Technology Insertion Process: Determining Task Deficiencies and Matching to Effective Technologies

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Summary

No other time in history have we seen as much readily available technology for training warfighters as we see today. There is an abundance of training technology in almost every warfighter domain. However, the challenge still remains as to how best to use this technology, and in particular, what tasks can benefit the most from insertion of technology into the training environment. The Air Force Research Laboratory (AFRL) in Mesa, Arizona recently made substantial progress toward this challenge by identifying how simulation technologies could be used to enhance flying within the U.S. Air Force, Air Education and Training Command (AETC). Researchers from AFRL developed a technology insertion process that included instructor pilot workshops, visits to flying training bases, training task definitions, assessment of current simulators, surveys to assess critical training tasks, and a Quality Function Deployment (QFD) to prioritize training technologies. The workshops were a critical component of the technology insertion process as they helped us identify the training requirements and tasks for several aircraft training courses including the T-6, T-38, T-1A, AT-38B, T-38C, F-15, and F-16. After the instructor pilots validated the task requirements, AFRL launched an internet-based survey to over 700 instructor pilots across the U.S. Air Force. The survey was designed to collect ratings on task difficulty, syllabus time allocation, how often tasks contribute to busted check rides, proficiency of graduates, and the adequacy of current simulation devices. This data identified the more critical training needs and formed the basis of an index for weighting the criteria in the subsequent QFD. QFD workshop participants included former and current instructor pilots, researchers, and engineers who have had exposure to updated training technologies. Participants in the QFD workshop assessed how useful 27 different advanced simulation technologies would be for training each task. The priority weights from the survey were then used as multipliers for each technology score to yield total weighted scores for each technology and a prioritized rank ordering of those technologies. This analytic process yielded valuable information to aid leaders in making decisions about technology investment. In this paper, we focus on the technology insertion process and how this process can be used to prioritize advanced simulation technology in a flying training environment.

1.0 Backround

In the last few years, rapid advances in simulation technology have provided more capability, especially in the areas of visual systems, networking, and realistic databases. However, a great deal of the current simulation training technology in the United States Air Force (USAF) has not been updated to take advantage of efficiencies offered by some of these newer technologies.

Paper presented at the RTO HFM Symposium on "Advanced Technologies for Military Training", held Genoa, Italy13 – 15 October 2003, and published in RTO-MP-HFM-101.

Report Documentation Page

Form Approved
OMB No. 0704-0188

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE **00 APR 2004**	2. REPORT TYPE **N/A**	3. DATES COVERED **-**

4. TITLE AND SUBTITLE **Technology Insertion Process: Determining Task Deficiencies and Matching to Effective Technologies**	5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Air Force Research Laboratory Warfighter Training Research Division 6030 South Kent Street Mesa AZ 85212**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES
See also ADM001667, NATO RTO-MP-HFM-101 Advanced Technologies for Military Training (Technologies avancées pour lentraînement militaire)., The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**UU**	**12**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

In November 2001, the USAF Air Education and Training Command (AETC) asked the Air Force Research Laboratory (AFRL) to assess the current state of flying training in AETC and to identify and analyze opportunities where advanced simulation technologies could be used to increase the efficiency and effectiveness of AETC flying training programs. The Command's motivation for the study stemmed from a desire to build a simulation technology integration roadmap that will guide the development and enhancement of flying training. The results of the study will assist modernization planners in the development of a technology integration roadmap that will identify the plan for insertion of those technologies with the greatest potential to assist in the capability to train, rehearse, refine, and remediate tasks in a safe, effective instructional simulation environment.

Systematically gathering data on training needs allowed for the prioritization of advanced training technologies to be implemented across AETC. This effort provided a first look at potential targets of modern and high fidelity training technology insertion in AETC Specialized Undergraduate Pilot Training (SUPT), Introduction to Fighter Fundamentals (IFF), and fighter Flying Training Units (FTUs). These training system enhancements could help AETC by:

- Reducing the number of busted check-rides, student wash-backs, and student wash-outs
- Training students to a higher level of proficiency than current course outputs
- Ultimately producing pilots that are more combat mission ready due to a higher level of mastery across a greater number of skills, tasks, and competencies

This study provided quantitative and qualitative survey data from the targeted IP populations, onsite evaluations of all ground-based simulator systems flown in AETC, and technology utility assessment scores from current instructor pilots. Scientists, engineers, and subject-matter experts from AFRL have made recommendations on technology applications based on analysis of the data and knowledge of the current state of the art for the various technologies being considered.

2.0 Evaluations of Current Simulators

One of the critical aspects of this study was an evaluation of the current simulation technologies being used at operational training sites. Scientists and engineers from AFRL visited six different training bases that have representative simulators for specialized undergraduate pilot training (SUPT), Euro-NATO Joint Jet Pilot Training (ENJJPT), and fighter aircraft flying training units (FTUs). The six bases visited allowed the research team to assess all the different training devices being used for the aircraft included in the study.

The objective of the simulator site visits was to evaluate the current state-of-the art for the simulators in AETC. The evaluation team constructed two evaluation tools to use in the evaluation. The first was a mission profile list called *AETC Simulator Evaluation Procedures*. This list contained the major mission areas the simulator operator would need to present during the evaluation mission such as takeoff, landing, night operations, and formation flying. This mission profile list was given to the technician or instructor operating the console. The second document was a simulator characteristic and technical performance checklist called the *Simulator Technology Assessment Questionnaire*. When filled out, it contained the physical description of the simulator system and the performance data observed, measured, or gathered by interview, during the pre-flight, mission flight, and post-mission debrief.

While a sizeable segment of the fleet of simulation devices in AETC is old by many standards, the architecture on which most of them are based (VME or PC) makes them potential candidates for upgrades that could be fairly easily integrated into existing training systems, thereby significantly reducing the cost to rebuild the devices. The technology throughout the fleet ranged from high fidelity cockpits with no visuals of any kind to trainers with full field-of-regard visual systems.

2.1 On-site Evaluation Procedures

Each simulator was evaluated using the same set of mission profiles and the performance evaluation checklist. The mission profile checklist given to the console operator is shown in Table 1. A brief explanation of the targeted evaluation is included.

Table 1. AETC Simulator Evaluation Procedures

AETC Simulator Evaluation Procedures	
Procedure	**Description**
1. Day VFR takeoff	During this phase, the ground environment was evaluated for scene fidelity, brightness, density, realism, and cultural features.
2. Pitch-out and landing and touch and go	Immediately following takeoff, the simulator was maneuvered for line-up on initial at pattern altitude and a pitchout to a touch-and-go was accomplished if the system had a visual. In those cases where the visual was of limited field-of-view, the downwind was flown to a radial and DME to begin the base to final turn in order to see if it was remotely possible, in a student environment, to use the simulator for transition training. This pass was also used to evaluate the richness of the database at the home field.
3. Climb to altitude and descend to low altitude for texture and scene evaluation	Following the touch and go, the simulator was zoomed to altitudes above 20,000 feet MSL. At altitude, the database was assessed for range ring settings, distance to the horizon, texture pattern interference, anti-aliasing, scene “popping”, and level of fidelity, in general. Following this initial look, the aircraft was dived towards the ground to a very low level to check the performance of the image generator and the effects, if any, of resolution changes in the out-the-window scene during the descent.
4. Low altitude flying for system performance evaluation	At very low altitudes, the simulator was placed in maximum power and flown across the database to assess the performance of the visual system with regards to frame rate effects, loss of frame rate, ability to judge height, and the effects of high angular rate aileron rolls over the terrain, in general, and over the home station airfield with cultural features (3D) in the scene.
5. While low altitude test collision detection with terrain and features	Following the low altitude assessments in step 4 above, the simulator was descended into the ground to determine if collision detection was present. In most implementations when a collision with the ground occurs, the simulator should halt permanently or in temporary freeze state releasable by the IP. In higher fidelity simulations, these same characteristics should be present when colliding with cultural (3D) models attached to the terrain surface of the database. It should be noted that collision detection is also a feature that can be selected or de-selected, depending on the training objectives of the mission.
6. Rejoin with other target(s) if capable	If the simulator was capable of generating another target in flight, it was then inserted on the fly. If the system was not capable of doing this, the system was reinitialized with the second aircraft in the scenario. The target was then located visually or using available sensors and rejoined using the standard turning rejoin procedures or straight-ahead rejoins if the target could not easily be turned. The purpose of this phase was to evaluate the visual image for resolution, the effects of frame rate, the fidelity of the aircraft models, and the ability of the host and image generator systems to produce a stable, non-jittering target when close aboard.
7. Evaluate occulting visually	This task was intended to assess the whether or not another aircraft would

and in avionics, if applicable	disappear from sight visually when flying behind another cultural feature such as a building or behind a terrain feature such as a mountain or ridge line. In addition, if the simulator being evaluated had radar, the same test was to be accomplished in order to determine if the other aircraft would “disappear” electronically from the sensor being used to detect it. Due to the wide range of fidelity throughout the “fleet”, the lack of the ability to easily maneuver computer generated entities in most of the AETC simulators, and the lack of networked targets to control in real-time, this area was assessed mainly by interviewing onsite or technical support center personnel.
8. Fly close formation with another aircraft, if able	Since most current systems have a reasonably high transport delay (time from stick input to measurable state change) and the flight aerodynamic model may not be exactly like the aircraft, this phase was not used to formally evaluate the ability of the simulator system to fly close formation. However, once aboard, the evaluator did fly in formation for a short period of time to assess other performance characteristics and to judge whether or not the system had the potential to operate in either a close, route, or extended trail formation environment.
9. Night approach	Upon completion of the day VFR tasks in Steps 1-8 above, the simulation was reconfigured on the fly or reinitialized to a night time environment. The first step was to evaluate the database fidelity, in general. That is, were there any visual clues to identify the ground environment, first, away from home field and, second, at the home field or primary night approach airfield? The evaluation also looked at the night sky to determine if any special features such as clouds and stars were present or available. Prior to leaving the night environment, a visual and an instrument approach were flown to the home field or practice instrument approach airfield. If the visual approach went well (no evaluator error), the instrument approach was accomplished with weather effects. The fidelity of the airfield environment in a night scene was also noted.
10. Experience special effects	If the simulation was capable, any special effects such as airburst, sun glint, lightning flashes, and missile smoke trails were implemented and evaluated. Most of the systems evaluated either had limited special effects available or none at all.
11. Air refuel, if capable	While no system in AETC had a fully operational air-to-air refueling simulation to include an articulated tanker boom, this portion of the evaluation consisted of rejoining on a tanker model, if available, or another aircraft such as the T-1, to observe the degree to which this phase of training could be simulated. Tanker (or other aircraft) fidelity and stability were two of the key parameters assessed.
12. Weather effects, if capable	During some point in the evaluation mission, a wide range of weather effects, as available, were instantiated and evaluated. This included general scene content when simply flying VFR, the ability to invoke cloud layers, the physical nature of the cloud layers (did they have thickness for example), the appearance of the weather effect, and the degree of simulation of fog and low visibility situations. To the best of our knowledge, no simulation system evaluated had the ability to present a physics-based environment where the weather phenomena simulated anything beyond just the visual effects. It should be noted at this point, however, that we know of NO real-time simulation used for training or research that does present a totally physics-based representation of the synthetic natural environment.
13. Full stop landing	After completion of the steps above, to the degree possible based on time available and system capability, the mission was terminated with a day VFR straight-in, full-stop landing. One last look was given to the airfield

	environment, the aerodynamic response of the host simulation system in the landing configuration, and the ability to land in the proper touch down zone and aero brake, if appropriate.
14. Discuss Instructor Operator Station	During mission execution, one of the AFRL evaluators was positioned at the instructor operator station (IOS) to observe and discuss the capabilities and ease of use of the IOS. Any further information needed by the flight evaluator was gathered by interview and demonstration following the simulator flight.
15. Discussions with contractors and users	Before leaving a site, an attempt was made to gather any technical data not easily available from discussion and gather any useful information pertinent to the technical characteristics or performance of those systems being evaluated. Where IPs (contractor or USAF) and/or students were available, the system just flown was discussed with them.

The *Simulator Technology Assessment Questionnaire* was used to gather the physical and performance characteristics of each AETC simulation system. The information collection was grouped into seven separate categories: System Identification, Visual Display System, Image Generator/Databases, Typical Problem Areas observed During Flight, Adequacy/Capability for Training Characteristics, Cockpit, and Instructor Operator Station. The physical characteristics were usually a fill-in-the-blank answer and included items like image-generator frame rates and display brightness. The performance data collected during an evaluation flight were answered with a simple "yes" or "no" assessment and looked for the existence of performance characteristics like double imaging or anti-aliasing.

The information collected on current training system architectures, features, capabilities, and performance characteristics helped the researchers determine an appropriate list of candidate technologies to be considered and evaluated by IPs later in the study.

3.0 Instructor Pilot Task Survey

The entire analysis of the study hinged on developing a comprehensive understanding of the current state of training in AETC and identification of the greatest training challenges or shortfalls. To gain this insight, the researchers constructed task surveys for each of the flying training courses in order to assess the current training programs and how well the existing training device technologies were meeting their needs.

Current instructor pilot (IP) involvement was essential for creating task surveys that were valid and understandable to each of the instructor populations. To help the researchers identify the appropriate flying tasks to use on the surveys as well as develop appropriate survey items, the researchers conducted a three-day workshop with current IPs from each of the different aircraft training courses being analyzed in this study. Table 2 summarizes the instructor qualifications and experience levels.

Table 2. IP Experience at Survey Development Workshop

Aircraft	Training Course	Base	Primary Aircraft	Military Flight Hours
T-6	SUPT	Moody AFB	B-52	4150
T-1	SUPT	Vance AFB	KC-135	2500
	SUPT	Laughlin AFB	C-5	2800
T-38A	SUPT	Columbus AFB	FAIP	600
	SUPT	Vance AFB	F-16	1100
	ENJJPT	Sheppard AFB	F-15	2500

AT-38B	IFF	Sheppard AFB	A-10	4216
T-38C	IFF (Pilot and WSO)	Moody AFB	F-15E	1200
F-15	B-Course	Tyndall	F-15	1100
	B-Course	Mesa Research Site (Retired F-15 pilot / IP)	F-15	3400
F-16	B-Course	Luke AFB	F-16	2300
	B-Course	Luke AFB	F-16	3400
	FAC-A, MANTIRN, NVG	Luke AFB	F-16	2600
			Average Hours	2451

After the survey development workshop, AFRL used its Internet-based survey tools to host the surveys on the Internet. The workshop IPs then had a chance to review and test the on-line version. To further ensure survey clarity, usability, and thoroughness the researchers traveled to various training bases to field-test the survey with small samples (at least two IPs) from each of the targeted survey populations. As a result of the field-testing, the wording of three of the questions and scales were clarified and the task lists for three aircraft were slightly modified.

Table 3 summarizes the final version of the five questions and rating scales that were used on the surveys for all of the different aircraft training courses included in this study.

Table 3. Task Survey Rating Scales

Question	Scale
1. How difficult is it for students to learn this task?	1 = Not difficult 2 3 = Difficult 4 5 = Extremely Difficult
2. How adequate is the amount of time currently allocated in the syllabus for the training of this task?	1 = Not enough 2 3 = Adequate 4 5 = Too much
3. How frequently does this task contribute to busted rides?	1 = Rarely 2 3 = Occasionally 4 5 = Frequently
4. How well trained are typical graduates of your course on this task?	1 = Barely proficient 2 3 = Proficient 4 5 = Mastered
5. How well do current training simulation devices prepare students for this task?	0 = No device available/applicable 1 = Poorly 2 3 = Adequately 4 5 = Extremely well

These survey questions were designed to collect information to help determine how well training is currently being conducted and identify those areas in which training is more difficult or problematic. The data collected from these surveys formed the basis for a priority weighting scheme. A priority weighting factor was created for each task that gave stronger weights to those tasks shown to be more difficult or problematic. Tasks with a higher priority weighting factor are greater targets of opportunity for enhancement by improved training simulation technologies. In the section on Quality Function Deployment, the use of the priority weighting factor will be further explained.

In addition to forming the basis for the technology investment prioritization, the survey collected a wealth of data that is expected to also be useful for those instructors and commanders making syllabus revisions or for helping decision makers understand the proficiency outputs of students in the flying training courses.

3.1 Data Collection

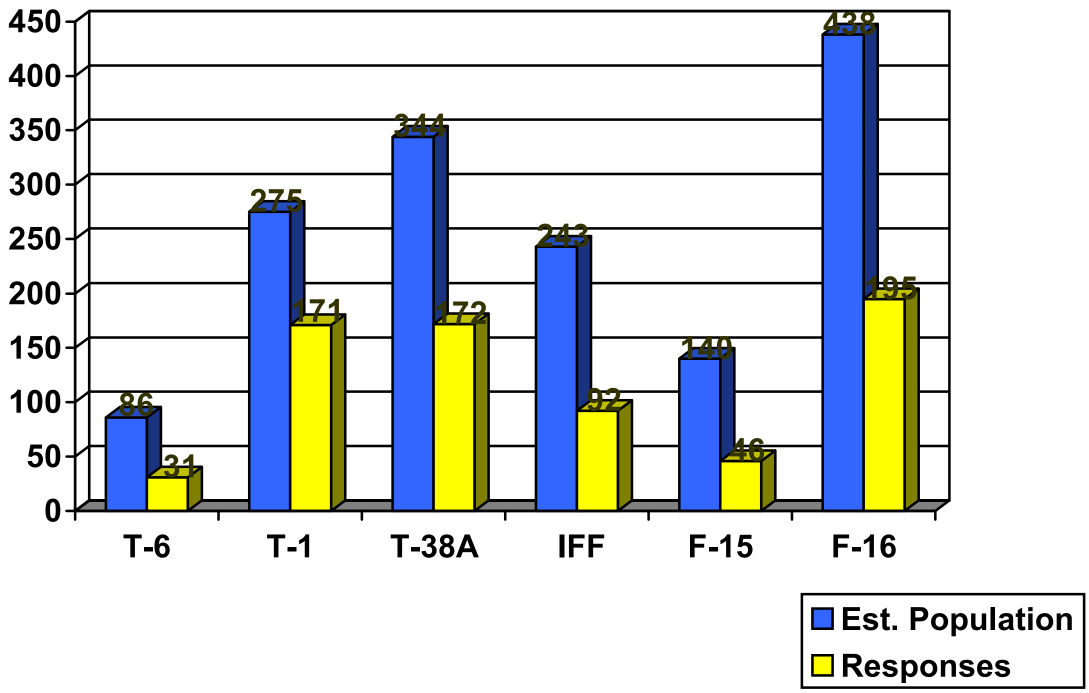
After field-testing of the surveys, they were administered on-line via the Internet to current IPs at each of the AETC SUPT, ENJJPT, IFF, and FTU bases. Table 4 lists the bases and training courses included in the study.

Table 4. Targeted Survey Populations

Base	Aircraft	Training Course
Laughlin AFB TX	T-38, T-1	SUPT
Vance AFB OK	T-38, T-1	JSUPT
Columbus AFB MS	T-38, T-1	SUPT
Sheppard AFB TX	T-38, AT-38B	ENJJPT, IFF
Moody AFB GA	T-6, T-38C	SUPT, IFF
Luke AFB AZ	F-16	B-course, NVG, FAC-A, and MANTIRN
Tucson ANG AZ	F-16	B-course, NVG
Springfield ANG OH	F-16	B-course, NVG
Kelly ANG TX	F-16	B-course, NVG
Tyndall AFB FL	F-15	B-course
Kingsley ANG OR	F-15	B-course, NVG

Official tasking came from the general officer level in AETC for all instructor pilots of the courses being studied to take the on-line survey. This kind of high-level interest and support was critical to achieve the kind of response rates we did and insure a valid data set. The Figure 1 shows the responses and estimated IP population sizes for each of the aircraft included in the study.

Figure 1. Survey Response Numbers



4.0 Quality Function Deployment

In order to assess the training technologies that could best be used in AETC, the researchers conducted a Quality Function Deployment (QFD) workshop with current IPs from each of the training aircraft being studied. When possible, the same IPs from the survey construction workshop were brought back for the QFD. Table 5 shows the experience of the IPs who participated in the QFD workshop.

Table 5. QFD Workshop Participants

Aircraft	Training Course	Base	Primary Aircraft	Military Flight Hours
T-6	SUPT	Moody AFB (USN pilot)	SH-60B	1500
	SUPT	Moody AFB	B-52	4150
T-1	SUPT	Vance AFB	KC-135	2500
	SUPT	Laughlin AFB	C-130	2000
	SUPT	Laughlin AFB	KC-135	2500
T-38A	SUPT	Columbus AFB	FAIP	600
	SUPT	Vance AFB	F-16	1100
T-38C	IFF (Pilot and WSO)	Moody AFB	F-15E	1200
F-15	B-Course	Tyndall	F-15	1800
	B-Course	Tyndall	F-15	1800
F-16	B-Course	Luke AFB	F-16	3400

	B-Course	Mesa Research Site (Reservist; former IP)	F-16	2800
	B-Course	Springfield ANG	F-16	2500
	FAC-A, MANTIRN, NVG	Luke AFB	F-16	2600
			Average Flight Hours:	2175

The purpose of the QFD was to have selected IPs score the usefulness of various simulation technologies to support the training of each task included in the survey of their aircraft. The 27 technologies were identified and defined by engineers and scientists from AFRL. They selected different simulation technologies that have the potential for being used for training various flying tasks. The findings from the simulator field evaluations helped the researchers define the candidate list of technologies. Some of the technologies already exist and are used in the field by only some of the simulators; others are newer technologies available today but are not being exploited yet; and a few are technologies that are not quite mature enough but should be in 2-3 years. To begin the QFD workshop, AFRL provided definitions, demonstrations, and discussions of the 27 different technologies to ensure that all the IPs had a common and thorough understanding of the technologies and their capabilities. The 27 different technologies scored in the QFD were as follows:

1. High Physical and Functional Fidelity Cockpit
2. Networked Simulators
3. Simulators Networked to Other Virtual Assets
4. Motion Platform
5. Force Cueing Devices
6. Cockpit Environmental Sounds
7. PC-Based Part-Task Trainer
8. PC-Based Part-Task Trainer, with Voice Interaction
9. PC-Based Part-Task Trainer, with Intelligent Tutoring
10. Visual Systems with 20/20 Visual Acuity
11. 72° Horizontal/62° Vertical Field-of-View Visual Display
12. 220° (Horiz) FOV Visual Display
13. 360° (Horiz) FOV (or as limited by aircraft design) Visual Display
14. Head-Mounted Display (a.k.a. Virtual Reality)
15. Eye-Tracking Technology
16. Photo-Realistic Visual Database
17. Accurate Sensor Simulations
18. Realistic Weather and Atmospheric Effects
19. 3-D Ground Models
20. Computer Generated Moving Models
21. Computer Generated Interactive Entities
22. Computer Generated Adversaries
23. High Fidelity Threat and Electronic Combat Environment
24. Mission Planning System Integration
25. Digital Debriefing System
26. Virtual Reality Brief/Debrief Tool
27. Current Part-Task Trainers

To conduct the QFD, the IPs broke into small groups based on their aircraft types with AFRL facilitators in each group. IFF, F-15, and F-16 IPs were in the same workshop group because the majority of their training tasks are the same across platforms. The IPs were instructed to score the tasks individually and then discuss their ratings within the group to then arrive at a consensus score. Forcing the groups to arrive at a consensus score, rather than just calculating an average score, drove a great deal of discussion and exploration amongst the participants. This discussion brought out different ideas on technology application that might not have been considered or adequately factored into the scores had the groups been allowed to use a more expedient averaging process.

IPs were instructed to score each technology based on the following scale of usefulness:

1 – Not at all useful
2 –
3 – Somewhat useful
4 –
5 – Very useful

They were also instructed to score the technology independent of cost and to ignore whether they already had the technology at their base or not. The raw QFD scores should just reflect how useful a technology would be for training a given task. A cost-benefit analysis is not a part of this analysis model. It is up to the modernization planners and system acquisition personnel to work with the contractors to determine estimated costs and assess the benefits. The results of this analysis show the planners how that technology can best be used for the greatest gains.

4.1 QFD Results and Technology Prioritization

The technology usefulness scores arrived at by consensus for each task during the QFD were then multiplied by a priority weighting factor. The priority weighting factor was derived from the data collected with the task survey described above that was given to all IPs across AETC. The priority score was created by:

- finding the mean IP rating for each task on each question (e.g., all of the IPs rated Task X on Question 1; the mean rating of Task X on Question 1 was calculated)**

- adding the mean ratings of each task from questions 1, 2, 4, and 5. Question 3, which asked IPs to rate how often a task contributed to busted rides, was not included in the calculation of the priority index because the AFRL team thought that the question was too speculative in nature and their was little coherence in the data collected.

For example, if 4 IPs were asked to answer questions 1, 2, 3, and 4 (Q1, Q2, Q3, and Q4) about tasks 1, 2, and 3, the resulting raw data would look like this:

	TASK 1				TASK 2				TASK 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
IP1	2	2	3	2	2	1	1	3	2	3	2	3
IP2	2	3	4	3	3	2	2	3	4	4	3	4
IP3	3	4	1	4	4	3	3	3	3	2	4	5
IP4	3	3	1	3	3	2	2	1	3	1	1	4

Next, the mean rating for each question on each task is calculated:

	TASK 1				TASK 2				TASK 3			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
AVG	2.5	3	2.5	3	3	2	2	2.5	3	2.5	2.5	4

**NOTE: Before the means were derived, the ratings collected in the survey process were rescaled so that each one was directionally congruent; on some of the rating scales, a "5" was a positive attribute and on other questions a "5" was a negative attribute. The ratings were rescaled so that higher ratings indicated more problematic tasks.

Then, the mean ratings for each question are added together to give a priority weighting factor:

	TASK 1	TASK 2	TASK 3
PRIORITY WEIGHTING	2.5+3+2.5+3= 11	3+2+2+2.5= 9.5	3+2.5+2.5+4= 12

The higher the priority weight, the more problematic a task is and the greater the target of opportunity for training enhancement with advanced simulation technology. In our example above, Task 3 would be the greatest target of opportunity for training enhancement with advanced simulation technology.

Each of the raw technology usefulness scores assigned by IPs during the QFD were then multiplied by the priority weighting factor for each task, thereby creating weighted priority scores that are composed of a technology usefulness score (from the QFD) and task ratings (from the IP task survey). These weighted priority scores for each technology were then added to yield a total weighted priority score for each technology. A higher score indicates that a technology has a greater potential for positive training impact for that course.

Continuing our example, if 3 training technologies (TECHNOLOGY 1, TECHNOLOGY 2, and TECHNOLOGY 3) were assigned usefulness scores during a QFD, the technology usefulness scores for each task would be multiplied by the priority weighting factor for each task; the resulting weighted priority scores for each technology would then be summed to give a total weighted priority score for each technology:

		TECHNOLOGY 1		TECHNOLOGY 2		TECHNOLOGY 3	
	Priority Weight Factor	Technology Usefulness Score (from QFD workshop)	Weighted Priority Score (priority score X technology usefulness score)	Technology Usefulness Score	Weighted Priority Score	Technology Usefulness Score	Weighted Priority Score
TASK 1	11	2	11*2 = 22	4	44	1	11
TASK 2	9.5	3	9.5*3 = 28.5	4	38	3	28.5
TASK 3	12	4	12*4 = 48	5	60	4	48
TOTAL WEIGHTED PRIORITY SCORE			**22+28.5+ 48= 98.5**		**142**		**87.5**

In the example, Technology 2 looks to have the greatest potential positive impact on training.

The technologies were then ordered from highest to lowest total scores. This rank order can help to identify the technologies that may have the greatest impact for improving pilot training. A cautionary note: the resultant technology priority lists are only ordinal in nature. That is, technologies with higher total weighted priority scores have a greater potential impact on training. However, a technology with a total weighted priority score of 400 does NOT have twice as much potential impact on training as a technology with a total weighted priority score of 200. In addition, total weighted priority scores should not be compared across platforms. Task surveys for different planes contained different numbers of tasks; and since the total weighted priority scores are products of the number of tasks on a survey, planes with surveys containing greater numbers of tasks would likely have overall higher total weighted priority scores for technologies.

5.0 Conclusion

No other time in history have we seen as much readily available technology for training warfighters as we see today. The analytic process described in this paper provides a useful way of identifying those training technologies with the greatest opportunity for enhancing flying training programs. Critical to this entire process was involvement by the instructor pilots themselves. Not only did the survey responses from over 700 instructors form the basis for the priority weighting, the instructor participation in the survey development and technology scoring workshops was critical. This process has yielded a great amount of useful data and recommendations for the leadership in the USAF Air Education and Training Command. The involvement by current instructors in the workshop as well as the analytic basis from instructor surveys yields great validity and credibility to the analysis and recommendations. The information from this process will form the basis for their simulation roadmap and guide their technology investments to enhance the training of U.S. Air Force pilots.