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Good afternoon. Like many of you, for years I've followed the advances of modeling and simulation and listened to promises of cost savings and better, faster, more efficient testing. And I've always been a huge fan of M&S, but the reality didn't always live up to the promise. In the early days the M&S folks would say, "We are 10 – 15 times cheaper than open air testing." But when you added in the cost of the simulation facilities, the cost to develop the simulations, and the cost of open air testing just to validate the simulation, it was sometimes hard to find any savings at all.

And later as our systems got more complicated the M&S folks would say "You need us now for repeatability and accuracy and speed, and to help you determine where to look during open air testing, and to do all the software 'what if's', and we are 10 to 15 times cheaper." All true but not compelling because when it came down to it, there was usually some glitch or issue that affected the accuracy of the simulation. So, like many of you, I've been disappointed when the reality didn't live up to the hype. A retired Admiral friend of mine once compared M&S to the economy of Brazil – it has wonderful potential, and always will have!

As a result, M&S has been the step-child of RDT&E. And while there have been some great success stories, what we remember most are the stories of mistakes and foibles. One of my favorites involves our allies the Aussies, who I had the pleasure to work with in Melbourne from 1989 – 1992.

As virtual reality simulators assumed larger roles in combat training, programmers went to great lengths to increase the realism of their scenarios, including detailed landscapes and--in the case of the Australian Northern Territory – they included herds of kangaroos and then modeled the local marsupials' movements and their reactions to low flying helicopters (since disturbed animals might well give away a helicopter's position).

Being efficient programmers, they just re-appropriated some code originally used to model infantry detachment reactions under the same stimuli, changed the mapped icon from a soldier to a kangaroo, and increased the figures' speed of movement.

Eager to demonstrate their simulator for some visitors, the hotshot Aussies "buzzed" the virtual kangaroos in low flight. The kangaroos scattered, as predicted, and the visitors nodded appreciatively... then did a double-take as the kangaroos reappeared from behind a hill and launched a barrage of Stinger missiles at the helicopter.

And, in fact, our M&S and software folks have been the brunt of several great jokes. My personal favorite is the one about the

Program Manager, chief engineer, head of logistics, and M&S lead who are riding together in a car that has suddenly lost its breaks and is careening down a mountain road. Fortunately, the road followed an old logging trail with several "runaway trunk ramps" built in. Just when it looks hopeless, the Program Manager, who is driving, sees one of the old runaway truck ramps and steers into it to stop the car. The PMA immediately says, "I want a tiger team to investigate this incident, want a POA&M to address our recovery plan, we need funding established and all POCs indentified." The Chief Engineer says," I want to field strip these brakes, do an non-destructive investigation, stress analysis and fault tree analysis and get the brakes back in service by tonight! The Chief Logistition says, "I want to see which parts are non RFI, do an RCM analysis on the brakes, and have the new parts ready to install by early this afternoon. The M&S lead says, "Hmmm, I didn't see this in the simulation, let's push the car back up to the top of the mountain and see if it does it again!"

Well I think we did ourselves a disservice by pinning the benefits of m&s on speed, accuracy, repeatability and cost savings. Yes, these are important; but if this is your only rationale, you face the value issue -- while the cost might be less, the product is worth less. As all of us who have been involved in test know, there is no substitute for open air testing.

But in the last few years, we've seen a growing tolerance for M&S. There are places where "open air testing" doesn't want to go or can't

easily go and is begrudgingly happy to have M&S around to help. Where might some of those places be?

First, dangerous tests – live fire testing might count here -- where the test article and the projectile are real but the environment is simulated. But if you don't want to count that as a true simulation, how about testing warning systems -- like aircraft ground proximity warning systems, or collision avoidance systems where you want to point the aircraft at the ground or another aircraft and see if the automatic warning comes on just in time to avoid disaster.

Second, there are tests where security could be compromised if done in open air such as testing an emitter at a new frequency, of testing the war modes of a system, or trying new tactics during OT that spying eyes might see.

Third, there are tests where it's impractical to do open air testing – jamming in open air – we once knocked out all the TV's on the east coast testing a new EA-6B jamming pod; or because of the density of the threat environment can't be replicated at one of our electronic ranges. We did the V-22 Operational Assessment on threat detection capability and response in the Air Combat Environment Test and Evaluation Facility at Pax River. By the way, it was critical to that test was that the Operational Testers had certified that for the purposes of the test, the facility was operational representative.

And finally there are tests that are just too big to routinely be done with open air testing.   As our systems get more complicated and integrated together, it's hard to coordinate live assets for test so we let M&S go first to work out any kinks. Testing MIDs (Multi-Functional Information Distribution System) which is a new system for sharing data-link and voice in the battle field, required numerous ships and aircraft operating together to test the ability of the system to provide a flow of information. The first time we tested MIDs on a large scale was in simulation to ensure we had the systems working OK before tying up a large number of real battle group assets. And sometimes the new systems or the systems with which our system under test must interface are also in development and aren't yet available and we have no choice but to use modeling and simulation.

As our systems get more complex, we can expect that we'll need M&S more and more in the future.   And our systems will get more complex. There is a saying, "As long as all things are created from scratch, growth can at most be linear". We're too clever to create things from scratch so you can expect that we will continue to use a building block approach. Accordingly the complexity of our systems will continue to increase non-linearly and modeling and simulations will become more and more important to prove that they are interoperable.

In fact, in June 2003, DoD put out a memo that declared their intention to test for interoperability over the life of the system.

So I think all of us involved in research, development, test, and evaluation believe that M&S finally has a seat on the bus. It may not be a window seat, but it's a seat. For RDT&E, M&S is tolerated, thank you very much.

In fact, if M&S was represented by a character in a movie, it would be the hapless city slicker in a Western -- trying to start a new life in the rough and tumble prairie. I can imagine a scenario where the tenderfoot is proudly standing on the front porch of his newly purchased ranch house, wearing his brand-new cowboy boots, surveying his vast holding. He is approached by a rough and tumble cowboy who represents "Open Air Testing". The cowboy says to the tenderfoot. "Welcome neighbor. I live about 5 miles down the road. I want to have a little get together tonight to welcome you to the territory."

 "Oh, that would be great" says the Tenderfoot.

"Yeah" says the old cowboy, come on over about sunset, we'll do some eating and drinking." "some fiddling and some dancing" "probably be some shooting" "definitely be some fighting" "but they'll be some loving, too".

"Who all is coming?" asks the Tenderfoot

"Oh, just the two of us." Says the cowboy

As our ability to accurately model systems increases, and as the memory and processing power of our computers increases, it's natural that our RDT&E infrastructure would support new areas in the life-cycle of our systems.   Two of these – demonstration and experimentation -- are at the beginning of a system's life, and two of these – training and rehearsal – are later in the system's life. The infrastructure built to support research, development, test and evaluation – the open air ranges, software support activities, hardware in the loop facilities and our facilities that create synthetic environments – is becoming host to rehearsal, demonstration, training, and experimentation – or the new RDT&E.

In fact, some months 10% of the events we support with our infrastructure are either rehearsals, demonstrations, training evolutions, or experimentation -- and it is growing. In the manned flight section of ACETEF, this percentage has grown from 50% to 80% in the last few years. Nearly every test flight is rehearsed in the ACETEF before it's flown. And in this new RDT&E, modeling and simulation doesn't just have a seat on the bus, it is driving the bus.

In our business, if you want to know what's important and what folks are willing to support, you follow the money. Joint Forces Command is competing a five year program starting in Sep to support USJFCOM's Joint Trainer responsibilities for planning and conducting

exercises, crisis rehearsals and other training events from inception through execution.

The long-term mission of this initiative is to incorporate service branches, interagency and multinational coalition partners. By 2009, the goal is to have the capability to train any audience in joint warfighting – whether it be a unified command staff, one of the services, or multinational and interagency personnel. The persistent network will focus on joint training, experimentation, testing, education and mission rehearsal, by linking command and control, training facilities, and ranges and simulation centers throughout the world.

Meanwhile DoD is creating the Joint Mission Environment Test Capability to provide testers and developers a robust nation-wide distributed engineering capability, by integrating live-virtual-constructive simulations with systems under test, giving the Department the capability to "Test like we fight." DoD wants to ensure interoperability between JMETC and JNTC, and is developing the JMETC to support the JNTC.

Here's what's interesting to me. A member of the new RDT&E – in this case training – is setting the standard for traditional RDT&E – in this case testing. We're likely to see more of this in the future.

And oh yes, M&S does save money in the new RDT&E -- especially with training. Real, measurable, auditable, money. All the services

have accepted simulation as a replacement for flight time – not just an augmenter for flight time. So have our allies – at the French Army Aviation Training Centre 30% of the training is performed in simulators and procedural trainers. There are lots of examples from the commercial side. Most new airline pilots do 100% of their training in simulators – the first actual flight is with passengers!

Very light jets are preparing to make their debut this year. The Eclipse 500 is tentatively scheduled for FAA approval this month. These jets cost under $3M each and are powered by 2000 lb thrust engines and weigh less than 12,500 lbs. Now you can always get insurance, especially since many of the inexperienced folks who can afford these personal jets can afford the insurance. But the key to getting affordable insurance, according to the under-writers, will be to participate in a highly focused and type-specific training program with significant simulation. A private pilot with a multi-engine rating and just 500 hrs total time who completes the manufacturers training program would pay about the same amount for insurance as a commercial pilot with 2500 hours and 500 hours of multi-engine time would pay.

A growing use of simulators is in a field related to training – mission rehearsal. Complicated missions are being flown in rehearsal before being flown for real. Simulation shows the pilot the expected outside environment (visual, radar and FLIR), the expected defensive threat laydown, and allows for rehearsal of the weapons employment.

SOCOM is developing a Common Environment/Common Database which will be integrated into the simulators for the US Army Special Operations Regiment. They have compiled a wide range of imagery, navigation, communications and radar data into a centralized database. Members of the Regiment are able to create customized simulation of the actual combat zone where they will be deploying an do it in hours, not months. One of the main reasons for the development is to shorten the mission rehearsal timeline. Now several of the other COCOMs are asking for simulators in theater – not only for training but for rehearsal as well.

All the services are investigating how game simulation can replicate real operations to help train warfighters. Everyone realizes that gaming isn't a valid substitute for real-world military training and live-fire drills, but gaming is being investigated as accepted as an alternate training method. The industry believes that videogame technology can fulfill many training needs at a much lower cost that traditional large-scale simulations. By the way, that may be the first time many of us have heard the words "traditional" and "simulation" used together.

The Navy is investigating whether a video game that replicates operations aboard an aircraft carrier can help train ship and aviation flight deck personnel. "24Blue" was modeled upon flight deck operations on the aircraft carrier USS Harry S. Truman. The objective of the game is to launch a sequence of fixed-wing aircraft—including the F-18 Hornet, the EA-6B Prowler and the S-3B Viking—off the ship before it's attacked.

Not sure about gaming? You think the folks who built games aren't interested in DoD as a customer? Consider this: game development studios are the closest thing we have to steady simulation talent – and Ben Sawyer a gaming expert and founder of the "Serious Games Summit" which was held in Arlington, VA in 2005, claims that most successful gaming firms are hybrid studios that do gaming and "serious gaming". Many believe that the importance of gaming will continue to grow, and although it has taken over the role of step-child from M&S, will one day it will have a role as important as M&S does today.

So while M&S is clearly supporting training and rehearsals, what's it doing for demonstration and experimentation? Keep you eye on this! Clearly M&S will have a huge role as we look at the "art of the possible" and develop new tactics for systems before they are even developed. M&S has been involved in past experiments, but it's been awkward. The folks responsible for the experiments didn't have funds to pay for the participation of new systems and had to have program managers and others offer their support. Today, the value of experiments is clear and money is being made available to the experiment leads to pay for the systems they believe are needed.

So what is the future? I believe the new RDT&E will drive M&S in the future. And while there are several 600 lb gorillas in DoD that will define M&S interface standards (JSF, FCS, JTRS) most of the standards for M&S will come from self-forming groups of interested

folks who reach agreement on where we need to go. And this group better include our contractor teammates.

So the future for M&S is pretty good. Now, let's go back to our tenderfoot standing on his porch and the grizzled cowboy that was having a little fun at the his expense. As the cowboy starts to leave he says with a grin, "See you tonight, pardner. And, oh by the way, my name's Tex. What's your's?" "Wayne" says the stranger, "John Wayne." Yes the future will be very interesting indeed. Thank you.