the E-10 multi-command and control platform weapons director; a naval surface officer from Norfolk, Virginia, who was assigned the role of the F-35 joint strike fighter providing Close Air Support; and an F-22 Air Force pilot who was playing the role of the division headquarters.

Not long into the scenario, Capt Wilson's computer display erupted in a shower of small-arms fire and rocket propelled grenades coming from west of his position. As his vehicle auto-drove to escape the fire while simultaneously adjusting the turret to conduct counter fire, a dialog box appeared prompting him to make his first radio call. He remembered from his readings that the M1A2 could withstand this level of firepower, but the same could not be said for the poor dismounts that were just a kilometer behind. He gave a spot report to division headquarters while simultaneously requesting close air support (CAS) from the airborne air support operations center on the E-10.

Within seconds, the learner who was playing the role of the E-10 weapons director was looking through a myriad of air support options. It was clear to him, given the high risk of fratricide that the best choice for CAS on this day would be the F-35. Shortly afterward, the E-10 player communicated his decision. Capt Wilson and his fellow players conducted an online strike briefing, discussing everything from all known friendly positions and anticipated enemy location and disposition to the best type of armament to use. After a few keystrokes, the virtual F-35 pilot was overhead and communicating with the Joint Terminal Air Controller, as played by the F-22 pilot. Executing perfect protocol, they coordinated a successful strike on the target. Minutes later, Capt Wilson's headset blared the sweet sounds of afterburning JP-8.

Almost like magic, the enemy fire stopped, the system alerted them of their collaborative success, and all avatars were transported back to the virtual classroom for the exercise debrief. After a short five minute recess, a debrief of the exercise was conducted and documented. The role-reversals for each of the four participants provided excellent insight opportunities for the other participants. After downloading his performance and block credit onto his GPCID for backup and reference, Capt Wilson relaxed. The scenario and results were also automatically loaded into the knowledge management archive and immediately available to other learners across the Air Force and joint community. His personal performance and grade would also be automatically forwarded to his online mentor.

With a successful mission behind him, he and the other learners spent a little under fifteen minutes at one of the chat rooms in MyBase, showing off a bit for potential recruits. Their entrance drew a flurry of questions, and chatting for just those few minutes provided the active MyBase chat proctor with half a dozen curious new potential recruits. Capt Wilson's day was finally over.

Attachment C: Vignette 3- MyBase Operational

> *Хакер is a very dangerous man, he is unique - a cyber warrior trained in the art of military planning. Trained in the Soviet military as a young man, Хакер, which translates to "Hacker" in English, worked for three years, planning simultaneous physical and cyber attacks on a highly classified U.S. government site.*
>
> *As Хакер would personally launch cyber attacks on critical infrastructure supporting the base, the terrorist cell he trained would attack from outside the security fences at the well guarded site. His plan was simple and deadly and if he was successful millions of Americans would die…*

Lt Maria Stringer was flying her avatar in the Air Force virtual world - MyBase. She was concerned about some information she just heard in a briefing by the A6 in HQ AF/Africa. She looked down at the Mentoring Center. Noticing the lights were on, she decided it was worth the time to see if "he" was in today. Lt Stringer had a specific mentor in mind. Landing in front of the door, she thought through what she wanted to say, he was a retired general officer after all.

After waiting for her pulse to slow down, she walked to the door and pushed it open. A host avatar, generated by the system, met her at the door. After it welcomed her, she asked which mentors were available. The avatar looked sideways and a screen appeared along its line of sight.

USAFA – GEN JENSEN, GEN FARRADY,
GEN MICHAELS, GEN CHILDRESS,
GEN LAWMEN, GEN CANYON,
CMSGT ANDREWS

WEST POINT – GEN MCALLEN,
GEN FREDRICKS

NWC – GEN PATTERSON,
ADM PENNINGTON

YES! Gen Canyon was the senior mentor Lt Stringer had been trying to catch in MyBase. At any time of night or day, Airmen could enter MyBase and choose from an extensive list of speeches being given by America's leaders, take part in academics at any Air Force or civilian college, or meet and speak with participating senior mentors. The learning opportunities seemed endless yet continued to expand. Just yesterday she had listened to an amazing presentation given by the Secretary of State speaking at the Air War College. Before she walked to Gen Canyon's avatar, she had to ask the host avatar one question, *"Who was Gen Farrady?"*

Instantaneously the avatar flashed up a biography and a running film of Gen Farrady's Air Force career. *"Impressive, I'll read up on him later."* The host avatar nodded, and added the biography to Lt Stringer's reading list.

Lt Stringer was thankful that so many of the senior Air Force leaders agreed to stay involved with the Air Force by mentoring Airmen in MyBase. Gen Canyon was considered the most influential AFCYBER commander in 20 years.

As she approached his avatar she wondered how much older he might look in person, contrasted with his avatar. He had been retired for a long time, but the habits instilled by decades of physical training were hard to lose.

After short introductions, her avatar spoke. *"Sir, I am concerned about some intelligence we received from one of the "unfriendly" countries in our AOR. It seems that a former Russian hacker has been tracked with known terrorists. My boss believes this is very bad news. However, we have been safe in MyBase since we developed Quantum computers. Should we be at a higher alert over a small time computer hacker using techniques that are 15 years old?"*

The General's avatar smiled and flashed up his response. *"AAH…excellent question, Lt Stringer. I listened to a report on critical infrastructure from the Department of Homeland Defense yesterday, it is so nice to keep informed from my home office, but I digress…"*

The General explained that the DHS briefer indicated that local infrastructure around critical sites such as water treatment plants may be vulnerable due to shrinking state and local budgets leading to slower upgrades to infrastructure systems.

"But sir, how can shutting down a water plant for a few hours hurt a critical site?" Her avatar shifted from one foot to the other and back while she waited for the General to answer. She hoped he didn't notice her avatar had been programmed to show her impatience when people were slow in MyBase.

The General's avatar leaned so far forward that she could only see his eyes on her laptop. *"If I drove my truck along the side of most bases, outside the fence, and lobbed fire bombs over the fence on to older wooden buildings, how would you stop the fire? How would you keep it from spreading? What could be let loose?"*

Lt Stringer knew she had focused too narrowly on the potential of the problem…she thanked Gen Canyon and stepped away. Several other Airmen had formed a line to speak to the General. She knew that she needed to move quickly…

> *Before delivering the execute command, Хакер turned to his client, "Watch the screen as I make history."*
>
> *" Execute!" His screen showed several vertical columns of numbers spreading across the screen. "In minutes they will burn and they will be unable to stop the fires..." The physical attacks by his terrorist cells would render the real long-term damage. He smiled thinking the attacks he planned were not appreciably different than those of the crusaders hundreds of years prior.*
>
> *Something did not feel right. Instinctively he turned to his monitor and saw it turn black. Horrified, he could not look away. Then the computer housed inside his screen exploded. Хакер realized that his plan had failed and he had no idea how the U.S. had reacted so fast, before he achieved his hard-earned moment of glory.*

Attachment D: Glossary

Avator: A graphical image of a user, such as used in graphical real-time chat applications, or, a graphical personification of a computer or a computer process, intended to make the computing or network environment a more friendly place.

Chief Learning Officer (CLO): The senior individual in the Air Force charged with managing the learning processes for developing the strategic human capital to support mission and force development requirements. The CLO delivers enterprise-wide education and training support by developing programs that capitalize on state-of-art and need learning strategies, creates a culture of program- and individual-based continuous learning, integrates training functions, and measures their impact on mission performance. The CLO is to learning what the CFO is to finance. Source: The Glossary of the American Society for Training and Development (http://www.learningcircuits.org).

Cognitive Domain: A grouping of levels of learning each defined by different cognitive abilities associated with mental activity. These levels are identified in *Bloom's Taxonomy of the Cognitive Domain*. Levels span *knowledge* (recall of material), *comprehension* (understanding communication of material), *application* (application of principle to concrete situation), *analysis* (break down material into constituent elements), *synthesis* (put together elements to form a whole) and *evaluation* (assess value of material for a given purpose). Full proficiency of a subject encompasses all levels. Today's information technology and societal change require Airman competency in higher order thinking skills.

Communities of Practice: The concept of a community of practice (often abbreviated as CoP) refers to the process of social learning that occurs when people who have a common interest in some subject or problem collaborate over an extended period to share ideas, find solutions, and build innovations. It refers as well to the stable group that is formed from such regular interactions. More recently, Communities of Practice have become associated with knowledge management as people have begun to see them as ways of developing social capital, nurturing new knowledge, stimulating innovation, or sharing existing tacit knowledge within an organization. Source: Wikipedia

Continuous Learning: The ability to teach Airmen to learn to how to learn. Specifically, approaching Airman learning as a continuous and life-long process of training, education, and experiential learning that has as its outcome the development of Airmen who can individually recognize the right skills, knowledge, and aptitude they need to accomplish assigned tasks and missions.

Continuum of Learning: Continuum of Learning links Education, Training and Experience through an Airman's career to produce the right person at the right place and time to achieve AF missions. The Air Force Continuum of Learning (CoL) is designed to deliberately integrate developmental opportunities through a common taxonomy to produce adaptable, knowledge-enabled Airmen for today and tomorrow. (AF/A1)

Critical Thinking: The intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation, experience, reflection, reasoning, or communication, as a guide to belief and action. Source: The Critical Thinking Community

Customized academics refer to a student's ability to accelerate through one section and slow down on another to ensure the greatest comprehension and synthesis of course material. A systematic approach for introducing new technologies into the learning environment will ensure all courses in all functional areas fit into an enterprise-wide learning architecture.

Distributed Learning: A method of instruction that relies primarily on indirect communication between students and teachers, including internet or other electronic-based delivery, teleconferencing or correspondence. Source: Wikipedia (http://en.wikipedia.org/wiki/Distributed_learning).

Education: Mastery of the cognitive abilities underpinning each level of learning in the cognitive domain (see above) to solve a wide range of problems. Education encompasses, and can be accelerated by, but is not defined by training (see below). Source: Moore, John W. *J. Chem. Educ.* 1998 75 135.

Expert System: also known as a knowledge-based system. A computer program that contains the knowledge and analytical skills of one or more human experts, related to a specific subject. Source: Wikipedia

Knowledge: Facts, information, and skills accumulated through education, training, and/or experience.

Knowledge Management: Knowledge management is the end-to-end continuous process that describes the systematic creation, acquisition, integration, distribution, application and archiving of knowledge to drive behavior and actions which support organizational objectives and mission accomplishment.

Learning: The cognitive process of acquiring knowledge, skills, and/or developing the full range of cognitive skills through study, instruction, or experience that results in adaptive habits of thought and action.

Learning Organization: An organization that imparts information, knowledge, and learning processes to members who then become effective continuous learners (see above). A learning organization itself continuously learns from its organizational experiences and makes changes to increase innovation, effectiveness, and performance.

Live, Virtual & Constructive (LVC) Training: The three mediums that training and education can be delivered. Live training exists in the physical environment – real people using real equipment. Live Training is the conventional Air Force delivery method which will never be replaced completely. Operations in the air, space and cyberspace mediums will always require a nominal level of live training regardless of the advancement and insertion of new technologies. **Virtual training** is accomplished with man-in-the-loop interaction in a virtual environment. Virtual education and training includes the use of computer-generated Avators controlled by learners and instructors. An example of a virtual learning environment is the Second Life virtual world. Government agencies are already migrating content into Second Life. **Constructive training** is characterized by the use of computer generated entities such as models, game-type simulations and computer based trainers. It allows for interactive training down to the squadron level in an unconstrained exercise environment. LVC education and training is best utilized when properly mixed amongst the three mediums.

Precision Learning: Delivering in a short, compressed period the appropriate education, training, or experience at the right time, in the right format, to generate the right learning effect.

Training: Imparting high proficiency in a specific skill. Training is not the same activity as education (see above).

Virtual Learning Environment: A software system designed to help teachers by facilitating the management of educational courses for their students, especially by helping instructors and learners with course administration. Source: Wikipedia

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