Top 10 Predict "Digital Twin" Field Simulation Training Service Tool Replicate Real Time Decision Prep

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The problem with mission “Digital Twin” Simulations is that most Marines really don’t know how to properly use simulation technology for it to be useful downrange. Several years ago we were given the assignment to find a way to help make Marines better problems solvers. After a couple years of back and forth discussions, the concept of innovation boot camp was set out.

Marine Corps Leaders are always searching for successful team-building exercises, frequently falling back on team sports or outside experts not in tune with the requirements of Marines. “Digital Twin” simulations offer an opportunity for team-based and cooperative play that can provide surprisingly innovative team-building tailor-made to be challenging, and more likely to encourage repeat play. Game Engines can help your team develop transferable skills—performing complex tasks while stressed, anticipatory planning, and communications among Marines.

“All we are doing is giving Marines exposure to new tools that can help them solve difficult problems in the field.” Problems range from access to Design Plans, parts supply, and having enough time to perform repair/upgrade to equipment they depend on so heavily to carry out the missions all Marines are trained to do.

“Digital Twins” aren’t a new concept, but their application throughout all stages of mission execution is. Smart Site Visit Executive will leverage “Digital Twins” – and achieve a product-centric and model-based enterprise – across operations.

The full potential of the “Digital Twin” concept is realised by using models to duplicate operation of complex assets in enough detail to fully understand their performance, even when facing never-before-seen conditions by duplicating operation of the asset incorporating wear or modifications into the simulation model.

Types of vehicles, equipment and weapon systems found in motor pools today cannot be utilised properly in both Design/Sustainment Phases without the authorised tools. Commanders, unit maintenance & supervisors must ensure that all sets, kits, and outfits & special tools are being used and maintained properly; properly accounted for; and promptly replaced when unserviceable or lost. Unit mechanics cannot be expected to properly troubleshoot, remove, or replace components unless the right tool is readily available and serviceable as called for in the equipment task order.

The ability to master various systems of modern combat is a valuable skill. Outside of expensive training time there are few opportunities to train on what is essentially high-stress multitasking. While a game engine is no substitute for getting in a combat vehicle and putting it and its crew through their paces, the stress of a game engine such as “Marine Grunt Simulation” can be an powerful addition to modern training toolkits.

“Marine Grunts Simulation” allows two teams to take the role of various bridge crewmembers on a starship. The players are assigned to one or more roles, operating the various systems of their ship. Many skill sets must be in the training tool box-- “Engineering” provides power to the other bridge positions. “Helm” maneuvers the ship. “Weapons” prepares and fires torpedoes at the enemy. “Sensors,” “Shields,” and “Tractor Beam” have duties as well. Tactical Boot Camp Design curriculums include training in simulation application design, 3-D printing, welding and microcontrollers. One player acts as captain, charged with making sense of the great mess that develops against another team of players on a similar enemy ship.

A “Digital Twin” Virtual Reality representation of a physical asset-- anything from a single control valve to a machine, a production line makes predictive Design feedback possible. Three types of tools commonly found at expeditionary unit level are:

1) Mechanic’s tool kits that consist of common hand tools kits are based upon the number of mechanics authorized.

2) Shop equipment, common and supplements, which contain tools are issued from a tool room or vehicle.

3) Equipment special tools required to perform unit level maintenance on specific equipment and listed in the applicable unit level repair parts task work order.

“Digital Twin” Simulations are not bound by the constraints of time so you can run simulations to predict how the asset will degrade and require repair/upgrade based on factors like age, runtime, or exposure to operational conditions . Using the results of these simulations, technicians can predict how and when the asset is likely to fail, long before it actually does.

Costs of major fleet mission items that have different repair/upgrade overhaul sequence i.e., structural subsystems such as hull, frame, or airframe; power subsystems such as engines or drive train & electronic/mechanical subsystems such as fire control system, armaments, guidance, or command & control equipment should be estimated & identified separately within work order elements. In some cases, the interval between end item overhauls may be expressed on work orders in terms of system operating hours, not calendar time.

Some repair/upgrade overhaul activities occur at time intervals ranging from several months to several years. For primary systems e.g., aircraft, tracked vehicles & ships on work orders, costs should be included in the estimate for the years in which they are expected to occur, accompanied by status updates on the cost per event & time interval between overhaul events.

Site Visit Executive directs Aircraft Product Support Metrics satisfy testing “S.M.A.R.T.” [Specific-Measure-Attain-Relevant-Timely] Selected metrics must be:

S = Specific: Clear & focused so good interpret to specify allowable range/threshold.

M = Measurable: Specified unit of measure tied to underlying process drivers so possible assess

A = Attainable: Achievable, reasonable, cost-effective & credible under expected Operations Concept

R = Relevant: Tied to field-level requirements scope designed to motivate behaviour linked to incentive

T = Timely: Executed within mission time frame

Recently Marine Logistics Command, partnered with us to teach what it calls “innovation boot camps.“ Weapons Systems repair/upgrade supervisors must screen equipment level parts schedules to obtain markings for special tools. They must also ensure status updates are prepared to maintain accountability for these tools.

The “Grunt Simulation” training course is designed to bring emerging technologies to Marines and help them solve complicated issues when deployed overseas. The training pushes Marines out of their comfort zones and familiarises them with skills they are not usually accustomed to with current Marine Corps training paradigms.
“A lot of it is knocking down the intimidation factor." The programme ends with a capstone project.

By creating a virtual representation of an asset in the field using lightweight model “Digital Twin” visualisation, and then capturing info from smart sensors embedded in the asset, you can gain a complete picture of real-world performance and operating conditions. You can also simulate real-world scenario conditions for predictive maintenance.

Most modern Simulations have a tutorial video available online, which turned out to be a necessary tool when candidates tried out “Marine Grunt Simulation.” The video allowed each team to learn the basic rules of the game engine in a logical and regimented fashion. The length of single game engine only lasts as per operating instructions, but the first session took longer since Marines needed some time to grasp the rules and flow of the exercise. The stress of not being able to do quite everything players want to do compresses time and heighten senses and sharpen decision-making skills.

The game engine is obviously not nearly as taxing as actually running a combat vehicle and its crew, but the advantages of “Marine Grunts Simulation” as part of a team-building exercise are many The communication between team members necessary to succeed in the game is not too far from that needed in vehicle operations. For example, learning how to tell your driver exactly where to place a vehicle is similar to telling the helmsman where to "fly" the ship in the Simulation. Of course, this is complicated by the dice interface, as directions on the maneuver dice are relative to the orientation of the ship model on the board.

The innovation boot camp concept was born out of previous work experience. "We went downrange, on deployment and we literally planned with Marines. We asked them what didn't go right with your day; if you had a piece of equipment that could help you solve the problems what would it be?"

There has been a general push over the years by the Marine Corps to provide additive manufacturing or 3-D printing in the field to bridge logistics and supply issues/tech have the potential to advance the expeditionary capabilities of the entire Marine Air Ground Task Force." Any Marine who has deployed downrange knows finding spare parts or tools to fix even a simple problem can be a supply nightmare. The Marine Corps is trying to bridge that gap by teaching short-duration, intense training sessions to turn Marines into better problem solvers.

The goal of the game engine is to maneuver a model of a spaceship on the playing board, collecting essential supply items avoiding collisions with astronomical bodies, and destroying the enemy. Players roll customised dice for each duty station to perform their functions—if their station has power. For example, the helm station has dice with symbols indicating various combinations of forward movement for one or two spaces, coming about, and turns to port or starboard. While powered, the helmsman may roll the helm dice and set aside those maneuvers that fulfill the captain's orders at each decision point. The other stations also have custom dice tailor-made for their particular functions.

Critical decision point in simulation training action commits organisational resources to a specific product, sustainment profile, choice of suppliers, Design contract terms, schedule & sequence of events leading to mission field deployment in theatre. The courses are generally open to any Marine, but Marines come from vehicle maintenance, communications and optics, and there have been some infantry students. "Anyone out there facing problems, we want them with new tools in their tool box."

In one simulation, a Marine manufactured his own mortar wrench with a 3-D printer. In another, a Marine was able to build a wireless simulation tracker that could eventually help Marines track enemy targets in real-time. A user only had to walk by the device to download the tracker, which meant the user didn't have to physically remove a simulation card from the device attached to the tracked enemy vehicle and potentially compromise an operation.

The insights from sensors connected to the product or process are used to provide real-time boundary conditions for the "Digital Twin" Simulation. The "Digital Twin" results can be calibrated based on the operation of the actual asset. "If we didn't get simulation alerts right on schedule, we wouldn't be able to carry out our business of doing what

Marines are trained to do.. We can now sleep at night knowing the right person will be contacted."

On-call schedules are centralised across all your monitoring tools, to empower dispatch signalling teams and reduce chronic alert concern in your life. Appointments recorded with details & set of reminders added to appointment. When Simulation Application running on day appointment was due & prior to time of that appointment, reminder messages for the imminent appointments were to be triggered. The job deals w/ addition & simulation form display when item was added to, or deleted.

The captain keeps schedules moving by directing the movement of energy from engineering to all of the other divisions. All the while, the enemy team is doing the same thing. Commands are issued and countermanded. The departments can indicate they need more power. Everyone is rolling dice during simulations like at a craps table, looking for the right combination of symbols that will load a torpedo tube or raise a shield or move the ship to just the right spot to fire on the enemy. Meanwhile, the teams steal glances across the table to see what the enemy is doing. It is stressful, barely controlled chaos.

"Digital Twin" innovation boot camp simulations are currently ongoing at Marine training installations and some classes have even taken place overseas. "The idea is to do learning by doing. If Marines break stuff or burn things out, that's all a part of the learning experience."

Training is not the most glamorous aspect of the Marines, but as "Digital Twin" simulation technology further matures, the service may have an opportunity to greatly increase its preparedness with this groundbreaking tool and it's potential for adaptive change. Simulation is becoming a bigger part of Marine training. And that has been quite a big shift, considering the historical Marines approach to training.

The difference between a "Digital Twin" construct platform and a traditional model or simulation is that the "Digital Twin" is responsive—it receives information from sensors on the physical asset and changes as the asset changes to yield a real-time model of the asset and its performance by looking for inconsistencies or non standard patterns and find problems that may not be easily identified through visual inspection or other traditional methods.

"Traditionally, we've got a really industrial model for training, really brick-and-mortar schoolhouses, classroom-centric, just like we all grew up with." The use of simulation today is focused on some of our more complex tasks: simulators for the ship bridge, simulation for an aircraft at a very high-end level of training.

"We're looking really hard at this Ready, Relevant Learning construct to launch the "Digital Twin" initiative to bring it into a less expensive format." The testing of the simulation equipment from the suppliers was successful. So were the acceptance trials. The installed equipment operated perfectly both times. During these mission periods, the specs systems remained unopened, the component was not required for the operation. It eventually got to go back to the base for another unit to use. And so did we.

Ready, Relevant Learning on “Digital Twin” platforms is aimed at delivering training at the right time, in the right place and in the right format for Marines to use. It becomes part of the everyday training routine, and more focused on simulation rather than knowledge. Role of simulations will continue to grow into the future, say, 10 years down the road. The old way of bringing in Marines and expecting the training to last them for 20 years is "wildly inefficient." Instead, they need to have training at the right times throughout the career, and that is where simulation can help.

"That’s what we’ve done with Ready, Relevant Learning. We take “Digital Twin” experts that understand what system requirements apprentice-level Marine need to master in first period reporting for duty, and distilled that into the training we provide for them."

In addition, establishing strategic communications between agents within the “Digital Twin” construct must be used to direct power requirements trade-off design characteristics of ship components in the simulation under fluid and constant operating conditions. Except when combat begins or the tractor beam is activated, both teams continuously roll dice, ready systems, and maneuver. Being able to think and make decisions on the fly about immediate needs while looking forward to the next requirement-- and the one after that is definitely a valuable skill to develop before it is needed in the real world.

Simulation provides an opportunity for Marines to start developing that "muscle memory" they cannot learn in the classroom. For example, Marines have reconfigurable flat-panel Virtual Reality simulation systems with a progressive gaming engine that allows users to walk around, open panels, turn switches and change configurations.

Attention to Configuration issues is especially important for fielded weapon systems undergoing modernisation, block upgrades, or component replacements, but it also plays role in “Design Phase” with changing configuration baseline. Addressing Configuration is requires deep, deliberate dives into details.

Almost all programmes are composed of complex “systems of systems.” To use a simple example, any aircraft platform includes, at minimum-- avionics, propulsion, airframe, communications, and maintenance-support subsystems. In many cases, aircraft may also include munitions, self-defense, and sensor subsystems. An aircraft relies on all of its subsystems to perform its intended mission—be it transport, attack, or intelligence/surveillance/reconnaissance.

Changes affecting any of the subsystems can undermine the aircraft’s ability to perform its mission if the changes are not properly designed and implemented. But even this description fails to capture the complex, interdependent nature of most modern weapons systems programmes, because it suggests subsystems are modular “boxes” performing isolated functions ie, communication, navigation, propulsion in support of the overall system but independent of other subsystems.

More realistically, subsystems not only support the overall system but interact with one another in ways that are sometimes difficult to anticipate. Guidance is one example. A guidance system may be upgraded as part of an avionics-system-improvement programme, but it’s likely the same guidance component also interacts with weapons or sensor subsystems. Thus, modification to the avionics system may have unintended consequences on the weapons and sensor subsystems.

To further complicate matters, the avionics upgrade may create new sources of heat or electromagnetic interference or may require additional power. Any of these issues could flow over to affect other subsystems in ways that are not readily apparent.

At yet another level, changes to a weapon-system “Design” may impact weapon-system maintenance or sustainment. Anticipating and resolving these issues is one of the critical challenges of systems engineering. Configuration/control are, together, the disciplined, systems-engineering process put in place to make sure these potential issues are fully considered before change is implemented.

"With Simulation like that, we actually provide an opportunity to gain reps and sets. So, for example, what we provide today at Training sessions we used to teach ground support technicians with a large block model, so they had a perspective of where switches are, but didn’t get an opportunity to manipulate gears.” With this flat-panel Simulation, Marines actually sit and it comes in a variety of modes you can come up and manipulate it with their hands."

The short duration of each game engine makes it possible to play “Digital Twin” Simulations multiple times in quick succession. This could allow squad or platoon leaders to juggle crew members to see how they interact in different combinations and allow the crews themselves to see how they interact in various situations. These flat-screen simulations allow every Marine opportunity to go through the sequence multiple times, meaning more Marines able to start right away compared with the old way.

At the end of the session, commanders direct solid after-action reviews to gauge how well the team performed and how they perceived the training. Additionally, the Review could serve to identify best practices in the Simulation and discuss any that have a direct correlation to operating in the real world.

"When we look at huge jumps in training period efficacy, we are looking to incorporate similar technology in other venues. Marines are exploring using Virtual Reality technology more often, although they are not quite mature enough where implementation would make sense for wide-scale use in training. But making systems available for Marines that would allow them to train as if they were deployed in real-world scenarios — seeing the jet blast deflectors lowered and raised, for example, or even feeling the temperature and the wind.

"This is an extremely exciting time to be in the training business. We need to stay ahead of new advances in “Digital Twin” technology.“ For many MOS there’s not much in the way of simulator trainer — not that you couldn’t do it, but they haven’t gone through the effort.

Prospects for operational use of “Digital Twin” simulation will certainly change in the future, however, one thing the Marines could do is take advantage of new platform technology, and with virtual reality systems, you can actually build simulators for other field scenarios without having to get the physical equipment. Then you can go through troubleshooting and repair."

As usual, funding is an obstacle and without proper support from Top Brass, real world mission requirements are not going to get money to speed deployment of “Digital Twin” simulation systems. But as the technology develops, the cost/benefit situation begins to improve and push the Marines toward more simulation.. Right now, there’s a lot of reliance on team trainers. "They could do some things to expand their capacity."

1. Systems design: Design before you build with a visual, simulation approach.

2. Asset-based system of system design: Specify, publish, find, and reuse organisation simulation systems,

3. Product-line engineering: Design product platforms and variants quickly and efficiently, and make better trade-off decisions.

4. Systems model review: Improve product quality and model consistency through early design reviews within a systems modeling tool.

5. Systems model simulation: Validate complex behaviour earlier in the design life cycle, and establish predefined standards and best practice–based process.

6. Establish an open, flexible simulation system: Such a system is necessary to incorporate information sets from multiple engineering domains and quality control

7. Align combat engineering teams for better collaboration: Disconnected combat engineering teams across mechanical and electrical systems working in their own workgroups must collaborate as needed-- utility of systems-level view of products must be evaluated

8. Balance vitality and stability: Balancing vitality of innovation with reuse and predictive stability during establishment of an innovation platform for simulation and during product design and engineering.

9. Unify simulation connected systems optimisation: A single view of cross-domain system, product, and process is required for successful simulations

10. Incorporate quality with design and development: Achieving high level of product

quality is why simulation virtually validates systems-level view. Assuring Incorporate/embed quality information from the early-stage design through subsequent product phases is key so simulations can more easily flow from system designs into product attributes.