

Lockheed Martin

Leverages DS PLM in SAIL simulations for up to \$100 million cost avoidance



LOCKHEED MARTIN 

Overview

■ Challenge

Lockheed Martin's Ship/Air Integration Lab (SAIL) shares complex information between aircraft engineering and aircraft-carrier operations at sea – domains of expertise so specialized they could not communicate effectively.

■ Solution

SAIL joins motion capture and virtual reality technology with DELMIA Envision software and CATIA V5 models to create Immersive Engineering.

■ Benefits

In addition to improved communication and problem solving, the cost avoidance achieved with SAIL simulations already equals the value of two F-35 Lightning IIs. The ROI for Lockheed Martin is roughly 15-to-1.

"We need to quickly identify maintainability and affordability issues. Without the credibility generated by the realism and accuracy of the electronic tools working through DELMIA with CATIA data, SAIL might not have gained acceptance."

Michael R. Yokell, Senior Manager,
F-35 Basing & Ship Suitability (BASS)

System tests operation of planes onboard ships virtually

U.S. aerospace manufacturer Lockheed Martin Aeronautics is engaged in the design, research and development, systems integration, production, support and upgrade of advanced military aircraft, rockets, missiles and related technologies. Customers include U.S. government agencies and military services, and allied governments around the world.

The Lockheed Martin F-35 Lightning II is entering production in Fort Worth, Texas. Originally designated the Joint Strike Fighter (JSF), the F-35 is one of only two supersonic "stealth" aircraft capable of evading radar detection

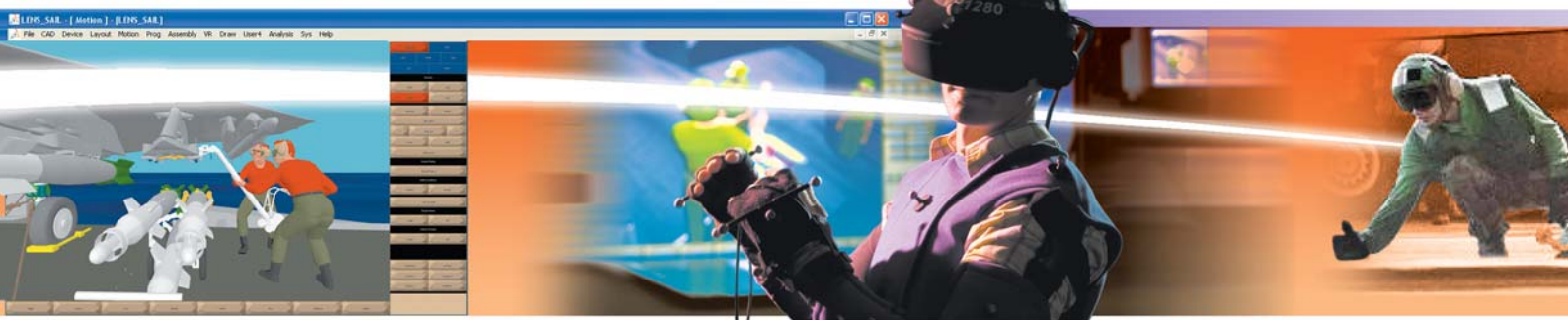
In the F-35 program, Lockheed Martin's Ship/Air Integration Lab (SAIL) shares complex information between aircraft engineering and aircraft-carrier operations at sea – domains of expertise so specialized they traditionally could not communicate effectively.

SAIL uses Immersive Engineering – the marriage of motion capture (Mocap) and virtual reality (VR). It has proven so effective for Lockheed Martin that estimated cost avoidance on the F-35 Lightning II military aircraft is approaching \$100 million.

As of early 2007, SAIL simulations "had already helped us avoid \$75 million to \$100 million in costs," says Michael R. Yokell, senior manager, F-35 Basing & Ship Suitability (BASS). Those savings were achieved using digital manufacturing software from DELMIA and digital 3D models created in CATIA, both brands of Dassault Systèmes, in BASS. BASS is readying the F-35 for sea duty with the U.S. Navy. "Avoiding rework could be many times more," he adds.

That sum is roughly equal to the cost of two F-35s (projected at full production), meaning the U.S. Department of Defense and the U.S. taxpayers get the equivalent of two free aircraft.





“It is always a hard sell when people who have spent their lives working with physical prototypes cannot touch one. To deal with this, we created SAIL.”

Pascale Rondot, F-35 SAIL lead

That \$100 million also represents a payback of approximately 15-to-1 on Lockheed Martin’s pioneering investment in SAIL.

Immersive engineering’s value is greatest where experts in one domain have difficulty sharing what they know and what they need with their peers in other domains. Without this sharing, understanding and overcoming challenges is nearly impossible. SAIL’s dramatic success is in joining the domains of military aircraft design with operations in aircraft carrier flight decks and hangar decks.

BusinessWeek magazine was so impressed it featured SAIL in a cover story.

DELMIA openness facilitates connectivity

Thanks to DELMIA’s open-software architecture, all the “middleware” connecting Mocap with VR consists of commercially available, off-the-shelf systems, or COTS. All the hardware, including projection systems, head-mounted displays and a spherical video camera, are COTS, too; nothing in SAIL was custom-built. Integration was done with the DELMIA Tools module.

The resulting simulations supplement physical mockups and, in many cases, replace them.

“It is always a hard sell for us when people who have spent their lives working with physical prototypes cannot touch one,” explains Pascale Rondot, F-35 SAIL lead. By combining Mocap and VR through DELMIA software with CATIA V5 models to create immersive engineering, SAIL allows engineering data and shipboard operational realities to be simulated. The simulations are lifelike, life-sized and panoramic with 3D stereographics and enhanced kinematics – better than anything ever done before.

Representing the Navy viewpoint within SAIL is Ray Harbor, F-35 carrier integration lead for BASS. “SAIL allows me to use my background and aircraft-carrier experience,” says Harbor, a retired U.S. Navy senior chief petty officer with nearly 18 years of experience on aircraft carriers. “In a hangar deck simulation, I can put the F-35 in with the legacy aircraft and see how its behavior relates to them, and whether that’s consistent with what the Navy actually does.”



When US Navy representatives see SAIL, Harbor adds, “they tell us, ‘You are spot on. This is exactly what we have needed.’ They know and I know that what they see in the VR and the simulations is consistent with the situations aboard ship.” Harbor and Yokell worked together closely in developing SAIL.

Finding errors earlier facilitates cost avoidance

The envisioned cost avoidance is roughly equivalent to the value of two F-35 Lightning IIs and an ROI of approximately 15-to-1 for Lockheed Martin. For this calculation, all identifiable costs were rolled in.

“When we do the simulations we find a lot of things that will work just fine and a few that will not,” Yokell says. “If we fix them now (in engineering) it costs us X. If we fix them a year from now (on the production line), the cost could grow by 2X or 5X. If we wait five years, the cost could be 10X. That is the justification for SAIL. The sooner changes are made, the less they cost.”

Aircraft-carrier flight-deck simulations include catapult launches, ensuring operation of the arresting cables and tail hooks during retrievals, tie-downs, mounting armaments on the aircraft,

servicing weapons, and reaching access panels when aircraft tails hang off the edge of the flight deck, over the ocean.

SAIL and VR are outperforming the traditional methods of addressing these challenges:

- Trial and error, which involve learning about design problems during training and “shakedown” cruises. Those are hard lessons and their cost can be enormous.
- Physical mockups, where aerospace engineering meets carpentry. “The mockup is a great tool but it is strictly limited to whatever it was initially designed for,” Harbor points out. “Any change will be slow and costly, if the mockup is even capable of being modified. The objects in it can’t be leveraged to address related tasks.”
- CAD files enhanced with kinematics, which are no more persuasive than anything else on a 21-inch color monitor.
- Step-by-step explanation with digital text and pictures. “Even with good illustrations, getting anything complicated across this way means you have to go through the material over and over, sometimes for weeks,” Yokell says.



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Ray Harbor, F-35 carrier integration lead for BASS and Retired Navy Senior Chief Petty Officer

“With SAIL, we can influence the engineering years sooner than we could have in previous programs,” Yokell adds. “When we do find issues, even at this late stage in engineering, we’re still finding them long before they would have been found through other means. SAIL backs that up because its virtual approach lets us rapid-prototype the changes without tying up the aircraft itself.”

Navy veteran Ray Harbor points out that “if we tried to represent a launch with a mockup, everything but what the carpenters actually built would have to be imaginary.” When all this is taken into account, “SAIL has not just lived up to all its expectations, it has performed better than even its greatest expectations.”

“We have been working for eight or ten years to find a way to quickly identify maintainability and affordability issues and find a way to verify that the

proposed fixes will be effective,” Yokell says. “This was a very radical idea for this conservative company. But without the credibility generated by the realism and accuracy of the electronic tools working through DELMIA with CATIA data, SAIL might not have gained acceptance.”

He notes that SAIL also is establishing credibility with the Navy for Lockheed Martin, traditionally an Air Force supplier.



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Michael R. Yokell, Senior Manager,
F-35 Basing & Ship Suitability (BASS)



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