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Revolutionizing Marine Corps Training: The Marine Corps Reconfigurable Consolidated Driver Simulator (MCRCDS) Initiative

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Revolutionizing Marine Corps Training: The Marine Corps Reconfigurable Consolidated Driver Simulator (MCRCDS) Initiative

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Abstract

The Marine Corps has made significant strides in recent years by acquiring modernized driver simulators to strengthen training effectiveness and operational readiness. However, the long-standing platform-centric approach—common across all military services—limits the ability to fully leverage emerging modular hardware, open architecture systems, and advanced terrain software that could support multi-platform use.

This paper introduces the Marine Corps Reconfigurable Consolidated Driver Simulator (MCRCDS) initiative, developed to address the fragmentation, inefficiencies, and high costs caused by over 48 standalone simulators across various commands. MCRCDS offers a reconfigurable, consolidated solution that incorporates Artificial Intelligence (AI), Machine Learning (ML), and the Explore, Experiment, and Excel (EEE) learning principle to provide immersive, adaptive, and personalized training aligned with the Commandant's vision for 21st-century readiness.

By integrating Live, Virtual, and Constructive (LVC) environments and standardizing data collection, MCRCDS supports broader Department of Defense goals to improve readiness predictions and identify training gaps. The initiative's phased implementation and cost analysis underscore its potential to significantly reduce administrative burden, enhance interoperability, and improve training outcomes.

This research highlights MCRCDS as a transformative solution for modern driver training—moving the Marine Corps toward a more efficient, scalable, and future-ready simulation capability.

Introduction

The United States Marine Corps has taken significant strides in modernizing the simulators/training systems for the land systems, particularly driver and craw simulators for their tactical vehicles. Moreover, they continue incorporating the latest technologies into their future drive estimator acquisitions.

The platform-centric approach in training systems is not unique to the Marine Corps or a specific service or particular capability tactile vehicle type.

The Commandant of the Marine Corps continues to emphasize technological advancement by adopting the latest technologies to maintain momentum and through collaboration with industry, academia, joint forces, and allies. The Marine Corps Systems Command DC SEAL initiative of the MCRCDS study is aligned with reducing duplication of efforts, maintaining technological superiority momentum, and reducing noncombatant vehicle fatal mishaps.

The Marine Corps is at a critical juncture, needing to modernize its training systems to meet the demands of 21st-century warfare. Once effective, the existing driver training programs are now spread across different Formal Learning Centers (FLCs) and commands, as shown in

Table 1. Due to the complexity and cost associated with changes to make the existing driver simulators interoperable, modernizing them is not feasible. This study will show the existing USMC driver simulator landscape and propose a new solution.

Problem Statement

The existing Marine Corps driver training systems are platform-centric and fragmented across different vehicle types, programs, and commands, leading to high operational costs, interoperability issues, and limited scalability. This fragmented approach undermines training effectiveness without significantly reducing non-combat driving mishaps.

Current Marine Corps Tactical Vehicle Driver Simulators Distribution

This section details the current distribution and future growth of Marine Corps tactical vehicle driver simulators. It highlights the fragmented nature of existing systems across various vehicle platforms.

As shown in Table 1, the Marine Corps driver training systems are currently dispersed across more than 48 standalone simulators.

Table 1: Breakout of 48 Operator Driver Simulators

Location	Cab Number	Instructor Operation Station(s)- IOS	Mobile Trailer
MCAS Iwakuni	2	1	X (Dual)
MCB 29 Palms	4	2	X (two dual)
MCB Camp Pendleton-California	6	4	X (two dual and two single)
MCB Camp Lejeune, North Carolina	5	3	X (two dual, one single)
MCB Okinawa	5	2	
MCB Hawaii	2	1	X (dual)
Fort Leonard Wood, Missouri	24	6	
Totals	48	19	

Please note that four Light Armored Vehicle Driver Trainers (supplied by Wegmann USA) are currently at the School of Infantry West at Camp Pendleton (SOI-W). The number of existing driver simulators for recent additions to specific programs has not been included and is in addition to the depicted number here.

Overview of Sources

This study builds upon the foundational concepts outlined in the Commandant's guidance, emphasizing technology integration. Insights collected from engaging with stakeholders across the Marine Corps and industry show the need for modernizing driver training systems.

The same concerns and solutions were echoed in the book *Kill Chain* by Christian Brose (2020), which emphasizes the need for a leap to 21st-century technology and a shift from platform-centric to network-centric approaches in defense acquisitions. In addition, Mark A. Miley and Eric Schmidt's paper published on August 5, 2024, in Foreign Affairs Magazine titled

“America Isn’t Ready for the Next Wars of the Future” raised the same concerns about the platform-centric approach. The MCO 3550.14 listed on the resources page and multiple documents related to PM TRASYS were also reviewed (U.S. Marine Corps, 2021). The review included the trade-off study conducted for the common Marine Corps Driver Trainer and articles on the ACV driver and Operator driver simulators published on Inside Defense.com and Breaking Defense.com.

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Study Approach

This study approach adopted here is like the aviation practice of a 360-degree clearing turn, where every aspect of the area is visually assessed prior to proceeding. This study has done the same with the existing driver simulators and the recommendation for change.

The interconnected elements of the Marine Corps’ current operator driver training systems were reviewed from many angles and phases of acquisition to sustainment. The associated current and future learning principles, policies, and previous studies for a standard driver simulator platform conducted by MCSC PM TRASYS 2023 were examined. A collaborative effort of engaging with stakeholders and subject matter experts provided information reflected throughout the paper.

Findings

How Did We Get Here & What Are the Symptoms?

As previously mentioned, the existing landscape of the Marine Corps driver training systems is dispersed due to a historically siloed approach to system capability-based acquisition. Each automotive vehicle program across the command and entities independently acquires its training systems, leading to a proliferation of standalone simulators (see Table 1). The capability-centric acquisition requirement and approach have resulted in redundancies and increased operation and sustainment costs. The symptoms of this fragmentation are evident in high costs, limited scalability, and the inability to standardize data across systems. The existing data extracted vehicle variants lack format uniformity due to proprietary issues and dispersed software licenses.

Additionally, non-combat driving mishaps have not decreased. Ground vehicle mishaps were the leading cause of deaths and injuries in the line of duty in the U.S. military between 2010 and 2021, according to Government Accountability Office Report 21-361. Most ground vehicle mishaps are caused by driver errors in judgment and deficient skill rather than external factors.

The following key factors that contributed to led us this point:

- Siloed Training Systems: Training programs are tailored to specific vehicle types, resulting in duplication of simulators, software, and maintenance. Per MCO 3550.14, funding for acquiring driver simulators is currently allocated to each program office within the PEO LS and other entities for Standard and Nonstandard Training Systems.

MCO 3550.14 defines standard and nonstandard training systems:

"A Standard Training System is a training solution developed and acquired for use with a specific system (e.g., weapons platform, vehicles), family of systems, or item of equipment (including subassemblies and components). Standard Training Systems may be standalone, embedded, or appended.

"Nonstandard Training Systems is a training solution developed and/or acquired independent of, and not directly associated with, a specific weapon system or other item of equipment. Nonstandard training systems may support general military training, system-specific, and non-system specific training requirements."

- High Costs: Each vehicle type requires a separate training system, which increases the costs of hardware, software, operation, and maintenance.
- Interoperability Issues: The presence of proprietary standards for each simulator has created a fragmented landscape, hindering interoperability, data exchange and standardization, and functionalities. In addition to the ascending operation costs of standalone systems, there is a lack of interoperability collaborative efforts, as aimed to be achieved by the TECOM Live Virtual Constructive (LVC) effort.
- Scalability Limitations: Current simulators cannot integrate new functionalities and collect biometric and training incidents in a standardized data format.
- Simulation System Design Flaws: Existing systems lack modular hardware and open-architecture software, which leads to inefficiencies in training module integration and data analysis.

The identified inefficiencies impact costs and contribute to the need for an enterprise driver operator simulator critical to maintaining combat readiness. However, these inefficiencies also present an opportunity to rethink and reimagine the future of Marine Corps individual and convoy driver training. The MCRCDS concept offers a pathway to provide a solution to address inefficiencies and set a new standard for driver training excellence across the Marine Corps.

Discussion

As pointed out in the above sections, the existing USMC driver simulator capability-centric acquisition approach has supported this study.

One measure to address data standardization issues is leveraging the computing power available to collect timely reports and objective analysis from training systems while also being able to extract valid reports that can be used as input to force readiness predictable models. Reconfigurability and consolidated platform for driver operator simulators must include comprehensive biometric data and real-time training incident scenarios using AI and ML. The need to augment the existing Crawl Walk Run (CWR) with Kolb's Experiential Learning Theory Explore, Experiment, and Excel (EEE) learning principle will support the integration of AI in future driver simulation.

Learning Principles and Data Standardization

The current system design acquisition is based on the CWR learning principle. The current training simulators require manually created training evaluation and lack standardized objective evaluation based on human and machine teaming concepts with embedded scoring algorithms to assess performance. The current training delivery method places a higher demand on the instructor, and after-action reviews must be held to identify student mistakes if they are noticed retrospectively. Currently, the training system acquisition and sustainment model omits the requirement for a standard open architecture driver simulator software or AI and ML technology integration, necessitating a paradigm shift. To ensure a successful leap to 21st-

century training, augmenting the existing CWR learning principle with the EEE learning principle grounded in Kolb's for future AI-enabled driver training simulators is crucial. There are no known development initiatives to address inefficiencies leveraging current computing power.

The power of AI and ML is reshaping traditional training methods, such as the CWR principle. Integrating AI and ML augmented by the EEE principle promotes an ongoing learning cycle that encourages trainees to explore new concepts, experiment with them, and excel by refining their skills to meet the demands of continuous learning. This adaptability required in today's dynamic technological environment is presented in the Marine Corps Project Tripoli, and the Army's Synthetic Training Environment (STE) projects are discussed . The Marine Corps Project Tripoli and the Army's STE, showcased on Marine Corps Times and Army.mil, demonstrate how LVC training elements enhanced by AI and ML offer a personalized and immersive training experience. The training starts with basic operations and progresses to complex and adaptive scenarios. The adaptive LVC training environment walks Marines through the basics and urges Marines or soldiers to experiment with different strategies and learn from their experiences.

The combination of an AI-empowered driver simulator augmented with CWR and enhanced with the EEE learning principles ensures that trainees are proficient in fundamental skills and equipped with critical thinking and adaptability, which are essential for modern warfare.

AI involves developing computer systems that can perform tasks requiring human intelligence, such as learning, reasoning, problem-solving, perception, and understanding natural language. Machine Learning is a subset of AI that automatically enables systems to learn and improve from experience. Standardization is the process of establishing and applying consistent protocols, criteria, and specifications across systems. Finally, biometric data refers to individuals' unique physical or behavioral characteristics. Integrating AI, ML, biometric data, and data standardization in driver simulators can generate data to predicate force readiness and identify training gaps. This data helps plan for the desired level in enhancing precise and relevant training scenarios of individualistic and standardized collective training.

The Chief Engineer Role

The Chief Engineer (CHENG) plays a crucial role in this initiative by overseeing these technologies' integration standards to ensure the system's scalability and interoperability while addressing the technical challenges associated with the transition.

Risks and Risks Mitigation

The transition to the MCRCDS carries certain risks. Incorporating AI and data standardization into existing systems presents challenges, including potential data security concerns and the complexity of operating high technological system costs. However, these risks can be mitigated with proper planning, continuous testing, and phased implementation. While the proposed unified training system offers numerous benefits, it has potential risks. Understanding and mitigating these risks is crucial for successful implementation and operation. The primary risks associated with the new system include:

- Technical Complexity: Integrating advanced technologies such as AI and biometric data collection introduces technical complexity that may lead to unforeseen challenges during development and deployment. These technical challenges could negatively impact cost, schedule, and performance.
- Data Security and Privacy: The new system will handle sensitive biometric and performance data, raising concerns about data security and privacy. Ensuring robust cybersecurity measures and compliance with data protection regulations will be critical.

- Cost Overruns and Reduction Measures: The new system's complexity and scale might lead to higher-than-anticipated costs. Budget overruns could occur due to unexpected technical challenges, extended development timelines, or additional unknown resource requirements. Although the initial estimate proposed in this study may seem lower than the average cost in the market, the use of Model-Based Systems Engineering (MBSE), digital documentation, and Commercial Off-the-Shelf (COTS) hardware solutions can help reduce the cost.
- Risk Mitigation: Risk mitigation aims to adopt robust project management, including conducting detailed cost analysis, enhanced cybersecurity measures, and the system's interoperability and scalability to reduce operation and maintenance costs. By proposing a consolidated system, the assumption is to reduce the number of driver simulator systems. The improvements in the reconfigurability and efficiency of the new systems suggest that the decrease in driver simulator systems will not significantly affect throughput or quality of training. A phased fielding and transition approach must mitigate any negative impact on force readiness. By proactively addressing these risks and implementing appropriate mitigations, the potential challenges associated with the new unified training system can be effectively managed, ensuring a successful transition and long-term operational success.

Phased Approach and Cost Analysis

A programmatic phased approach is recommended to ensure a structured and efficient transition to the MCRCDS. This approach allows for stakeholder engagement, phased development, and iterative refinement, ensuring the final system meets all operational requirements and technical standards. The initial study phase focuses on gathering detailed information on the current state of the Marine Corps driver simulators, identifying gaps and challenges, and exploring the potential benefits of transitioning to a consolidated, reconfigurable system.

Study Limitations

Studies are inherently limited by their preliminary nature; with buy-in from stakeholders, the findings must lead to viable solutions. Due to the complexity of the fact-finding process, the large number of existing assets, and time constraints, this study primarily serves as a guide to inform decision-makers.

Benefits to the Marine Corps

The MCRCDS is not just a solution to the current standalone driver simulator problems facing the Marine Corps; it is a strategic investment in the future. By standardizing data, integrating new technologies, and transitioning to a network-based enterprise solution, the Marine Corps will modernize its training standard and nonstandard training systems fleet, reduce costs, and improve readiness. This approach aligns with the Commandant's vision for 21st-century warfare. By embracing new learning principles and technologies and adopting a network-centric approach, the Marine Corps will be better equipped to meet the challenges of the 21st century. The lessons learned from the MCRCDS can be applied to other training systems, such as gunnery and combat crew training systems, ensuring that the Marine Corps remains at the cutting edge of military readiness.

Conclusion and Next Steps

The current landscape of driver simulators across services, including Marine Corps driver training systems, is characterized by a fragmented and inefficient structure that contributes to duplicated efforts, inflated costs, and diminished system performance. The challenges are multifaceted, extending beyond the technical difficulties of software updates,

hardware replacements, and sustainment issues. They include a burdensome logistics footprint that directly impacts force readiness. This status quo is unsustainable, and a cohesive, scalable, and future-proof solution is critical.

The proposed MCRCDS is designed to address these challenges head-on. By net-centric consolidated driver-operator simulators across multiple vehicle types into a unified, adaptable system, the MCRCDS represents a significant advancement in operational efficiency. The proposed solution streamlines infrastructure reduces maintenance and operational expenses, and lays the foundation for a more responsive and agile training capability that can evolve with the Marine Corps' changing needs.

One of the MCRCDS's key advantages is its modular design, which ensures the system can quickly integrate new vehicle types and adapt to emerging technological advancements. By leveraging AI, ML, and standardized data protocols, the system can dynamically adjust training scenarios and provide on-demand, tailored experiences that meet mission-specific needs. This adaptability enhances training effectiveness and ensures scalability for future requirements, making the MCRCDS a rapid response solution capable of evolving with modern warfare demands.

Investing in the MCRCDS is a strategic decision that aligns with the Commandant's vision for 21st-century warfare. By adopting a net system-centric approach and incorporating advanced learning principles, the Marine Corps will significantly enhance its operational readiness and efficiency, ensuring its training systems remain at the cutting edge of military capability. In addition to technological advancements in the future generation of driver simulators, reducing fatal non-combat driving training mishaps is essential.

Strategic Implications

The adoption of the MCRCDS is far more than a technical enhancement; it represents a strategic investment in the Marine Corps' future operational capabilities. By transitioning from platform dependency to a net system consolidated solution and standardizing driver-operator training systems, the Marine Corps will be better positioned to meet the challenges of modern warfare. The efficiencies gained from this system will reduce costs and ensure that the Marine Corps can maintain a high state of readiness across all vehicle platforms.

Moreover, the principles and lessons learned from implementing the MCRCDS can be extended to other critical training systems, such as gunnery and combat crew training. This holistic approach will ensure that the Marine Corps remains at the forefront of military readiness, capable of adapting to the evolving demands of 21st-century warfare.

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