

# Military aircraft essay

[Environment](#), [Air](#)



This evolution has also been based on the most current aviation technology and it has changed the crew makeup from a four person cockpit to a two person cockpit. Crew makeup can have more of an adverse affect on military crew than civilian crew based on the type of flying that the military accomplishes, for example performing a combat airdrop instead of flying from point “ A” to point “ B” in a no threat environment. Two pilots are asked to do what two pilots, a flight engineer, and a navigator used to do and still do on some military aircraft.

The only change has been the technology that has been developed In order to cut out the engineer and the navigator due to budget cuts and unending on training these two additional crew members. From my experience flying in the Air Force, this really becomes an issue when you get away from the everyday simple missions like taking off and landing to the complex ones where those extra people make and break the success of the overall mission.

The purpose of this paper will review how new aviation technology has changed the way the military has to view and implement CRM based on the specific crew component of each individual aircraft, and what might be done in future research to help train aircrews to use the ‘ OFF paper was gathered from literature that is closely related to the subject. All references and works cited are from Embryo-Riddle Aeronautical University Jack R. Hunt Library online database of books in electronic format and Aerospace Database via the Hunt Library Research Databases.

The overall theme of this topic is that new technology is the end all be all of military aircraft with little consideration on how to train the aircrew to

function with one or two fewer crew members. Statement of Issue CRM in the military is not a new concept, it has been around formally since the id sass (O'Connor, Hahn, & Nullifier, peg 446). Military Airlift Command now Air Mobility Command in the Air Force was the first to establish CRM training for its aircrew (O'Connor, Hahn, & Nullifier, peg 450).

It was not until 1994 that the Air Force required CRM training for all its aircrew no matter what airframe as prescribed in Air Force Instruction (IF) 11-290 which was not around until 1998 (O'Connor, Hahn, & Nullifier, peg 450). Military aviation Just like civil aviation has benefited from new technology and this new technology has forever changed the way CRM is incorporated and trained across al levels of military aircraft, from the single seat fighter to the large transport aircraft.

From the start large military aircraft had a four person flight deck (pilot, co-pilot, navigator, and flight engineer). This was due to the primitive nature of the flight instruments and the lack of navigational capability without the extra crew members. The first aviation technology advances were the development of larger and faster aircraft and they still had the need for the extra crew members, but the CRM between them remained the same because only the components of the aircraft changed not the crew component.

In the past two decades aviation technology has advanced so much that it has allowed the flight deck of large aircraft go from four flight crew members to now only two flight crew members on the flight deck. For example the C-130 has been around since the sass and until the late sass was flown by a

four person flight deck, this change was due to the production of the C-J model equipped with the most advanced avionics around at the time of design and was able to eliminate the need for a navigator and flight engineer.

This example of the C-130 community is a prime example of how CRM has to change as technology hangers the physical makeup of the aircraft even though the mission of the aircraft stays the same. Technology has forever changed the way military aircraft are flown and that technology has a great impact on the application of CRM in military aircraft. Significance of the Issue New aviation technology and CRM go hand in hand. When technology changes, CRM must change as well in order to stay current with how aircrew interacts with their systems.

If CRM does not change along with technology it can have negative effects on how the mission will get accomplished as well as safety. But when trained ropey or when a crew works well together it is like watching a symphony where the crew is in sync with each others actions and knows what the other person will need before them ever having to ask for it. The effect technology has on this interaction is that the aircraft will giving inputs to the pilot instead of another crew member.

So it is imperative that the pilot set up the aircraft's systems so they get all the In talking with an experienced C-130 pilot who flew the C-AH for 10 years and just recently switch to the C-J said that the C-J is simply amazing, he can set up he aircraft's systems to show him everything he needs to know on his Heads-Up- Display (HAD) and very seldom have to look inside the cockpit to

obtain information such as airspeed, altitude, specific descent points in order to land the aircraft on the first attempt.

He also stated that this set up requires different CRM that he was used to in the C-AH, for example if either he or the co-pilot goes heads down for more than a couple of seconds they have to announce it to prevent both pilots looking inside the cockpit at the same. This is not the case in the C-AH because the aviation is running the mission computer which allows both pilots to concentrate on flying the plane to its intended destination. I gave an example of an experienced pilot who knows exactly what information he needs at any given time and with the new technology he is able to display everything he needs by himself.

This can be the contrary for a new pilot who might see all this information and get overloaded and not know what information they need at that time. This can cause confusion and force the pilot into misinterpreting the information presented. Another example is two videos of C-130 air show demonstrations, one is of a C-J at the Paris Airship and the other is of the C-AH Fat Albert of the Blue Angels flying at the Barked FAA Airship. These two videos both show how CRM is supposed to work, the difference is how the amount of people supplying information can affect the results.

The C-J crew there are only two people talking, the pilot and the co-pilot (barrier, 2011). The pilot is the one flying, but he is not controlling the throttles, the co-pilot is doing that so the pilot can concentrate on the flying (barrier, 2011). This adds an extra piece of communication where the pilot has to ask for power at some points, but most of the time the co-pilot knows

when to add power and reduce power based on the point of the demonstration. Most of the talking is done by the pilot, the co-pilot only has to talk when he acknowledges the aircraft's audio warnings and backing up the pilot during the maneuvers (barrier, 2011).

This is due to the aircraft's technology, the aircraft tells the pilot where they are in relation to the airfield at any given point, the majority of the CRM is on flying the plane. The Fat Albert demonstration is quite a bit different, there are three people talking (coccid, 2009). The pilot, co-pilot, and flight engineer all have prescribed roles in what information they must provide to the pilot. The co-pilot is doing the job of the flight computer, constantly giving the pilot updates to where they are in relation to the field along with backing the pilot up during the maneuvers (coccid, 2009).

The flight engineer is calling out airspeeds, pitch, bank angle, altitude, and configuration settings to set (coccid, 2009). There is a lot more talking and coordinating with each other on the Fat Albert demo than the C-J demo and this is due to that the aircraft is not showing the crew the following without looking into the cockpit: altitude, airspeed, pitch, bank angle, and where they are in relation to the field (coccid, 2009). These examples show how new aviation technology influences CRM and how a crew works together to accomplish the same mission/result.

Review of Relevant Research The integration of CRM and new aviation technology is relatively new. The technology that is being developed now is allowing pilots to do more with less. With controlling the aircraft by looking in only one place, typically a screen called a multi functional display (MED). The

military has been on the trailing edge of aviation technology when it comes to the large transport aircraft with flight decks consisting of more than one person. For example the C-17 and the C-130 were designed using glass technology and are now the most technologically advanced transport aircraft in the Air Force's inventory.

These new aircraft are using the same type of CRM training that the older aircraft are using. The only difference is the implementation of that training. As aircraft change with new technology, CRM is also changing to meet the requirements of the military. New Aviation Technology New aviation technology has advanced to a point where anything is possible when it comes to what engineers can design for an aircraft's cockpit. Some major breakthroughs are the glass cockpit, extensive automation, and the Heads-up-Display (HUD).

These new technologies have changed the way pilots fly and interact with the aircraft. The all glass cockpit is where all essential gauges and flight instruments are displayed using a couple of screens located directly in front of the pilots and allows the pilots to access any information they need pertaining to the flight or aircraft at the touch of a button (NASA, Para 10). The first glass cockpit was designed by Boeing in the 1970s for their 737 fleet and used cathode ray tube screens (NASA, Para 13).

Since then the technology has evolved to the screens were made out of liquid crystal display (LCD) with buttons located on the side and now the LCD screens are touch enable allowing more ease of use. The glass cockpit was designed out of necessity and opportunity, aircraft of the mid 1970s had over

100 gauges, instruments, and controls located throughout the cockpit (NASA, Para 14). Engineers were looking for a way for pilots to access all that information without having to scan the entire cockpit this led to the design of the first glass cockpit and MFC (NASA, Para 17).

The biggest design difficulty was finding the proper balance of what the pilot should do and what the computer should do (NASA, Para 17). The military had a large need for glass cockpits and thus were some of the first to receive them once NASA tested and deemed them safe for use (NASA, 19). The first were installed on fighter aircraft where the need for a less cluttered cockpit was more crucial to safe flight operations. It was not until the mid 1980s and the release of the C-17 that military transport aircraft would have a glass cockpit. This completely changed how these large aircraft would be able to operate.

The C-17 replaced the aging C-141 fleet that had a traditional design along with the navigator and flight engineer positions on the flight deck. The glass cockpit effectively replaced these two individuals by allowing the aircraft's computer to monitor navigation and aircraft systems. According to Funk & Loyal (2003): Flight deck automation, consists of machines on the commercial transport aircraft flight deck which perform functions otherwise performed by pilots. Current flight deck automation includes autopilots, flight management systems, electronic flight instrument systems, and warning and alerting systems (Para 1).

The first automation was the invention of the autopilot, this allowed the pilots to take their hands off the controls and concentrate on other things



inside the cockpit. Automation has now something is wrong Funk & Loyal, Para 2. ) For military aircraft this automation poses a problem, especially when the aircraft are operating in areas where the automation can be detrimental to the flight. For example, during an airdrop of supplies to troops on the front lines, it is much easier for the pilot to confirm they are in the correct place to drop.

Many things in the aircraft's flight systems can get corrupted and have the aircraft think it's in one spot when it is actually in another. The human aspect has the ability to stop this chain of events due to the automation of the aircraft's systems. Another piece of aviation technology that changed the way pilots fly is the HAD or heads-up-display. This device puts information such as attitude, airspeed, altitude, ND heading all on a screen that sits in between the pilot and the windshield in front of them (Perked, Para 1).

HI-JDK were originally designed for military fighter aircraft, but recently they have been making their way to large transport aircraft, in the last decade they have also started making their way onto civilian aircraft (Perked, Para 5). HUTS give pilots almost unlimited situational awareness, they allow the pilot to concentrate the majority of their time looking outside the cockpit instead of inside. This is very important when the aircraft is in close proximity to the ground reforming a landing or for military aircraft an airdrop.

A common problem with the HAD are that they can overwhelm a novice or inexperienced pilot to where they do not know what information they need to obtain from the HAD in critical phases of flight (Perked, Para 6). But to an

experienced pilot it is the most beneficial piece of technology that new aircraft have. It allows them to set the aircraft up on the ground and fly almost the entire flight with only looking inside the cockpit when something has to change such as a radio frequency or the next turn point. Crew

Resource

Management With all this new technology changing how pilots interact with the aircraft they fly, CRM is growing as well. CRM has been growing since its inception in the sass, but now with the changing cockpits require new CRM that focuses on how the pilots have to interact with the aircraft systems along with the other crew members on board. CRM has four main core areas: situational awareness (AS), task management, communication, and decision-making (Cockpit/Crew, peg 3). These four areas each have multiple subsections but this section will focus of the four main.

AS is the ability to know exactly what is going on around you and be able to block out distractions that would prevent you from completing your objective (Cockpit/ Crew, peg 3). AS is seldom constant, the demand from outside the cockpit can lead towards confusion, disorientation (Cockpit/Crew, peg 3). The goals of the new technology previously stated, if used properly can tremendously help AS. The glass cockpit allows pilots to access everything they need for flight on one screen.

Automation gives the pilot time to take in all the information they are receiving in order to build upon their AS and start thinking about what is next instead of concentrating on now. The HAD pulls the glass cockpit and automation into one spot where the pilot is able to monitor the aircraft's

flight without even having to look down, increasing AS through the pilot's ability to decipher the information the HAD displays. Task management is the ability to prioritize tasks from the start of the mission debrief (Cockpit/Crew, page 10).

Two parts of task management are overload and under load; overload is where a person gets bogged down with all they are trying to do and ends up not completing much at all and under load is where a person does not have enough to do and messes up the easy things because they are not staying engaged (Cockpit/Crew, page 11). New technology allows pilots to receive mass amounts of information in a short period of time, which translates to them being able to manage their tasks such as checklist items and standard operating procedures efficiently and effectively.

As a result pilots that are trained and fly with new technology are less likely to get overloaded, but have to keep themselves engaged to prevent a under dad situation. Communication is extremely important when it comes to aviation. In terms of CRM, communication is where all persons involved understand explicitly what each person is saying (Cockpit/Crew, page 6). Effective communication also requires concise speaking coupled with good listening (Cockpit/Crew, page 7).

Communication is key to other aspects of CRM and can have adverse affects if it is not used properly, communication can also be a indicator of where a person's AS and ability to make a decision might be (Cockpit/Crew, page 7). The way communication plays into CRM with ewe technology is with new technology there is less communication required between crew members

because each crew member is able to look at the configuration of the aircraft or what is displayed and figure out the aircraft's current state.

Don't be mistaken that there does not need to be effective communication, it still plays a pivotal role in effective CRM. Decision-making as it pertains to CRM is making an effective decision using proper assessment, Judgment, probability of events, and using all known available resources (Cockpit/Crew, page 9). There are two types of decision-making, analytical and intuitive (Cockpit/Crew, page 9). Analytical otherwise known as the classic method is used when time is not a factor and the individuals involved are able to step their way through the process and come up with the best course of action (Cockpit/Crew, page 9).

The intuitive method also known as the automatic method is used when a decision needs to be made quickly in emergencies and when a thorough analysis is not practical due to the situation (Cockpit/Crew, page 9). In military aircraft such as the C-130], analytical decision-making has become easier because the pilot has many more tools at hand to be able to make effective decisions. There is less time and energy wasted on figuring out the problem and more time spent being able to execute the solution.

With regards to the intuitive method technology's effect has made the decision-making process a little easier because the pilots are not trying to find the problem, the aircraft will tell them but the stress of make the quick decision is still there. Summary of Major Findings and Conclusions The military aviation community continues to change based on what technology is being used on their aircraft. Not only are operations of the aircraft

changing because of the new technology, the people flying them also have to change the way they integrate with the aircraft and with each other.

This integration is different across all aircraft based on how many personnel are on the flight deck or cockpit and what technology the aircraft is equipped with. The older aircraft such as the C-47 still is when a new or improved training platform is designed, like the implementation of the fifth generation of CRM where CRM is used for error management (Helices, Merritt, & Wilhelm, page 7). Unlike in new aircraft such as the C-17 or C-130, they also have to implement new training ideas/programs, but also consider the integration of errors and aircraft in order to fully understand how the aircraft should be flown for safely and effectively.

Technology is a great tool in the advancement of military aviation, but with the new technology there has to be consideration of CRM and what has to be done for the military to operate their aircraft in a ever changing airspace. As the military moves forward and their aircraft continue to change the men and women who fly them will be required to adapt and overcome a new set of problems. Recommendations for Future Research or Action Plan to Address the Issue CRM has been extensively studied over the course of the last 30 years.

The improvements that have been made have been centered around new concepts and ideas about CRM and not how much technology is effecting the overall outcome of CRM. In the short term there needs to be more research done on how new technology has to be incorporated into CRM instead of just an after thought to the new concepts of CRM. For example in C-130 training,

the C-AH aircrew members and C-J aircrew members go through the same CRM training, it might be taught by different instructors but the training syllabus is the same.

This short term research will allow aircrews such as the C-sass to get a better understanding of their position on the aircraft along with how important it is to know how to interact with the aircraft's systems. CRM is going away from how to interact as a crew to how to interact with the aircraft's computer and then with the crew. With more detailed research how the effects of technology on how to combine human with computer, there will be a better stepping stone for research into the future.

Long term research on CRM needs to account for new technology as it is being invented, instead of dating for the technology to come out then try and figure out what changes need to be made. That is the current dilemma this area is in and the only way to get out of it is to get ahead of the technology. If new CRM concepts are not created in respect to technology, the military aviation community will continue to be behind the power curve in an ever changing flying environment that requires precise flight and the deviation for error is small.