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Achieving Positive Cost Avoidance in the Employment of the Marine Corps Operator Driver Simulator

March 2026

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Naval Postgraduate School

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Prepared for the Naval Postgraduate School, Monterey, CA 93943.

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ABSTRACT

This thesis develops a methodology and an estimate of the Marine Corps Operator Driver Simulator (ODS) training system cost-avoidance potential. It uses historical data on operations and sustainment (O&S) expenditures on the Medium Tactical Vehicle Replacement at each of the Third Marine Expeditionary Force (III MEF) installations and Training and Education Command. This methodology aims to support the Program Manager of Training Systems as it seeks to understand how much ODS usage is required for the ODS site to achieve positive cost avoidance, given the number of vehicle operator authorizations. Using historical data on O&S expenditures, the number of vehicle operator authorizations, and exponential smoothing forecasting, the analysis estimates that positive cost avoidance can be achieved at each III MEF installation by implementing at minimum an 8-hour per year ODS training requirement in the motor vehicle operator training plan. This minimum requirement would achieve an estimated $1.4 million in positive cost avoidance across these installations. Given key performance parameters in the ODS Capabilities Production Document, each ODS site can support this quantity of training. This analysis provides decisionmakers with a data-backed methodology to support ODS training mandates for motor vehicle operators across the fleet.

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LIST OF ACRONYMS AND ABBREVIATIONS

AGTS	Advanced Gunnery Training System
CEN	Cost Element Number
CLS	Contractor Logistics Support
CLIN	Contract Line-Item Number
CPD	Capabilities Production Document
CY	Constant Year
EVAMOSC	Enterprise Visibility and Management of Operating and Support Cost
FOC	Full Operating Capability
FMF	Fleet Marine Force
FY	Fiscal Year
GAO	Government Accountability Office
HMMWV	High Mobility Multi-Purpose Wheeled Vehicle
IOC	Initial Operating Capability
JLTV	Joint Light Tactical Vehicle
KPP	Key Performance Parameter
LVSR	Logistics Vehicle System Replacement
MARDIV	Marine Division
MATV	MRAP All-Terrain Vehicle
MAW	Marine Air Wing
MCAS	Marine Corps Air Station
MEF	Marine Expeditionary Force
MCB	Marine Corps Base
MLG	Marine Logistics Group
MOS	Military Operational Specialty
MOVOC	Motor Vehicle Operator Course
MRAP	Mine Resistance Ambush Protected

MROC	Marine Requirements Oversight Council
MTVR	Medium Tactical Vehicle Replacement
ODS	Operator Driver Simulator
O&M	Operations and Maintenance
O&S	Operations and Sustainment
PM TRASYS	Program Manager for Training Systems
ROI	Return on Investment
SYSCOM	Marine Corps Systems Command
TECOM	Marine Corps Training and Education Command
TFSMS	Total Force Structure Management System

EXECUTIVE SUMMARY

This research develops a methodology and provides an estimate of the Marine Corps Operator Driver Simulator (ODS) training system's cost avoidance potential using data from four different Marine Corps installations. The ODS is an immersive simulator training platform that provides Marine tactical vehicle operators with the ability to conduct simulated driving scenarios to complement their real-world training. The Marine Corps developed the ODS to mitigate tactical vehicle accidents by introducing a safer alternative for training its vehicle operators and developing essential skills.

The Marine Corps currently operates the ODS at eight installations. Program Manager for Training Systems (PM TRASYS), which is a Direct Reporting Program Manager to Marine Corps Systems Command (SYSCOM), is responsible for the ODS program. Professionals at PM TRASYS seek to understand how much usage of the ODS at each installation is necessary such that the ODS costs are offset. The central assumption of this research is that training in the ODS is both safe and effective, and that ODS training should be considered as part of Marine units' training plans. The potential benefits of ODS training can be two-fold: it provides Marines with a totally safe training environment by mitigating all risks associated with operating live vehicles in hazardous terrain and complex scenarios, and operations and sustainment (O&S) costs associated with the ODS are much cheaper than those associated with real vehicle operations. One of the main drawbacks to using the ODS is the lack of real feedback. While modern simulators have extremely high fidelity, the physical and sensory attributes to training in a real vehicle cannot be perfectly simulated. Hence, it is important to evaluate the tradeoff between ODS and real vehicle training such that the Marine Corps will benefit by training its Marines risk-free in various scenarios while avoiding costs tied to real vehicle operations.

In this study, I collected data on ODS and real vehicle O&S expenditures at the Third Marine Expeditionary Force (III MEF) installations: Marine Corps Base (MCB) Hawaii, MCB Okinawa, Marine Corps Air Station (MCAS) Iwakuni, and the Fort Leonard Wood (FTLW) Marine Corps Detachment. FTLW is home to the training school for the Marine Corps tactical vehicle operators. From this data, I documented patterns in the O&S

spending on ODS and real vehicles from FY2020 to FY2025. I then constructed a cost avoidance model for different scenarios of ODS training plans to determine how much spending could be avoided by training in the ODS instead of live tactical vehicles. To achieve positive cost avoidance, the amount of costs avoided by training in the ODS had to be greater than the costs associated with the O&S of the ODS systems themselves.

I find that based on the most recent cost data, positive cost avoidance can be achieved at each of the III MEF installations if each motor vehicle operator trains for eight hours per year or twenty miles per year. The ODS Capabilities Production Document (CPD) includes a KPP (KPP) that states the ODS will be operationally available for training for 38 hours per week. Given the existing number of ODS systems at each installation, eight hours of ODS training for each motor vehicle operator is feasible. The 8-hour per year benchmark would achieve an estimated $1.2 million in CY$20, or $1.4 million in CY$26, of positive cost avoidance across these installations.

Currently, training in the ODS is not a requirement in fleet Marine units' training plans. However, Marines at the Fort Leonard Wood school house are required to train for 4.66 (280 minutes) in the ODS, and positive cost avoidance is currently being achieved there.

The cost avoidance model developed here is easily adjustable to support decisionmakers to account for any combination of hours or miles trained in the ODS to generate an estimate of cost avoidance. Yet this research has limitations defined by three main facets. The first is the accuracy and availability of complete cost data associated with the O&S of real vehicles at each command. The second is a complete and accurate estimate of the future costs associated with the ODS program and the continued operations at each ODS site. The third stems from accuracy on the number of motor vehicle operators at each installation: while the Total Force Structure Management System (TFSMS) allows users to view the number of vehicle operator authorizations at each command, it does not show the actual number of operators physically present at each command.

After conducting this research, my recommendations are two-fold. The first is that SYSCOM urges TECOM to modify the Motor Vehicle Operator Training and Readiness

Manual to include a certain minimum of hours of ODS training for each individual motor vehicle operator every year. The second is that PM TRASYS consider my cost avoidance formula and, in the future, include a cross-installation metric so their cost avoidance calculations may become more granular and system specific. In the longer term, my recommendations include collecting more granular data and assessing the cost avoidance generated by the minimum hours of ODS training, identifying any challenges but also opportunities for maximizing the effectiveness of motor vehicle operator training.

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I. INTRODUCTION

This research is focused on the Marine Corps Operator Driver Simulator (ODS) training system. The ODS is an immersive simulator training platform that provides Marine tactical vehicle operators with the ability to conduct simulated driving scenarios to complement their real-world training. Developing the ODS is one of the steps the Marine Corps has taken to mitigate and prevent tactical vehicle accidents by introducing a safer alternative for training its vehicle operators and developing their essential skills.

The Marine Corps currently operates the ODS at eight installations. Program Manager for Training Systems (PM TRASYS), a Direct Reporting Program Manager to Marine Corps Systems Command (SYSCOM), is responsible for the ODS program. Professionals at PM TRASYS seek to understand how much usage of the ODS at each installation is necessary such that the ODS sustainment costs are offset. The central argument of this research is that training in the ODS is both safe and effective, and that ODS training should be incorporated into Marine units' training plans. Right now, it is not a requirement, unlike in the aviation community. The benefits of ODS training are two-fold. First and foremost, it provides Marines with a totally safe training environment by mitigating all risks associated with operating live vehicles in hazardous terrain and complex scenarios. Second, operations and sustainment (O&S) costs associated with the ODS are much cheaper than those associated with real vehicle operations.

The purpose of this research was to develop an appropriate method to calculate cost avoidance in the operations of these ODS systems. To do this, I collected cost data associated with operating tactical vehicles in real life and determined how much spending could be avoided by training in the ODS instead of in live tactical vehicles. To achieve positive cost avoidance, the amount of costs avoided by training in the ODS had to be greater than the costs associated with the O&S of the ODS systems themselves. With a data-backed argument for the utilization of the ODS, SYSCOM may urge decisionmakers to drive higher participation in ODS training.

This research focused on the Third Marine Expeditionary Force (III MEF) installations and the Fort Leonard Wood Marine Corps detachment. The III MEF installations are Marine Corps Base (MCB) Hawaii, MCB Okinawa, and Marine Corps Air Station (MCAS) Iwakuni. By constructing my cost avoidance model, I found that positive cost avoidance can be achieved at each III MEF installation if each motor vehicle operator trained in the ODS for eight hours per year or drove at least twenty training miles per year starting in FY2026. Marines at the Fort Leonard Wood school house are already required to train for 4.66 hours in the ODS, and positive cost avoidance is currently being achieved there.

Eight hours of training by each operator would achieve approximately $1.2 million in positive cost avoidance across these installations, and twenty training miles driven would achieve approximately $2.2 million in positive cost avoidance. All dollar figures in this thesis are in constant year 2020 dollars (CY$20) unless otherwise stated. The ODS Capabilities Production Document (CPD) includes a Key Performance Parameter (KPP) that states the ODS will be operationally available for training for thirty-eight hours per week. Given the number of ODS systems at each installation, eight hours of ODS training for each motor vehicle operator is supportable.

A. PROBLEM STATEMENT

The Marine Corps currently lacks a data-driven framework to deliberately achieve positive cost avoidance in the employment of the Operator Driver Simulator across its installations.

B. RESEARCH QUESTIONS

1. What is an appropriate methodology to calculate cost avoidance when different commands document largely dissimilar O&S costs for real vehicles?
2. Do ODS O&S costs vary based on usage or geographical location?
3. Can ODS systems support enough simulator training to achieve positive cost avoidance?

To answer my research questions, I conducted quantitative analysis and created a model to visualize various outcomes based on user inputs. I gathered data from multiple sources and devised a multi-phase equation based on the data points I consolidated. I utilized three main data sources to gather the necessary information to conduct my analysis. First, I used the Total Force Structure Management System (TFSMS) to identify the number of Motor Vehicle Operator MOS authorizations at each of my desired locations. Then, I used EVAMOSC to calculate how much each major command spends each year to operate its MTVRs. Finally, I used PM TRASYS logs to quantify all costs associated with operating the ODS at each location and to identify trainee throughput. I then organized the data in a way that allowed me to create a calculation in Microsoft Excel to determine possible levels of cost avoidance at each ODS location.

To calculate cost avoidance, I multiplied each command's number of motor vehicle operators at a certain installation by a hypothetical number of miles or hours. I then multiplied those products by each command's cost to operate an MTVR per hour and then per mile. I then added those products together, which gave me a total cost to operate an MTVR at one installation, capturing each command's expenditures in one dollar figure. I repeated that process for each installation. I then subtracted the cost to operate the ODS systems at each corresponding installation from those values, giving me the net cost avoidance at each installation.

After collecting O&S costs for the ODS systems at each installation from PM TRASYS, I observed no indication that usage levels or geographical location significantly affected O&S costs. Their differences in reported O&S costs varied due to the number of simulators at each site. After determining the number of hours required to theoretically achieve positive cost avoidance at each installation, I concluded that each site could in fact support that amount of training.

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II. BACKGROUND AND LITERATURE REVIEW

Between FY2010 and FY2019, the Marine Corps reported twenty fatal tactical vehicle accidents, thirteen of which were caused by vehicle rollovers (GAO, 2021). Even before this timeframe, the Marine Corps realized a need for a safe tactical vehicle training system and began fielding the Operator Driving Simulator (ODS) to provide Marines with a virtual, immersive environment for building foundational driving skills, conducting sustainment training, and safely practicing complex scenarios. The ODS reached full operating capability (FOC) in 2013 (PM TRASYS, 2024).

The Marine Corps currently employs the ODS at eight locations: MCB Quantico, MCB Camp Pendleton, MCB Camp Lejeune, Marine Corps Air Ground Combat Center Twentynine Palms, MCB Okinawa, MCAS Iwakuni, MCB Hawaii, and Fort Leonard Wood, the home of Motor Vehicle Operators Course (MOVOC). This system can currently support training on three distinct families of vehicles, but this research will focus on the Medium Tactical Vehicle Replacement (MTVR) variants. The ODS is used for initial and sustainment training for Marines in the motor transportation Military Occupational Specialty (MOS) as well as incidental drivers. Marine Corps Systems Command (SYSCOM) seeks to achieve positive cost avoidance in its employment of the ODS. Cost avoidance in this research is measured by the amount of spending "avoided" by training in the ODS instead of operating a tactical vehicle in real life. There is currently not a data driven metric that can help decisionmakers drive participation in simulator-based training, and simulator training is often absent from unit training plans. The aviation community has determined an appropriate mix of simulated and real-world training, but this does not exist in the motor vehicle operator community. I have hypothesized that this leads to the under-utilization of the ODS, and therefore, unnecessary increased spending and incurrence of unnecessary risk in real vehicle operations.

Aside from the potential cost avoidance benefits of simulator training, the ODS provides vehicle operators with the opportunity to train in dangerous and complex scenarios while completely mitigating risk. As Marines seek to prepare for any operational environment, it is important that they are provided with opportunities to safely train in difficult scenarios that may be impossible or extremely risky to conduct in a live training environment. Marines stationed in Hawaii will never get the opportunity to train in snowy or icy conditions at their home station, but they must be prepared to do so in the event they are deployed to places such as Russia or North Korea. The ODS can simulate this type of scenario for them though, and they may repeatedly train that scenario with no risk to themselves or their vehicle. This research aims to provide decisionmakers with credible data so they may drive higher participation in these training systems to not only avoid increased spending, but to safely prepare Marines for high-stakes operating conditions.

ODS usage data including hours of operation and users trained is collected monthly to support scheduling and distribution across installations. However, while utilization is tracked, the Marine Corps lacks an appropriate analytical framework to determine how much usage of each ODS is required to achieve positive cost avoidance across the eight aforementioned installations. Leadership at PM TRASYS in Orlando, Florida seeks to determine how much ODS usage at each installation is necessary to achieve positive cost avoidance. However, this research is not entirely driven by cost savings. Positive cost avoidance is a baseline goal, but the safe training of the Marine Corps' vehicle operators and the avoidance of accidents are the ultimate mission. By identifying installations that are not leveraging the ODS to its full potential, SYSCOM may provide Marine Corps leadership with the data-backed insight needed to drive higher participation. This will not only improve force readiness and training safety but also generate cost avoidance through reduced tactical vehicle usage.

Within the Marine Corps, every Marine is assigned a primary MOS, for which they attend a specialized training period of instruction following their basic combat training post boot camp. Marines assigned as Motor Vehicle Operators attend a 38-day period of instruction at Fort Leonard Wood in Missouri. Fort Leonard Wood is a U.S. Army Base but is home to a Marine detachment which administers MOVOC. At this school, Marines are trained to operate two families of tactical vehicles: the MTVR and the Logistics Vehicle System Replacement (LVSR). MOVOC trained Marines to operate the High-Mobility Multi-purpose Wheeled Vehicle (HMMWV) up until 2021, at which point, the Fleet Marine Force (FMF) changed the MOS manual such that students need train only on medium (MTVR) and heavy (LVSR) tactical vehicles. The HMMWV, consequently, became an incidental platform, requiring a separate, follow-on course to obtain its operating license. Similarly, the new Joint Light Tactical Vehicle (JLTV), which is currently being fielded to the Marine Corps to phase out the HMMWV, also requires a separate licensing course. The Marine Corps detachment at Fort Leonard Wood is home to twenty-four ODS systems. The current MOVOC training plan prescribes that each Marine train in the ODS for 4.66 hours (Headquarters, U.S. Marine Corps, 2019).

The Motor Vehicle Operator's role is primarily to provide logistical support by loading and transporting supplies with the aforementioned vehicle types and their associated trailers. Secondary and tertiary mission sets include the transportation of ground troops and route clearance and reconnaissance (COOL, 2025). These vehicles may also be outfitted with medium and heavy machine guns with which to defend themselves. Motor Vehicle Operators are trained to man and operate these weapons as well. Figures 1 through 4 are graphics depicting these vehicle variants.

Figure 1. Joint Light Tactical Vehicle. Source: Keller (2024).

Figure 2. High Mobility Multi-Purpose Wheeled Vehicle. Source: Military.com (2025).

Figure 3. Medium Tactical Vehicle Replacement. Source: PR Newswire (2023).

"MTVR" is the name of the family of vehicles that belong to that program. It is important to note that there are multiple variants of the MTVR. These include short-bed and long-bed variants, which each can be "un-armored" or "up-armored." One variant, for example, is the AMK23. This would be an up-armored, short-bed without a winch. Should it be an AMK25, it would be up-armored, short-bed, with a winch. Another example would be the MK27 or MK29. These are both un-armored, long-bed variants. The MK27 has no winch, while the MK29 does have a winch. The MTVR can be "dressed" so that it may transport ground troops in the bed, or "undressed" so that it can carry cargo.

Figure 4. Logistics Vehicle Service Replacement. Source: Defense Industry Daily (2025).

In the 21st Century, the Department of War has seen casualties from tactical vehicle accidents mount at a staggering rate. The Department of War defines a Class A accident as one that results in the death or permanent total disability of a servicemember, or damages costing $2 million or more. A Class B accident is one that results in permanent partial disability, inpatient hospital care for three or more individuals, or damages costing $500,000 or more. From FY2010 through FY2019, the Marine Corps alone saw 21 Class A and B tactical vehicle accidents, thirteen of which were the result of vehicle rollovers. Out of 478 total accidents reported during this period, 83% were the result of driver error. Over this same period, the Marine Corps saw an annual average of 2.3 MTVR accidents per every 1,000 vehicles operated (McDowell, 2024; United States Government Accountability Office, 2021).

These accidents are not always due to treacherous operating conditions, though. They can easily happen during broad daylight on a flat road, simply because the operator took a turn too fast. Up-armored vehicles are top-heavy, which lends to their rolling over when not operated carefully. Their top-heaviness magnifies risk when they are driven on windy, uneven, unpaved roads. Motor Vehicle Operators are often called upon to transport bulk cargo and personnel along unimproved roads, through steep terrain, and during times of poor visibility. Many Marine Corps installations are mountainous, and many of the roads utilized during training run through rugged, steep terrain. Not only is the driver at risk under these conditions, but more so are the Marines riding in the back of the MTVR (McDowell, 2024).

Marine Corps Training and Education Command (TECOM) submits that the ODS offers significant operational impacts for the FMF, as they publish: "This system provides Marines familiarity with these vehicles prior to driving them in austere environments while avoiding costs for fuel consumption and the wear-and-tear on the actual vehicles. Twenty percent of the required driving mileage to obtain a tactical vehicle driver's license can be accomplished using the ODS" (TECOM, 2025). Beyond entry level training, the ODS can be leveraged for sustainment training across the motor vehicle operator population, as it can help Marines maintain their essential skills, while also providing a wide range of scenarios and environments that are unachievable at many installations (Marine Requirements Oversight Council, 2011).

The ODS is a computer-based driving simulator designed to train vehicle operators and incidental drivers. Incidental drivers are Marines with a primary MOS other than 3531 who earned a license to operate a tactical vehicle after entering the FMF. The system can train tactical vehicle operators on three distinct families of vehicles. These include the MTVR, both un-armored and up-armored, the up-armored HMMWV, and two MRAP variants. The ODS uses a modular, manufactured cab system that can support interchangeable dashboard sets to replicate the functionality of each of these vehicle types. The user will sit inside the cab and see out, viewing a 180-degree electronic display. The display screens will render output based on input from the driver, i.e., the driver pushes the accelerator, and the screens' output will depict the vehicle moving forward (United States Marine Corps Training and Education Command, 2025).

Figure 5. Operator Driver Simulator Program Picture. Source: PM TRASYS (2024).

The ODS CPD outlines that "The USMC ODS provides realistic training that simulates the visual, aural/audio, and haptic cues for the driver of a tactical vehicle. The USMC ODS reproduces the behavior of a vehicle in motion under varied road surfaces, passenger and cargo configurations, weather conditions, and stages of daytime and nighttime illumination" (Marine Requirements Oversight Council, 2010). Terrain databases the ODS features include:

- On/Off Road
- Mountains
- Forest
- Eastern Europe
- Middle East
- Serpentine/Obstacle Course (United States Marine Corps Training and Education Command, 2025)

ODS capabilities include the following, which are published by TECOM:

- Provides exposure to various immersive training scenarios for training and testing in various weather conditions, road types or traffic environments.
- Provides After Action feedback.
- Models the effect of different weather patterns, various terrain and tactical environments.
- Teaches Marines to drive under a variety of potential road conditions.
- Provides incidental level and driver sustainment level training.
- Trains Marines on a performance evaluated system of licensing and sustainment in accordance with the USMC Technical Manual and Motor Transport Licensing Official Manual.
- Provides an operational check of a Marine level of proficiency.
- Creates, stores, utilizes, and shares scenarios with other units through digital format acceptable transportation modality (U.S. Marine Corps Training and Education Command, 2025).

The ODS CPD also explains that the ODS system was largely fabricated with commercial-off-the-shelf (COTS) components. PM TRASYS is the ODS material solution provider and is responsible for future modifications to the ODS as new requirements are identified. The ODS program reached Initial Operating Capability (IOC) in 1999, and FOC in 2013. One of KPPs outlined in the CPD states that the operational availability for each ODS system is 95%, or 38 of 40 hours per week. The supporting rationale for this threshold of availability states that:

> Operational Availability is defined as the probability that the system will be ready to perform its specified function, in its specified and intended operational environment, when called for at a random point in time by the User. Availability as measured by the user is a function of how often failures occur and corrective maintenance is required, how often preventative maintenance is performed, how quickly indicated failures can be isolated and repaired, how quickly preventive maintenance tasks can be performed, and how long logistics support delays contribute to down time... (Marine Requirements Oversight Council, 2011, p. 16)

Figure 6 is a collage of photos taken from the ODS CPD displaying the ODS trailer support system, the ODS control room, the cab and screen display, and the dashboard set up.

Figure 6. Operator Driver Simulator Housing, Cab, Display, and Dashboard. Source: Marine Requirements Oversight Council (2010).

In their study aimed at determining an appropriate mix of simulator and live training, Dunne, Cooley, and Gordon (2014) developed a cost avoidance formula centered around the Advanced Gunnery Training System (AGTS) and the M1A1 tank. The study included three Marine Corps tank crews that trained on the AGTS and their subsequent performance at a live-fire qualification range. Due to a significant improvement in live-fire performance after having trained in the AGTS, Dunne et al. (2014) concluded that simulator training does assist in building technical skills that transfer to the real world and argued that substantial costs may be avoided by training warfighters in simulators to complement their real-world training. Simply put, simulator training could avoid costs by refraining from firing live rounds through the tank and instead training in the AGTS.

Dunne et al. (2014) explained their cost avoidance model by stating "In equation form, where LRa = costs avoided by not firing live rounds, Com = simulator operation and maintenance costs, and CAnet = net costs avoided" (Dunne et al., 2014), and their formula is:

$$\Sigma\,[\mathrm{LR_a}] - \Sigma\,[\mathrm{C_{om}}] = \mathrm{CA_{net}}$$

Dunne et al. (2014) calculated approximately $1.5 million in FY13 dollars in cost avoidance over the three-month study. They essentially subtracted the costs to operate and maintain the AGTS from the cost of live M1A1 rounds. Every round fired in the simulator was a live round expense "avoided."

Dunne et al. (2014) documented several key limitations in their study, to include its scope, gaps in data collection, and training standardization. They noted that since the study included just three tank crews in a single location over three months, the study was simply too small to generalize the cost avoidance and training benefits that the AGTS could have had on the entire Marine Corps tank community. The authors also noted that the AGTS software was incapable of capturing certain shot performance data and exporting it in "an easily readable format," which necessitated manual processes which may have added "variability and inconsistency" due to human error (Dunne et al. 2014). The authors also noted that the AGTS training iteration was developed by a local Marine Corps authority and not by the tank community training office and therefore, the findings from the study should be carefully considered when generalizing them against the larger tank community (Dunne et al. 2014).

In their conference paper "Calculating Simulation-based Training Value: Cost Avoidance and Proficiency," Cooley, Seavers, Gordon, Roth and Rodriguez (2015) laid out the foundation for determining cost avoidance for multiple military platforms and discussed the return on investment (ROI) of simulation-based training systems. They admitted that various qualitative benefits to simulation training exist but are difficult to include in the calculation of cost avoidance. Simulators can provide scenarios that present the trainee with precarious environments which are both difficult and risky to recreate for training purposes and take virtually all the risks of training live out of the equation. Simulators allow trainees to conduct repetitions and make mistakes without the consequences associated with operating real tactical vehicles. While these factors add significant value to the ROI, they are difficult to directly include in the cost avoidance calculation, as they are qualitive in nature. Cooley et al. (2015) then focused their cost avoidance calculations on quantitative metrics. They used the following equation to calculate total cost avoidance across a variety of systems, to include shooting simulators, the ODS, and flight simulators:

$$\begin{aligned}\mathrm{CA}_{\mathrm{net}} = \ & \Sigma\,(\text{Number of Simulated Rounds Fired}) \times (\text{Cost per Round}) \\ & + \Sigma\,(\text{Number of Simulated Vehicle Miles Driven}) \\ & \times (\text{Cost Per Vehicle Mile}) \\ & + \Sigma\,(\text{Number of Simulated Aircraft Hours Flown}) \\ & \times (\text{Cost per Aircraft Hour}) \\ & - \Sigma\,(\text{Cost to Operate and Maintain the Simulator Systems})\end{aligned}$$

Over the three-year study, Cooley et al. (2015) discovered that the net cost avoidance of all simulator systems combined was significant, with avoided spending from FY2012 to FY2014 totaling nearly $12.5 million. They identified that particular systems produced minimal cost avoidance on certain years but argued that these simulator systems are certainly worth having due to the qualitative benefits they provide (Cooley et al., 2015).

While these formulas can provide decision makers with total cost avoidance figures across a variety of systems, more granular analysis on a specific system may be made while factoring in different major commands and installations. To complete my research, I developed a new model, centered around the potential trainee population and by-unit O&S costs to calculate both gross and net cost avoidance at each ODS site. The greatest difference between my cost avoidance analysis and these studies is that I considered the different commands at each installation and factored in how much they each have spent on the O&S of a specific platform over a five-year period to better estimate future levels of cost avoidance at different installations.

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III. COST AVOIDANCE MODEL AND ANALYSIS

The central objective of this research is to determine an appropriate method by which to calculate the cost avoidance of ODS sites across Marine Corps installations. This is a case-by-case analysis of individual ODS sites at each of the III MEF Marine Corps installations and Fort Leonard Wood to determine how much usage of each system is required in order to achieve positive cost avoidance at those sites. This analysis was based off the number of Motor Vehicle Operator MOS authorizations at each installation, the costs associated with operating the MTVR live at each III MEF command and TECOM, and the costs associated with sustaining the ODS systems at each III MEF installation and Fort Leonard Wood. The methodology is driven by three core components: data collection, analytical framework, and evaluation criteria.

Evaluation criteria I used for my research included but were not limited to:

- Simulator usage hours and miles pulled from PM TRASYS logs
- Actual usage relative to possible utilization based on MOS authorizations
- Cost avoidance estimate modeled by the savings or expenditures from simulator-based training compared to live-vehicle operations (factoring in all cost elements provided by EVAMOSC)
- CLS costs associated with the operations of the ODS systems at each III MEF installation and Fort Leonard Wood

A. APPROACH

To answer the primary and supplemental research questions, I collected data from multiple sources. First, I explored simulator usage data by pulling usage records for ODS systems from PM TRASYS. Communication with current professionals at PM TRASYS was conducted throughout the conduct of this research, and they granted me access to their Teams page to view these records, which included data on simulator uptime, training hours conducted, user throughput, and the types of training events executed per location over the past three fiscal years. PM TRASYS also shared contractor logistics support (CLS) data for the ODS systems with me, which provided the costs associated with the operations and maintenance (O&M) of the systems.

Second, I researched the O&S costs associated with the operations of real MTVRs. I accessed this data on the Enterprise Visibility and Management of Operating and Support Cost (EVAMOSC) system, which aggregates O&S data for weapon systems across the Department of War. I pulled cost data from FY2020 through FY2025 for the MTVR and determined the costs to operate each III MEF-owned vehicle per year, per mile, and per hour. For the purpose of this research, I simply included all variants in the MTVR family in my search, as the MTVR ODS configuration does not discriminate beyond un-armored or up-armored dash sets.

Finally, to determine possible usage levels of the ODS, I formulated my main independent variables. I utilized the Total Force Structure Management System (TFSMS) to identify the number of existing Motor Vehicle Operator MOS authorizations from each major command at each of the III MEF installations. This key piece of information gave me a baseline to determine possible levels of ODS usage at each installation, and more accurately estimate cost avoidance. After compiling and refining these sets of data, I designed a cost avoidance model based on the independent variable. The number of authorized MOS billets at each installation indicated the potential trainee population and ultimately allowed me to calculate cost avoidance achievable by each ODS site.

B. DATA COLLECTION AND ORGANIZATION

The data used in this research come from EVAMOSC, TFSMS, and PM TRASYS documentation.

1. Vehicle O&S Data

This research focused on the MTVR because while the ODS currently has three main configurations, the Marine Corps is currently phasing out the HMMWV and replacing it with the JLTV, and the Marine Corps has completely phased out the MRAP and MATV. So, over the last three FYs, the MTVR configuration has seen the most usage and will likely continue to do so until the JLTV configuration is FOC. I also filtered my search by major command, meaning I pulled data from each major subordinate element within III MEF, while also searching for the III MEF command element and TECOM. These subordinate elements included 3d Marine Division (MARDIV), 3d Marine Logistics Group (MLG), and 1st Marine Air Wing (MAW). I collected O&S costs for the MTVR from FY2020 through FY2025. I kept all cost figures at CY$20. All dollar figures in this paper have been converted to CY$20. EVAMOSC also allows the user to filter their search by Cost Element Number (CEN), which separates O&S data by different cost elements. These include Operations, Unit-level Maintenance, Operating Hours, Hardware modifications, and so on. EVAMOSC outputs a chart that depicts "Total O&S Dollars by Cost Element and Fiscal Year." I decided to include all CENs in my search, so that a complete representation of costs was included. This allowed me to pull the total dollar figure that each major command spent on each of its vehicles per year. EVAMOSC populates the number of vehicles by type that each command owns per FY, the number of total operating hours per vehicle type, the number of total operating miles per vehicle type, and the total cost per year per vehicle. Figure 7 is the chart EVAMOSC provides depicting these values for the III MEF command element. Charts for the other major commands I researched can be found in the Appendix.

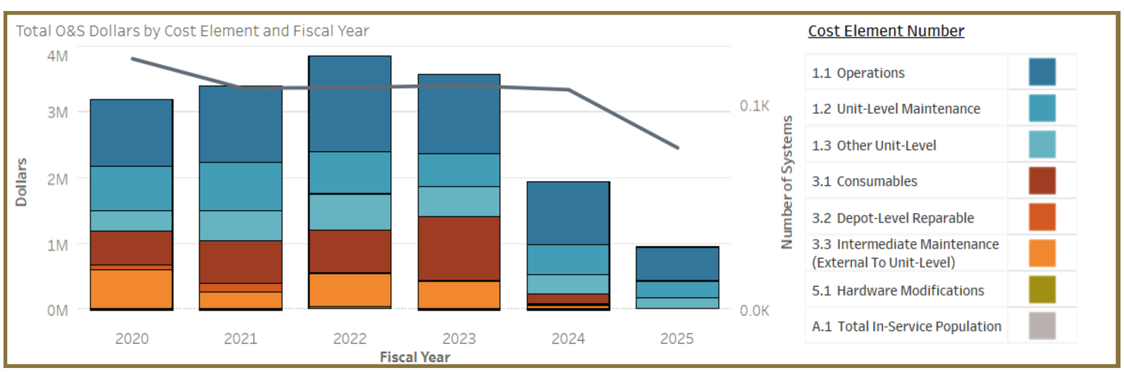

Figure 7. III MEF Total O&S Dollars by Cost Element and Fiscal Year

Using those numbers, I calculated how much it cost each major command to operate each vehicle per mile and per hour by dividing the total number of hours operated and miles driven by their number of vehicles. That gave me the average number of hours operated, and miles driven per vehicle. I then divided the total cost per vehicle by the average number of hours operated and the average number of miles driven. I then did this for each year and each command. This process of operations can be seen in Table 1.

Table 1. 3d MLG Average MTVR Cost per Hour Formula

=G9/I9

Year	No. Systems	Total Miles	Total Hours	Total Cost/Vehicle	Avg Miles/Vehicle	Avg Hours/Vehicle	Cost/Mile/Vehicle	Cost/Hour/Vehicle
2020	266	189,013	59,015	$ 65,455.69	710.58	221.86	$ 92.12	=G9/I9
2021	239	385,182	76,709	$ 64,426.01	1611.64	320.96	$ 39.98	$ 200.73
2022	247	239,257	69,917	$ 80,625.70	968.65	283.06	$ 83.23	$ 284.83
2023	269	211,545	74,355	$ 73,707.41	786.41	276.41	$ 93.73	$ 266.66
2024	270	214,401	65,933	$ 34,118.45	794.08	244.20	$ 42.97	$ 139.72
2025	195	133,306	50,287	$ 8,433.41	683.62	257.88	$ 12.34	$ 32.70

I then used Microsoft Excel to exponentially smooth those costs over the five years to estimate costs in the sixth year. I also fit a linear equation to the raw data points to provide a tertiary means to estimate costs in future years. One of these charts is depicted below. Figure 8 depicts the III MEF command element's cost per hour to operate an MTVR between FY2020 and FY2026 in CY$2020.

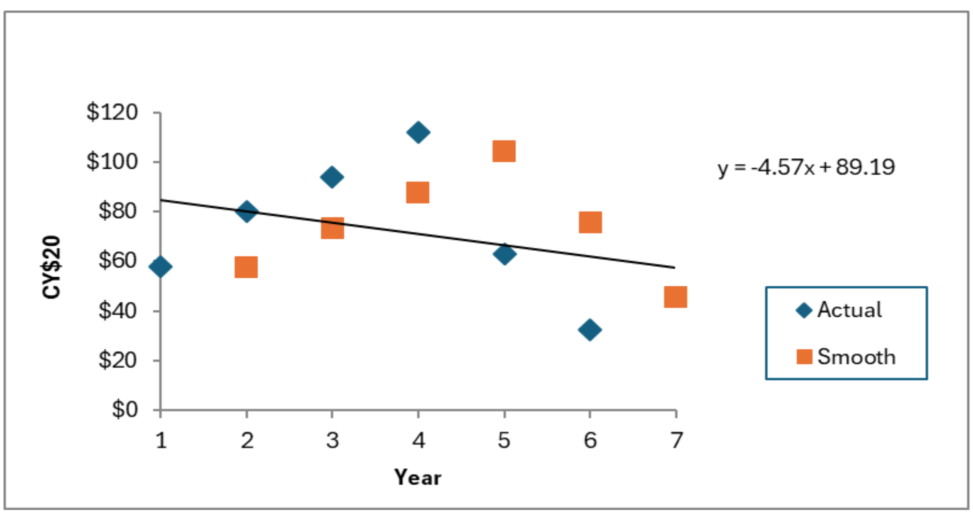

Figure 8. III MEF O&S Cost per Hour

The blue points depict the actual cost per hour each year, with year 1 being FY2020. The orange points represent the exponentially smoothed values or the estimated cost per hour each year. Similar graphs for the other commands researched and the cost per mile at each can be found in the Appendix.

2. ODS Usage Data

PM TRASYS granted me access to their Teams page so that I may analyze ODS usage data. While this data did not directly factor into my cost avoidance calculation, I was able to use it to determine which "sites" have been achieving positive cost avoidance. This data was broken out by installation, or ODS site, so I focused on the III MEF installations and the Motor Vehicle Operators school house, which included MCB Hawaii, MCB Okinawa, MCAS Iwakuni, and Fort Leonard Wood. I pulled data from FY22 through FY25 and focused on the "Marines Trained" and "Hours Trained" data points. To compliment this metric, I used TFSMS to see how many Motor Vehicle Operator authorizations exist at each of these installations in FY26. It is important to note that often times, units in the fleet will not possess as many Motor Vehicle Operators that are authorized, but for the purpose of this research, I assumed that each unit did possess the number of operators that they were authorized. Table 2 depicts the number of Motor Vehicle Operator authorizations that currently exist in each major III MEF command (vertical axis) as well as at each III MEF installation (horizontal axis).

Table 2. Vehicle Operator Authorizations per Installation by Unit

Vehicle Operators	III MEF	3d MLG	3rd MARDIV	1st MAW	TECOM	Total
OKI	95	187	251	72	-	605
IWAKUNI	-	5	-	35	-	40
HAWAII	6	38	51	17	-	112
FLTW	-	-	-	-	1,800	1,800

By comparing this TFSMS data with ODS usage data, I was able to see how much participation the ODS sites were producing relative to how many vehicle operators are authorized to each of those installations. Table 3 depicts the number of Marines Trained

(MT), Hours Trained (HT), Miles Driven (MD), and how many hours each Marine Trained at each ODS site in FY2024.

Table 3. FY24 Operator Driver Simulator Usage Data

FY24	MT	HT	MD	Hr/Marine
HAWAII	9	32	352	3.56
OKI	345	517	4,132	1.50
MCASI	71	245	2,163	3.45
FTLW	4,297	3,929	41,374	0.91

We see that at MCB Okinawa (depicted by "OKI"), there were 605 vehicle operator authorizations, but only 345 Marines trained in the ODS for an average of 1.5 hours each. This suggests that the ODS systems at MCB Okinawa, of which there are five, were somewhat underutilized during that year. Conversely, there are 40 vehicle operator authorizations at MCAS Iwakuni (depicted as "MCASI"), but the two ODS systems at that installation trained 71 Marines for an average of 3.45 hours each. While this data point suggests that the ODS systems at MCAS Iwakuni were appropriately utilized, this does not guarantee positive cost avoidance. The reason we see a greater number of Marines trained than the number of Marines physically present at that installation is because each time a Marine conducts training at the ODS site, they are counted. So, one individual Marine may train on multiple occasions and be counted as another "Marine Trained" each iteration. As we look at the Fort Leonard Wood schoolhouse, we see that 4,297 Marines trained for 3,929 hours, which equates to 0.91 hours per Marine. The Motor Transportation Instruction Company training plan prescribes that each Marine will train in the ODS for 4.66 hours, though, and there are only up to 2,200 trainees a year, so again we see an instance of individual Marines training on multiple occasions but being counted as another "Marine Trained" each time.

3. ODS Cost Data

PM TRASYS shared CLS data for the ODS systems which depicted each cost element to sustain ODS operations at each site during each Option Year (OY). This data ran from 2021, which was the "Base Year," through 2025. It was broken down by Contract Line-Item Number (CLIN), and each CLIN had a total cost tied to it. On top of the cost elements factoring into the total CLIN cost, the ODS network requires annual security scans which cost $20 thousand, as well as an authority to operate (ATO), which costs $164 thousand every three years. I added these additional costs to the total CLIN costs to determine a complete cost figure to operate the ODS at each site. Once I had a total dollar figure for each ODS site for each year, I again exponentially smoothed those numbers to estimate costs in the next year and fit a linear equation to the raw data points. Figure 9 represents the costs for the MCB Hawaii ODS site. Charts for the Fort Leonard Wood, Iwakuni, and Okinawa ODSs can be found in the Appendix. Similar to the vehicle O&S chart, the blue dots represent the actual cost each year, and the orange dots represent estimated costs. Year 1 is the Base Year, or 2021.

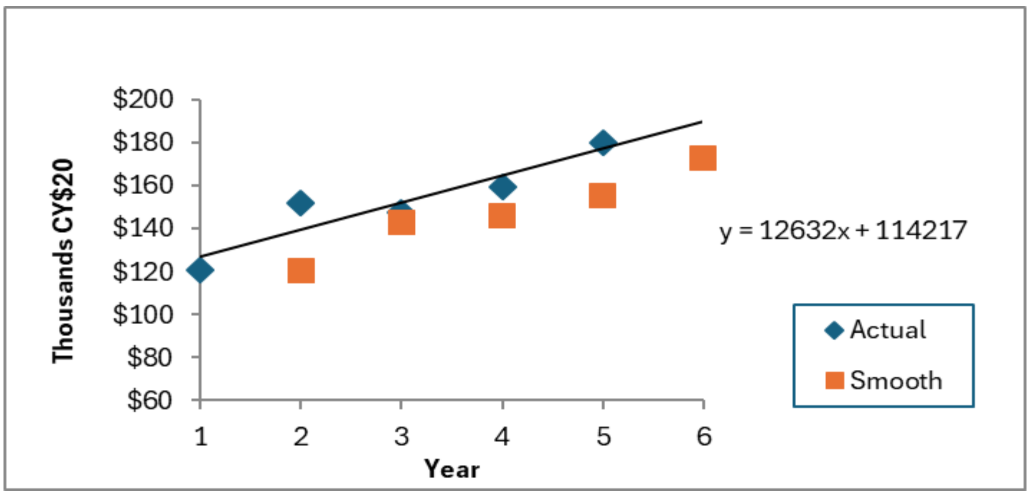

Figure 9. MCB Hawaii Operator Driver Simulator Operating Costs

C. CALCULATING COST AVOIDANCE

In an effort to make my analysis robust, I calculated cost avoidance through four different techniques. My preferred method used the exponentially smoothed cost estimates for the O&S of MTVRs in each unit and the ODS systems at each installation. While there was considerable variability in vehicle O&S expenditures between FY20 and FY26 by certain units, the preponderance of the data points largely followed a trend year to year.

1. Quantifying Expenditures at Each Installation

Each major command spends significantly different amounts of money to operate its MTVRs per hour and per mile, and each command has Marines stationed at the different III MEF installations. Marines from each command may use the ODS at each of those locations, and cost avoidance will vary based on which command's Marines train in the ODS. Table 4 shows the estimated FY26 costs to operate an MTVR in each unit which was found by exponentially smoothing each unit's average cost per vehicle each year.

Table 4. Estimated FY26 O&S Costs by Unit

		Costs/Operator	MEF	MLG	MARDIV	MAW	TECOM
		Per Year	$ 13,836.96	$ 21,046.94	$ 6,730.76	$ 56,256.32	$ 7,570.52
Proj Year	FY2026	Per Hour	$ 45.43	$ 76.27	$ 37.85	$ 1,087.88	$ 117.74
		Per Mile	$ 33.15	$ 25.59	$ 13.80	$ 488.46	$ 50.50

The dollar figures in Table 5 are from the exponentially smoothed data points for each installation's ODS costs, rounded to the nearest thousand.

Table 5. Estimated FY26 Operator Driver Simulator Costs

Estimated FY26 ODS Costs	
Okinawa	$ 198,000
Iwakuni	$ 221,000
Hawaii	$ 173,000
FLTW	$ 510,000

I then built two charts into which I can input a hypothetical number of hours and miles trained in the ODS to see how many total hours and miles would be trained via ODS at each installation. This is driven by the number of motor vehicle operator authorizations at each installation from each command. By modifying the number of hours and/or miles, each cell will repopulate a new number of hours/miles trained at each installation by multiplying the new 'x' number by the constant number of motor vehicle authorizations. These charts are depicted in Table 6.

Table 6. Calculation for Total Hours and Miles Trained by Installation

	Number of operators * Hours trained at each site						Total Hours
			MEF	MLG	MARDIV	MAW	
Hours Trained		OKI	760	1,496	2,008	576	4,840
		IWAKUNI	-	40	-	280	320
x (hours) =	8	HAWAII	48	304	408	136	896
		FTLW	-	-	-	-	8,388

	Number of operators * Miles driven at each site						Total Miles
			MEF	MLG	MARDIV	MAW	
		OKI	1,900	3,740	5,020	1,440	12,100
Miles Driven		IWAKUNI	-	100	-	700	800
		HAWAII	120	760	1,020	340	2,240
x (miles) =	20	FLTW	-	-	-	-	36,000

2. Cost Avoidance Based on Hours Trained

After designing a framework to calculate hypothetical quantities of hours and miles trained in the ODS, I calculated the gross cost avoidance of the ODSs by first multiplying the number of hours trained by the estimated costs to operate the MTVR per hour given a certain projected year. I input a certain number of hours trained, in this case 8, which gave me my total number of hours trained by each command at each installation (Number of operators × 8). I then multiplied the number of hours trained by each command at a certain installation by that command's hourly cost to operate an MTVR. Then I simply summed up all those numbers. That gave me the gross cost avoidance for that one installation; I then ran the same calculation for the remaining installations. This process of operations is depicted in Table 7.

Table 7. Hours Trained Cost Avoidance Formula

=(E30*E24)+(F30*F24)+(G30*G24)+(H30*H24)

B	C	D	E	F	G	H	I
		Costs/Operator	MEF	MLG	MARDIV	MAW	TECOM
		Per Year	$ 13,836.96	$ 21,046.94	$ 6,730.76	$ 56,256.32	$ 7,570.52
Proj Year	FY2026	Per Hour	$ 45.43	$ 76.27	$ 37.85	$ 1,087.88	$ 117.74
		Per Mile	$ 33.15	$ 25.59	$ 13.80	$ 488.46	$ 50.50
	Number of operators * Hours trained at each site						Total Hours
			MEF	MLG	MARDIV	MAW	
Hours Trained		OKI	760	1,496	2,008	576	4,840
		IWAKUNI	-	40	-	280	320
x (hours)	8	HAWAII	48	304	408	136	896
		FTLW	-	-	-	-	8,388
	Number of operators * Miles driven at each site						Total Miles
			MEF	MLG	MARDIV	MAW	
		OKI	1,900	3,740	5,020	1,440	12,100
Miles Driven		IWAKUNI	-	100	-	700	800
		HAWAII	120	760	1,020	340	2,240
x (miles)	20	FLTW	-	-	-	-	36,000
ODS Cost Avoidance		OKI	G24)+(H30*H24)		Net cost avoidance (hours)		$ 653,246
(hours)		IWAKUNI	$ 307,657				$ 86,576
		HAWAII	$ 188,761				$ 15,964
		FTLW	$ 987,583				$ 477,200

3. Cost Avoidance Based on Miles Trained

I then applied the same process to calculate gross cost avoidance for miles trained by multiplying the number of miles trained by each command at a certain installation by that command's per mile cost to operate an MTVR and then ran the same calculation for each installation. In Table 7 and Table 8, we can see which cells feed my gross cost avoidance calculation for the MCB Okinawa ODS site.

Table 8. Miles Trained Cost Avoidance Formula

=(E37*E25)+(F37*F25)+(G37*G25)+(H37*H25)

B	C	D	E	F	G	H	I
		Costs/Operator	MEF	MLG	MARDIV	MAW	TECOM
		Per Year	$ 13,836.96	$ 21,046.94	$ 6,730.76	$ 56,256.32	$ 7,570.52
Proj Year	FY2026	Per Hour	$ 45.43	$ 76.27	$ 37.85	$ 1,087.88	$ 117.74
		Per Mile	$ 33.15	$ 25.59	$ 13.80	$ 488.46	$ 50.50
	Number of operators * Hours trained at each site						Total Hours
			MEF	MLG	MARDIV	MAW	
Hours Trained		OKI	760	1,496	2,008	576	4,840
		IWAKUNI	-	40	-	280	320
x (hours)	8	HAWAII	48	304	408	136	896
		FTLW	-	-	-	-	8,388
	Number of operators * Miles driven at each site						Total Miles
			MEF	MLG	MARDIV	MAW	
		OKI	1,900	3,740	5,020	1,440	12,100
Miles Driven		IWAKUNI	-	100	-	700	800
		HAWAII	120	760	1,020	340	2,240
x (miles)	20	FLTW	-	-	-	-	36,000
ODS Cost Avoidance		OKI	$ 851,247		Net cost avoidance (hours)		$ 653,246
(hours)		IWAKUNI	$ 307,657				$ 86,576
		HAWAII	$ 188,761				$ 15,964
		FTLW	$ 987,583				$ 477,200
ODS Cost Avoidance		OKI	G25)+(H37*H25)		Net cost avoidance (miles)		$ 733,339
(miles)		IWAKUNI	$ 344,478				$ 123,397
		HAWAII	$ 203,578				$ 30,781
		FLTW	$ 1,817,998				$ 1,307,615

4. Net Cost Avoidance

Table 9 depicts the gross cost avoidance at each installation based on the projected year (FY26), the hypothetical number of hours (8), and miles (20) trained at each site, the net cost avoidance at each site, and then the total net cost avoidance. The net cost avoidance was calculated by simply subtracting the estimated cost to operate the ODS at each site from the gross cost avoidance at that site.

Table 9. Calculated Gross and Net Cost Avoidance

ODS Cost Avoidance (hours)	OKI	$ 851,247	Net Cost Avoidance (hours)	$ 653,246	Totals CY$20
	IWAKUNI	$ 307,657		$ 86,576	
	HAWAII	$ 188,761		$ 15,964	
	FTLW	$ 987,583		$ 477,200	
					$ 1,232,986
ODS Cost Avoidance (miles)	OKI	$ 931,340	Net Cost Avoidance (miles)	$ 733,339	
	IWAKUNI	$ 344,478		$ 123,397	
	HAWAII	$ 203,578		$ 30,781	
	FLTW	$ 1,817,998		$ 1,307,615	
					$ 2,195,132

Again, all values will refresh when a new number of "Hours Trained" or "Miles Driven" is input, which allows the researcher to see how much cost avoidance is achieved for different quantities of training. We can see that given the aforementioned parameters, the Marine Corps could in theory achieve positive cost avoidance in the employment of its ODS systems at all three III MEF installations and the Fort Leonard Wood schoolhouse in FY26.

5. Alternate Cost Avoidance Calculations

As was mentioned, I conducted three other cost avoidance calculations after using different strategies to manipulate my data. I first used pure averages for all O&S costs I collected. I simply averaged every unit's O&S cost for their MTVRs over the six-year period and averaged the ODS O&S costs at each installation. While the ODS costs were very well behaved over the five-year period, the O&S costs at certain units varied wildly. I wanted to estimate the next year's O&S costs as realistically as possible, and the average O&S costs at some units were simply too dissimilar to their trend over recent years.

I also mentioned that I assigned a linear equation to fit the raw O&S costs for each unit and each ODS site over the six-year period. In looking at certain units, I noticed that the slope of the linear equation is simply too steeply positive or negative which ruled out that strategy as a viable method to approach cost avoidance. One example of this scenario is represented in Figure 10 where we see a steeply negative slope. In the case of 3d MLG, we see that in less than two years, the estimated O&S cost will be negative, which means that this unit will be making money by operating its MTVRs, which is of course impossible.

Due to instances such as this, I chose not to use the linear equation method as a suitable strategy for this research. I reasonably expect 3d MLG's O&S expenditure to not fall much lower, but more than likely to increase over the next few years.

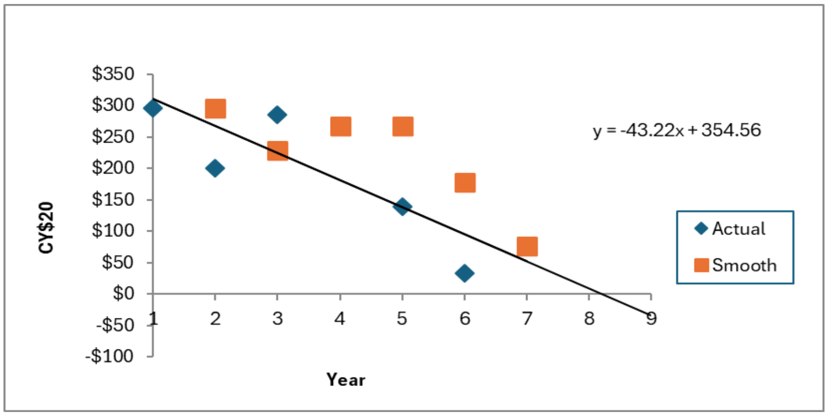

Figure 10. 3d MLG O&S Cost per Hour

Third, I took each unit's lowest O&S cost recorded over the six-year period and used that figure in my cost avoidance calculation. While this strategy yielded realistic cost avoidance outcomes, I ruled it out, because again there were some instances where some units' lowest documented O&S expenditure were simply too dissimilar to its spending trends in recent years. We can see this in the case of 1st MAW in Figure 11, where their lowest expenditure was in Year 1, but their spending in recent years has increased significantly.

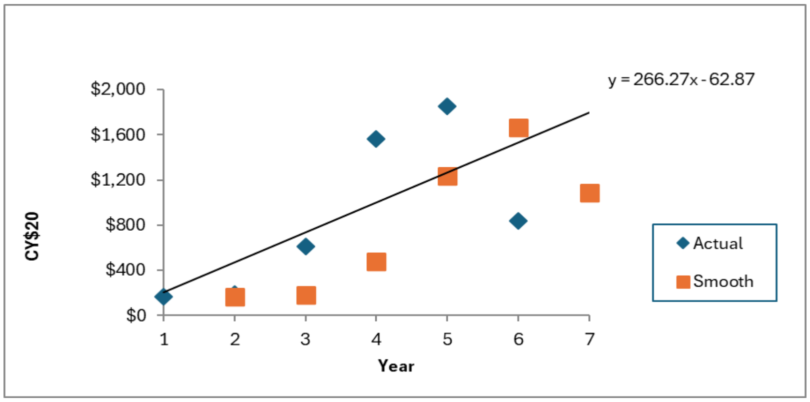

Figure 11. 1st MAW O&S Costs per Hour

D. DISCUSSION AND ANALYSIS

It is important to note that there is no equivalency between hours trained and miles driven in my cost avoidance framework. They are independent of each other by design, as there can be much variation between hours trained and miles driven, both in real-world operations and in the simulator, as scenarios trained and speed driven will heavily influence the number of miles driven per hour. Additionally, the calculation for hourly cost avoidance at Fort Leonard Wood is independent from that for the III MEF installations. This is because the Motor Vehicle Operator training course at Fort Leonard Wood prescribes a set number of simulator hours trained in its training plan, which is 4.66 hours per operator. Furthermore, while the Motor Transportation Instruction Company can train up to 2,200 operators per year, I estimated conservatively and included 1,800 operators in my estimates. Then, I multiplied by 4.66 hours to get the total number of hours trained at Fort Leonard Wood. With this model, the researcher may modify the number of operators at any installation, and the model will automatically recalculate gross and net cost avoidance. This is beneficial to the researcher because the number of MOS authorizations at different commands may change from year to year.

If each motor vehicle operator conducted eight hours of ODS training at each location, I estimate that approximately $1.2 million in cost avoidance can be achieved when considering just the III MEF installations and Fort Leonard Wood, expressed in constant dollars 2020 (or $1.4 million in 2026 dollars). Twenty miles of training would also achieve positive cost avoidance at each installation, totaling approximately $2.2 million (or $2.5 million in 2026 dollars). I argue, though, that implementing an hour-based training requirement is more beneficial to the Marine Corps from a force readiness standpoint than a miles-based metric. I contend this for these reasons: (1) simulating a treacherous environment would greatly reduce the number of miles actually driven compared to driving on an improved road, but the time spent in the simulator is still beneficial, and (2) this will avoid the instance of Marines driving exceedingly fast just to reach the necessary number of miles, which would detract from training value.

Each ODS site is currently able to support the total number of hours of required training, assuming away any significant periods of simulator down time, as KPP 3 from the ODS CPD states that each simulator must have an operational availability of 38 hours per week. The number of required training hours per simulator per week is under 20 hours at each installation. There are five simulators at MCB Okinawa, which equate to 968 hours per simulator per year, and 18.6 hours per week. There are two simulators at MCASI, which equate to 160 hours per simulator per year, and just 3 hours per week. There are two simulators at MCB Hawaii, which equate to 448 hours per simulator per year, and just 8.6 hours per week. I can then hypothesize that net cost avoidance can reach significantly high levels if the ODS is utilized more heavily at each installation, as this model was based off just the number of MOS authorizations at each installation, and did not include incidental drivers. If incidental drivers were also required to complete eight hours of training per year, ODS participation would be much higher. The amount of usage, though, is of course limited by many factors to include each unit's operational tempo, the number of actual vehicle operators (not just MOS authorizations) at each installation, and simulator uptime.

In addition to calculating cost avoidance, I sought to understand a relationship between the average cost to operate an MTVR at each installation and hours trained in the simulator to the end of achieving positive cost avoidance. Put more simply, I wanted to see how much it would need to cost to operate an MTVR at each installation per hour to achieve positive cost avoidance when different quantities of hours trained were applied. To do so, I set up the equation:

$$\text{ODS Cost}_i = \text{Operators}_i \times \text{Hours Trained} \times \text{Cost per Hour},$$

where ODS Cost_i is the total cost to operate the ODS site at a certain installation i, Operators_i is the number of vehicle operator authorizations at a certain installation i, Hours Trained is the number of hours that the researcher may choose to use, and Cost per Hour is the unknown average cost per hour to operate a real MTVR.

I then solved for Cost per Hour at each installation given the number of vehicle operators at that installation, the cost to operate the ODS at that installation, and different numbers of hours trained, between two and ten. This calculation assumes away the fact that Marines from different commands technically generate different levels of cost avoidance, because as mentioned, different units spend varied amounts on the O&S of their MTVRs. This formula holds all vehicle operators equal in terms of their parent units and purely seeks to understand how much it must cost to operate an MTVR at a certain installation, not unit, to achieve positive cost avoidance at that installation by training in the ODS. Figure 12 represents the findings of this formula for the MCASI ODS site. It shows that if every vehicle operator trained for just two hours in the ODS, the average cost to operate an MTVR aboard MCAS Iwakuni per hour would need to be greater than $2,764 in order for the ODS site to achieve positive cost avoidance, and so on. A more realistic quantity would be six or eight hours, and we can see that it must cost $921 or $691 to operate an MTVR per hour to achieve positive cost avoidance. Similar charts for the remaining installations can be found in the Appendix.

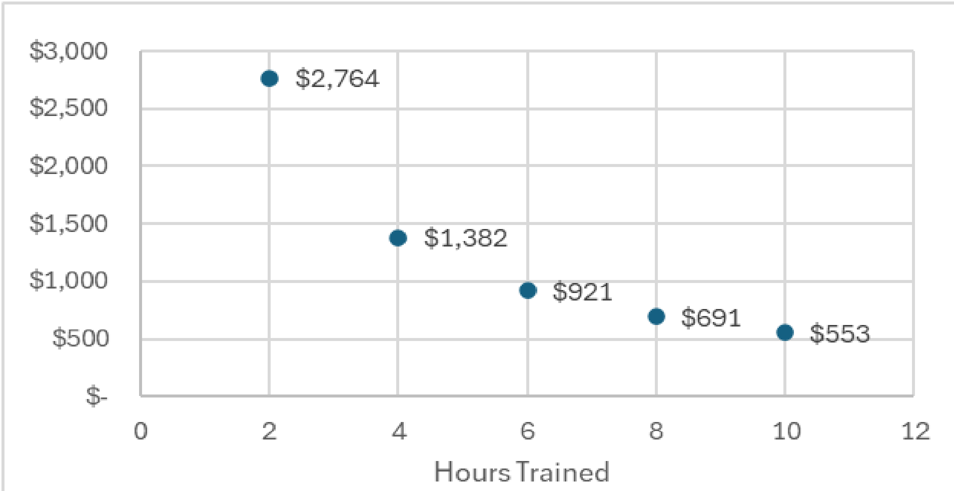

Figure 12. MCAS Iwakuni Break-Even Costs for Real Vehicle Training per Hours Trained in ODS (in CY$20)

By continuing to add more accurate data to my cost avoidance model, PM TRASYS and SYSCOM may provide TECOM with a data-backed argument to drive higher participation in the ODS. This analysis can complement the central argument that simulator training is safe and effective by showing how much spending may be avoided by conducting ODS training versus operating vehicles live to develop essential skills. The goal of this research is not to replace live training with simulated training, but instead to prove to decisionmakers that significant costs may be avoided by utilizing the ODS to develop basic MOS skills when operating vehicles live is not necessary. It can therefore assist decision-makers in prescribing a set number of hours or miles for motor vehicle operators to train in the ODS each year.

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IV. CONCLUSIONS AND RECOMMENDATIONS

This research allowed me to draw several conclusions regarding the employment of the ODS across Marine Corps installations and generate multiple recommendations, both for decisionmakers and researchers seeking to conduct further analysis on this topic.

A. CONCLUSIONS

ODS training may benefit the Marine Corps by training its Marines risk-free in various scenarios while avoiding costs tied to real vehicle operations. In this thesis, I aimed to address the following questions:

1. What is an appropriate methodology to calculate cost avoidance when different commands document largely dissimilar O&S costs for real vehicles?
2. Do ODS O&S costs vary based on usage or geographical location?
3. Can ODS systems support enough simulator training to achieve positive cost avoidance?

To address the first question, I developed a methodology to estimate the Marine Corps ODS training systems' cost-avoidance potential using data from four different Marine Corps installations.

The model I developed allows a researcher to calculate ODS cost avoidance across installations while considering multiple commands by factoring in each command's O&S costs. I determined possible ODS usage levels at each III MEF installation by leveraging TFSMS and quantifying the number of Motor Vehicle Operator MOS authorizations that currently exist at each installation. Based on CLS data provided by PM TRASYS, I identified that ODS costs do vary slightly across installations, but this did not yield significant inconsistencies in my cost avoidance outcomes. Finally, after identifying how much usage is required to achieve positive cost avoidance at each ODS site, I calculated how much uptime for each simulator was required to support that amount of training. I determined that each ODS site is in fact able to support enough simulator training to achieve positive cost avoidance given the outputs of my model.

This model may be leveraged by cost analysts to calculate cost avoidance with high granularity. This research was limited by the completeness of accurate data, but since this model is very modular, a researcher may directly input more refined data to achieve more accurate results. As the Marine Corps seeks to avoid increased spending and limit unnecessary risks associated with operating live vehicles for training, this cost avoidance model will provide a complimentary, data-driven argument to drive higher participation in ODS training across installations. This model is available upon request and open to modification.

B. RECOMMENDATIONS FOR DECISION MAKERS

After conducting this research, my recommendations for key stakeholders and decision makers are two-fold. The first is that SYSCOM urges TECOM to modify the Motor Vehicle Operator Training and Readiness Manual to include a certain minimum number of hours of ODS training for each individual Motor Vehicle Operator and incidental operator every year. This will consequently require each FMF unit that possesses motor vehicle operators to update their annual and quarterly training plans to include ODS training to meet the MOS training requirement.

The second is that PM TRASYS consider this cost avoidance framework and, in the future, include cross-installation and cross-unit metrics so that their cost avoidance calculations may be as granular as possible. Furthermore, I recommend that they conduct both a 'miles driven' and an 'hours operated' analysis when considering the ODS so that their cost avoidance calculation may have two dimensions. This will provide decision makers with a more robust understanding of cost avoidance and more flexibility in determining training standards.

C. RECOMMENDATIONS FOR FUTURE RESEARCH

I recommend that future research on this subject includes the addition and refinement of relevant data. This should consist of the quantification of incidental vehicle operators at each installation, further documentation of real vehicle O&S costs, the addition of various vehicle types compared to their ODS equivalent, the extended collection of ODS cost data, and the inclusion of the remaining Marine Corps installations that operate the ODS.

I mentioned that my cost avoidance formula was based around the number of MOS authorizations at each command. I was unable to determine the number of incidental operators at those commands as well. This research would have benefitted from gathering the number of incidental operators, but I could not find a data source that documented those figures. I believe this is simply because incidental operators carry a primary MOS, and Marine units typically will not list incidental licenses or supplemental certifications that Marines own on their Table of Organization and Equipment. Including incidental operators in this research would ultimately provide a more complete cost avoidance outcome.

In taking this research forward, the researcher may continue to document O&S costs for real vehicles rather easily. EVAMOSC is extremely user friendly and gathering O&S costs was very straightforward. Researchers may choose to add each new year into the model or use the five most recent years as I have done. Additionally, as new configurations of the ODS are fielded to the FMF, the researcher may gather O&S costs for vehicle types that correlate to the new ODS configurations. The JLTV ODS dash configuration is not FOC yet, but that is an example of a future variant that could be added to this research.

Collecting ODS cost data was the most challenging step in this research. My lack of program knowledge, document access, and trade expertise hindered my ability to deliberately acquire a complete and accurate cost figure associated with operating the ODS sites. Professionals at PM TRASYS provided me with copious documentation that captured ODS cost data, however, my indirect relationship with the ODS program may have detracted from ability to completely quantify accurate cost figures. While I estimate that my ODS cost data is mostly accurate, this research would benefit from a program manager or other professionals at PM TRASYS directly inputting ODS cost data into the model. While my cost data may not be entirely accurate, the model I developed will deliver credible cost avoidance estimates when provided the complete and appropriate data.

Should PM TRASYS or SYSCOM utilize this model to inform decision makers, and amendments are ultimately made to the Motor Vehicle Operator training requirements, an assessment should be made at a future date to determine if the desired results of the model were achieved.

APPENDIX

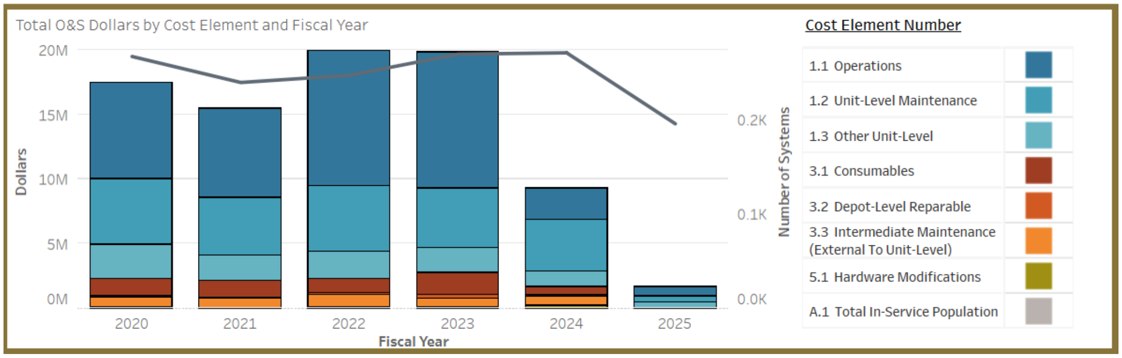

Figure 13. 3d MLG Total O&S Dollars by Cost Element and Fiscal Year

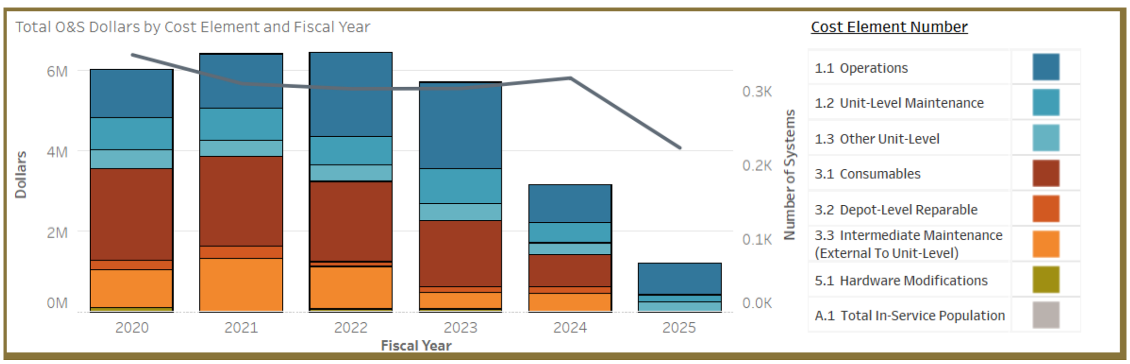

Figure 14. 3d MARDIV Total O&S Dollars by Cost Element and Fiscal Year

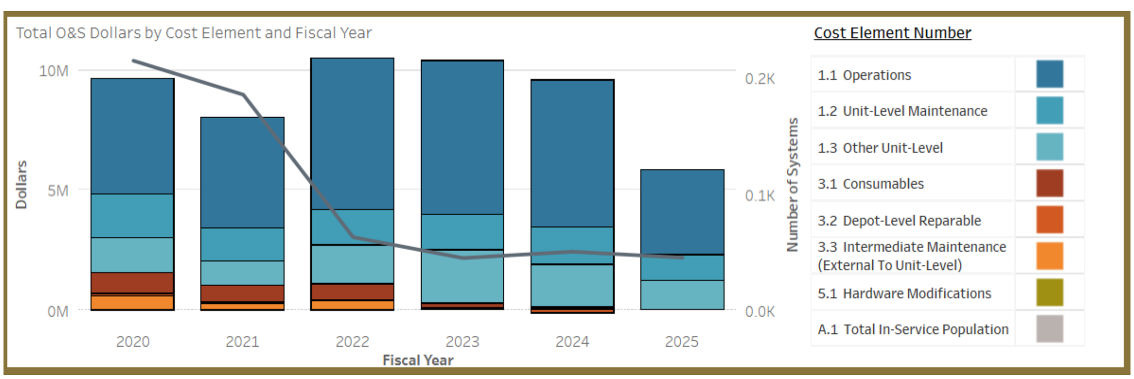

Figure 15. 1st MAW Total O&S Dollars by Cost Element and Fiscal Year

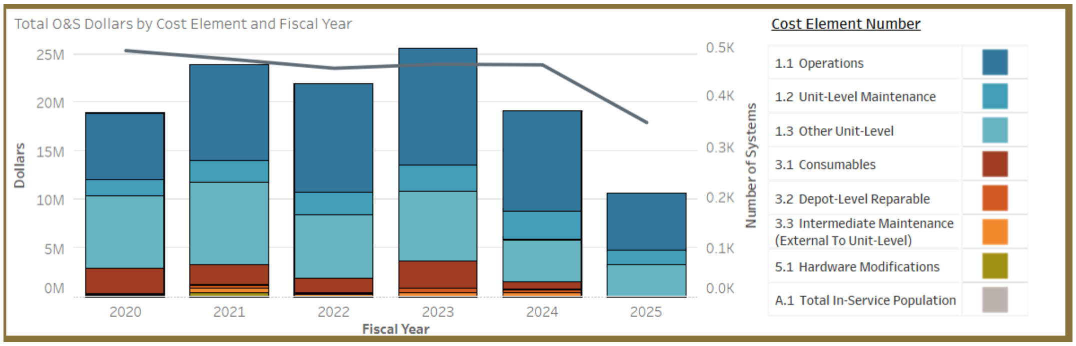

Figure 16. TECOM Total O&S Dollars by Cost Element and Fiscal Year

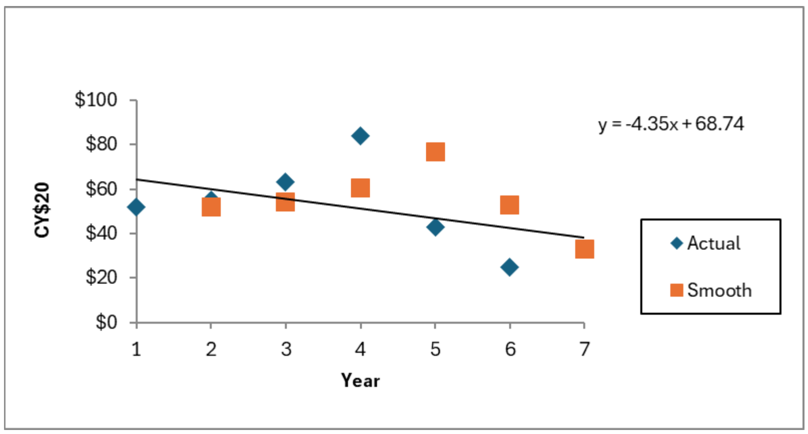

Figure 17. III MEF O&S Cost per Mile

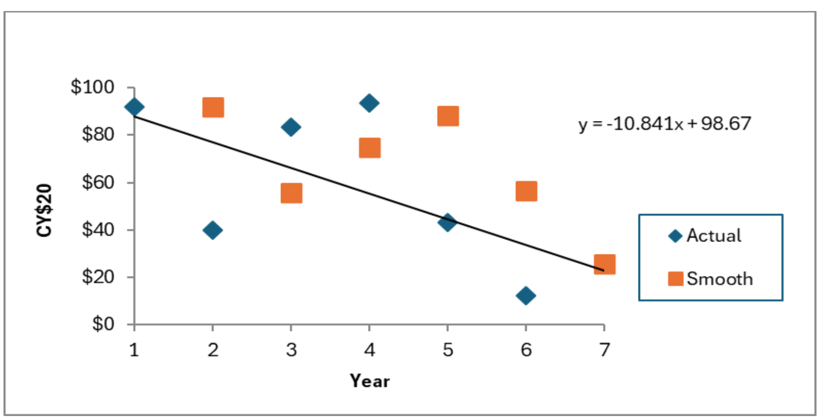

Figure 18. 3d MLG O&S Cost per Mile

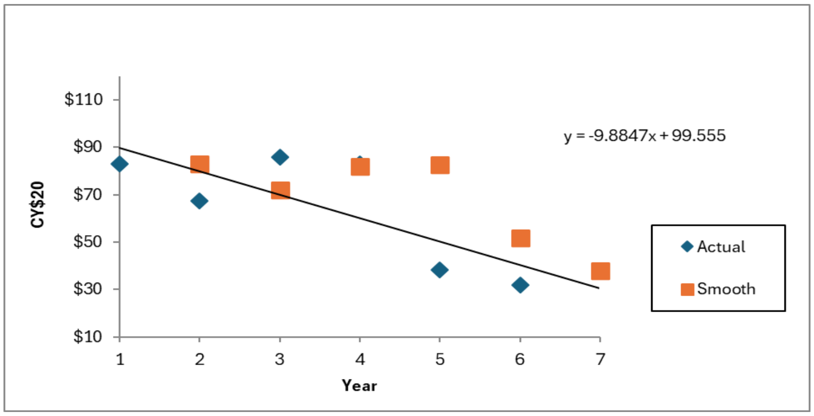

Figure 19. 3d MARDIV O&S Cost per Hour

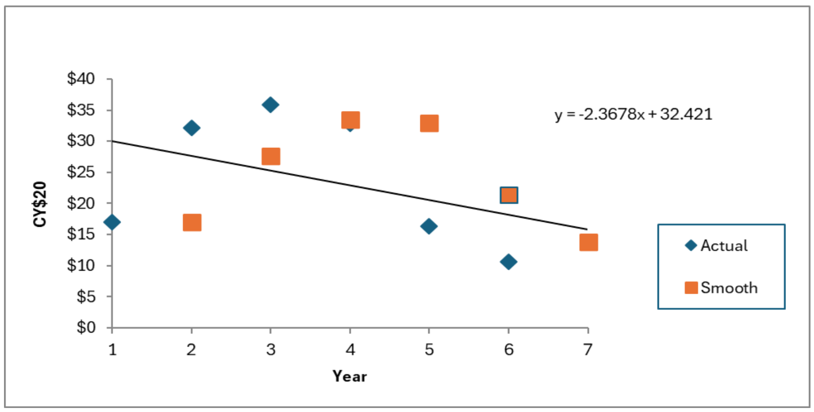

Figure 20. 3d MARDIV O&S Cost per Mile

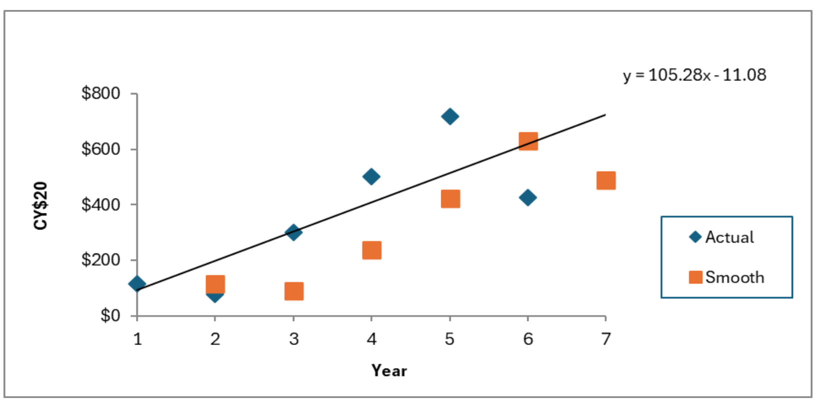

Figure 21. 1st MAW O&S Cost per Mile

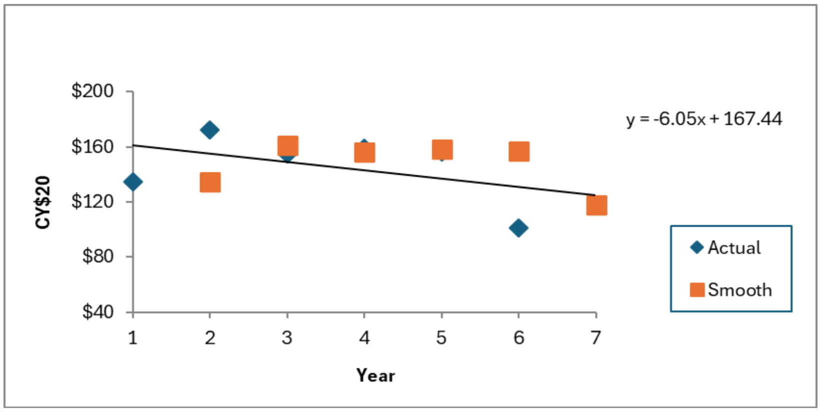

Figure 22. TECOM O&S Cost per Hour

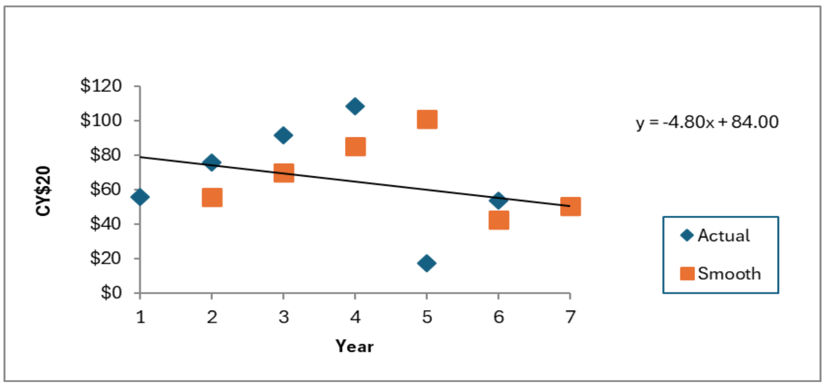

Figure 23. TECOM O&S Cost per Mile

Table 10. FY22 Operator Driver Simulator Usage Data

FY22	MT	HT	MD	Hr/Marine
HAWAII	48	200	-	4.17
OKI	672	978	-	1.46
MCASI	17	64	-	3.76
FTLW	8,604	8,415	-	0.98

Table 11. FY23 Operator Driver Simulator Usage Data

FY23	MT	HT	MD	Hr/Marine
HAWAII	-	-	-	-
OKI	284	418	3,317	1.47
MCASI	38	98	1,078	2.58
FTLW	5,235	5,143	68,748	0.98

Table 12. FY25 Operator Driver Simulator Usage Data

FY 25	MT	HT	MD	Hr/Marine
HAWAII	-	-	-	-
OKI	364	546	-	1.50
MCASI	47	131	-	2.79
FLTW	5,302	6,810	-	1.28

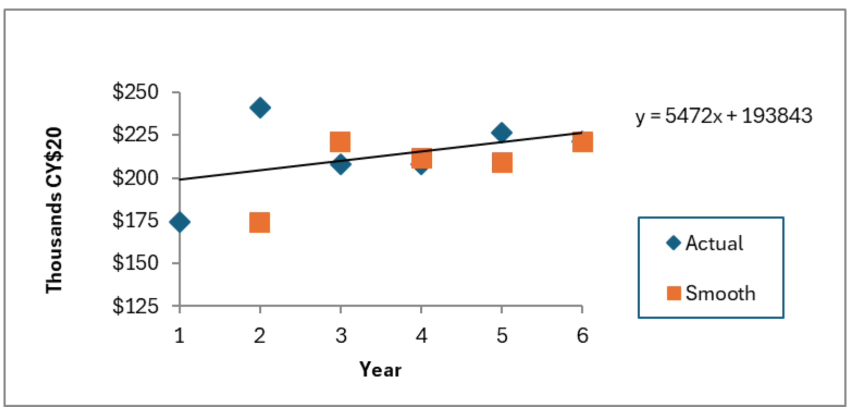

Figure 24. MCAS Iwakuni Operator Driver Simulator Operating Cost

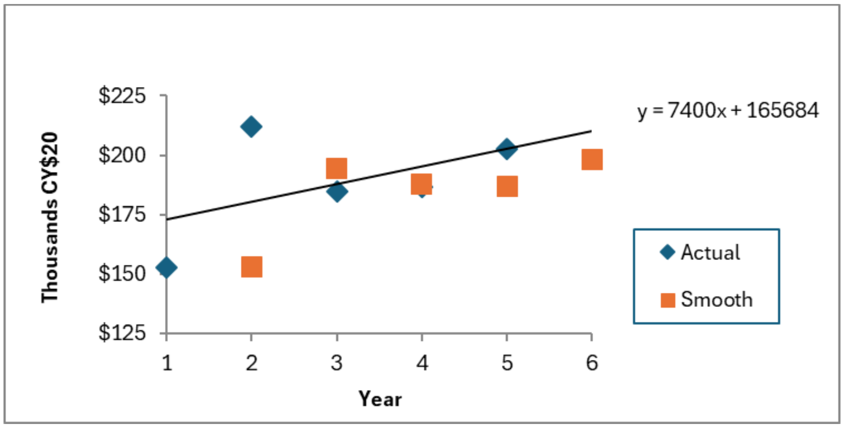

Figure 25. MCB Okinawa Operator Driver Simulator Operating Cost

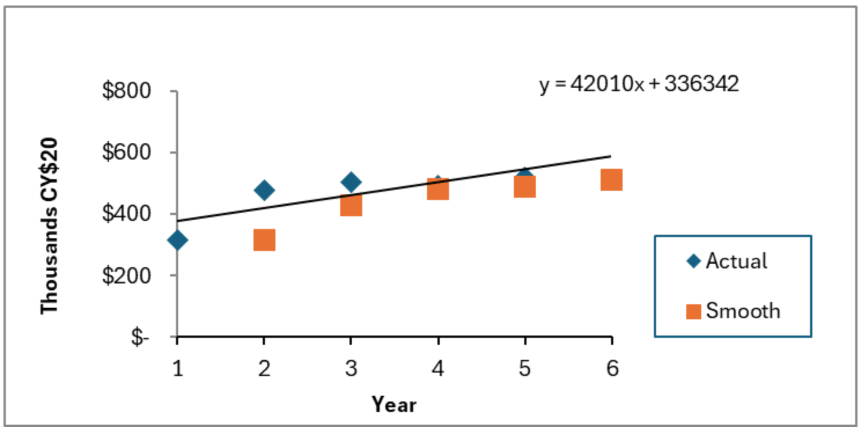

Figure 26. FTLW Operator Driver Simulator Operating Cost

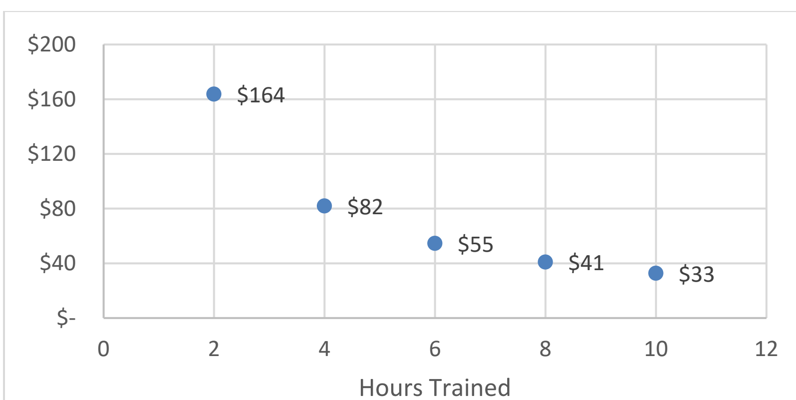

Figure 27. MCB Okinawa Break-Even Costs for Real Vehicle Training per Hours Trained in ODS (in CY$20)

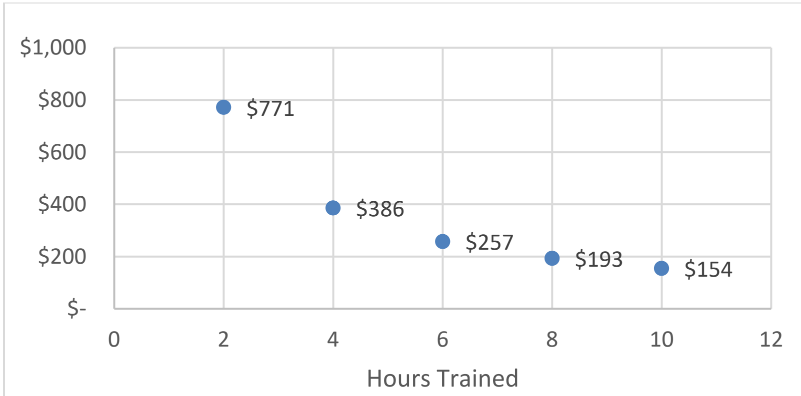

Figure 28. MCB Hawaii Break-Even Costs for Real Vehicle Training per Hours Trained in ODS (in CY$20)

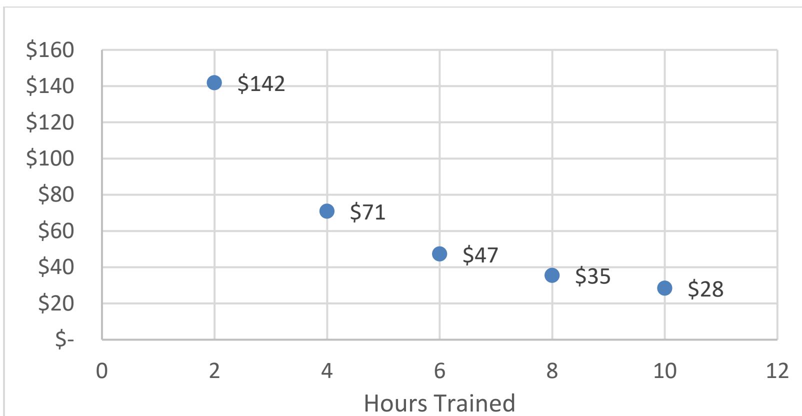

Figure 29. FLTW Break-Even Costs for Real Vehicle Training per Hours Trained in ODS (in CY$20)

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