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IMPROVING AIRCREW INTEROPERABILITY IN COALITION WARFARE - EXAMINING THE HUMAN DIMENSION OF THE AIR POWER EQUATION

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ABSTRACT

Despite the stunning results of recent offensive air operations such as those witnessed in Desert Storm, the planning and execution of an effective coalition air campaign in a modern combat theatre can be a tremendously complex interoperability challenge. Not only must the Coalition Force Air Component Commander (CFACC) bear the weight of the combined political expectations of minimal losses, precision targeting, low collateral damage, and rapid decisive results, he is expected to rapidly and seamlessly integrate the disparate elements of multinational contributions assigned to the air operation into an effective fighting force.

Given that the maximum exploitation of air power is achieved through a unified approach to the air campaign under a centralized command and control system, and through the flexible, integrated assignment of tactical forces to the dynamic taskings of the unfolding operation, the requirement for interoperability amongst the multinational participants is crucial to the effectiveness of the air campaign. Although the need to focus on interoperability from a technical perspective is self-evident in the context of modern warfare employing highly sophisticated aircraft and munitions, this would be an incomplete assessment of the broader requirements necessary to strengthen the air power equation.

Consequently, this paper will argue that the CFACC and his planning staff would be well advised to vigorously pursue the issue of interoperability from an aircrew perspective during in-flight operations since this human dimension component of the air power equation has the potential to either impede or enhance tactical operations and ultimately the success of the air campaign plan, depending on how the underlying factors are addressed.

PART 1 – COALITION AIR WARFARE IN PERSPECTIVE

> *Leaders must consider…military backgrounds when they construct the plan to form collective activities. Generally, the most effective coalitions are those that integrate resources and capabilities...*[1]

In contrast with excruciatingly detailed planning and preparation permitted within the static environment of the Cold War era, modern coalition warfare exemplifies controlled chaos at best.[2] The assumption amongst North Atlantic Treaty Organization (NATO) armed forces that the next war would be fought in central Europe against a known threat, in cooperation with familiar allies using well-practiced war plans seems complete folly since the fall of the Berlin Wall. Instead, the era of the "peace dividend" resulted in a plethora of operations against a broad range of diverse threats in unexpected regions of the globe applying rapidly devised and improvised campaign plans.

Concomitant with this dramatic change in the global security environment has been the preference for ephemeral "coalitions of the willing" comprising either a subset of the partners to traditional alliances such as NATO, or a mix of such countries with other non-traditional allies.[3] Operations Desert Shield and Desert Storm were the most poignant examples of this sudden emergence from the Cold War paradigm. Although coalition warfare is certainly not new, the difference today with previous coalition conflicts such as the World Wars and Korea are the elements of timely response and complexity of modern warfare that demand higher unit readiness, greater technological sophistication, as well as increased personnel skills, training and education.[4]

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[1] Alan Ryan, "The Strong Lead-nation Model in an ad hoc Coalition of the Willing: Operation Stabilise in East Timor," *International Peacekeeping*, p. 42.
[2] Bernd Horn, "Complexity Squared: Operating in the Future Battlespace," p. 8.
[3] Myron Hura, *Interoperability – A Continuing Challenge in Coalition Air Operations*, pp. 23-27.
[4] Bernd Horn, pp. 9-14.

Unlike in situations of unilateral military action (ie. the United Kingdom fighting Argentina in the Falklands), or operations with traditional defence allies (ie. NATO's Operation Deliberate Force in Bosnia), coalition operations are *ad hoc* in nature and diverse in composition. Typically created on short notice to deal with an unexpected crisis on the international stage, prior planning or collective preparation for the mission will be minimal, contrasted with the inevitable political expectation for quick and effective military solutions to the problem. Furthermore, such coalition operations can result in an unpredictable mosaic of multinational participants brought together temporarily for a variety of parochial national interests, unified more by a superficial political cause than a lasting military commitment.[5]

While political leaders may view the strength of these hastily assembled *ad hoc* "coalitions of the willing" in terms of the numbers and diversity of the participating countries, the opposite effect could easily prevail at the operational level given the inevitable differences in equipment, training and capabilities between the participants. Consequently, *ad hoc* coalition warfare presents problems of time and structure that combine to create incredibly complex challenges for those who are responsible to plan and execute the military solutions. Ultimately, the appointed Coalition Joint Force Commander (CJFC) and his assigned Component Commanders (CCs) must apply a new dimension of operational art wherein particular attention must be given to the timely reconciliation of the multinational differences within a workable command and control structure, so as to quickly establish a harmonized fighting force that can effectively respond to the international crisis.

Arguably, the CFACC has the greatest challenges to overcome of the other CCs with respect to the constraints of time and the requirements of structure on the success of his air campaign plan. Since the beginning of World War II, history has repeatedly demonstrated that

[5] Martha E. Maurer, *Coalition Command and Control – Key Considerations*, pp. 9-14.

air superiority is both a vital requirement for successful defensive operations and an essential prerequisite for victory in offensive combat operations.[6] In other words, success in stemming further aggression by the enemy (ie. deterring Saddam Hussein from attacking Saudi Arabia with defensive counter air operations in Desert Shield), or in shaping the battlefield advantage for offensive operations (ie. achieving air supremacy prior to launching ground offensive in Desert Storm) must be achieved quickly and effectively by the CFACC before other CC objectives can be fully prosecuted. Consequently, time is not a luxury in the air campaign – rather it is an imperative that significantly compresses the planning, preparation and execution phases of the coalition operation depending on the urgency of the crisis. Fortunately, and in contrast to the Maritime and Land CCs, the air force assets can arrive in the theatre of interest and commence operations far quicker in relative terms than naval forces, and land forces in particular. However, as we shall see this inevitably results in a "come as you are" situation for the initial assigned forces that serves to limit the CFACC's options in the early stages of the operation.

From a structural perspective, the CFACC's dilemma is more acute than his other CCs as it pertains to the impact of the differences in equipment, training and capabilities between the multinational participants. To exploit the full potential of air power, the CFACC views the theatre airspace as an indivisible whole that is best managed by a centralized command and control structure, since experience has repeatedly proven that this approach maximizes the responsiveness, mobility and versatility of aircraft while permitting the most effective surveillance, control and defence of the entire airspace.[7] Given that such a command and control structure requires the integration of the disparate national forces into a collective pool of

[6] John A. Warden III, *The Air Campaign – Planning for Combat*, p. 10.
[7] United States Air Force, *Air Force Basic Doctrine – Air Force Doctrine Document 1*, pp.28-30.

resources with which the CFACC and his staff can prosecute the air campaign, interoperability will be the decisive factor in determining the degree of integration achievable.

But what is the causal link between interoperability amongst the assigned multinational forces and the coalition air campaign plan? Quite simply, it can influence the outcome, either positively or negatively. Consequently, the CFACC would be well advised not to proceed too quickly with operations until an acceptable level of interoperability is assured, while concurrently pursuing every reasonable means to improving it as much as possible.

PART 2 – INTEROPERABILITY: A DOUBLE-EDGED SWORD

> *...the more intense the operations, the greater the risks posed by asymmetry while, at the same time, the greater the incentives to deal with any problems arising from it.*[8]

In its simplest form, the air power equation is built upon a triad of structure, technology and people. As previously discussed, the preferred method for the employment of air power is from an integrated, centralized command and control structure. This in turn places a high premium on interoperability for the technological and human dimensions of the air power equation. But what exactly does interoperability imply? Commissioned by the United States Air Force to undertake an in-depth analysis of the matter in 2000, RAND determined that the following, commonly used Department of Defense and NATO definition was quite appropriate:

> *Interoperability. **The ability of systems, units, or forces** to provide services to and accept services from other systems, units, or forces, and to use the services so exchanged to enable them **to operate effectively together**.*[9]

Given that air forces exist to support flying operations and that aircraft are the focal point of these activities, it is not surprising that any concerns regarding interoperability would begin with a focus on the technological dimension. Fortunately, problems are usually quite obvious. Aircraft and equipment made by different companies or manufactured in different countries are likely to have differences in capabilities, while connectivity problems between different communications or computer systems will become immediately apparent. Thus, there is little likelihood of hidden surprises. Conversely, the asymmetry in capabilities will mean hard choices for the CFACC as to whether to exclude a nation altogether, include them in a lesser role where interoperability is less critical or fully accept them with a drop in collective capabilities. Such

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[8] Steven Metz, "The Effect of Technological Asymmetry on Coalition Operations," In *Problems and Solutions in Future Coalition Operations*, p. 65.
[9] Myron Hura, p. xiii. Bold text added for emphasis.

was the case for Operation Allied Force (OAF) and the CF-18. In order to include the CF-18 on the offensive air combat missions, the CFACC accepted the risk of communication jamming for all coalition aircraft in order to accommodate the CF-18's lack of the Have Quick II anti-jam system that was common in all other aircraft. But how much emphasis should be placed on the technological dimension in relation to the human dimension and are the problems as easily identifiable? It may be useful to examine the situation from the operational-level perspective of the CJFC to gain a proper appreciation.

For the CJFC there would be several interesting deductions to be made. From a coalition campaign perspective, the establishment of air superiority would be a primary sequencing objective, thereby giving the CFACC the least amount of time amongst the three environmental CCs to rectify his technological interoperability problems in relative terms. Secondly, the CFACC would have the greatest quantitative challenges, given that there would be far more airplanes than naval vessels, or tactical army formations (Battalions, Brigades, Divisions and Corps). And thirdly, and perhaps most importantly, the CFACC would be relying on less experienced officers than the CFMCC and CFLCC to deal with the interoperability issues at the tactical level. While ships and Battalions are normally commanded by senior officers with many years of experience, most aircrew are relatively junior officers by comparison. Consequently, they would possess the least professional development in the realm of joint and combined warfare, and would have had less opportunity to gain prior operational experience in other coalition operations. Similarly, the aircrew would be less likely to comprehend the vagaries of the higher-level operational imperatives or fully comprehend the implicit implications of the intentions of either the CFACC or the CFJC. This issue will be explored further in due course.

So what does this brief analysis mean for the CJFC? Quite simply it means that at the individual level, aircrew shoulder a disproportionate amount of responsibility for the outcome of the overall coalition campaign. Despite having the least amount of career experience of the key individuals executing the tactical missions in the respective environmental campaign plans, they face some of the more complex technological interoperability challenges and the risk of a negative consequence due to an error on their part is statistically higher given the number of tactical sorties generated compared with the frequency of tactical engagements (by ships and battalions) in the naval and land campaigns.

Thus in returning to the air power equation, it is unequivocally clear that while attention must be given to the requirements of the technological dimension, aircrew feature prominently in determining the results achieved with the war-fighting technology. Consequently, if the full potential of interoperability is to be realized, additional attention needs to be focused on where and how coalition aircrew interact as a team.

PART 3 – AIRCREW INTEROPERABILITY: THE CRUCIAL ENABLING FORCE

Never in the field of human conflict was so much owed by so many to so few.

Winston Churchill, August 20, 1940
Reflecting on the Battle of Britain

As already established, the integration of resources into a centralized command and control structure lends itself to the creation of temporary teams at the tactical level through the process of assigning units to mission taskings through the daily Air Tasking Order (ATO). It is within this mix-and-match, ephemeral team approach that interoperability amongst aircrew takes a significant role. Each mission has its own unique requirements depending on the nature of the task, the targets to be attacked, the expected threat level to be encountered, the time of day (night versus day conditions) and the duration (potential requirement for air refueling). The CFACC's operations staff will task units for each new mission based in part on the specific requirements of the mission itself (aircraft capabilities and munitions employed), as well as the availability of necessary aircraft from the collective pool of assigned units. In turn, each unit will assign aircrew to each specific tasking depending on their own internal scheduling process.

Although some units and aircraft may be assigned to relatively simple, low risk missions (ie. intra-theatre transport flights over friendly territory), others will be needed to participate in complex, higher risk missions that involve "packages" of numerous aircraft of various roles and capabilities, brought together for the prosecution of offensive air operations into enemy territory. Typically composed of formations of air superiority fighters and tactical attack fighter-bombers, they will be given direct mission support by other specialized aircraft (ie. Suppression of Enemy Air Defences) to enable the

penetration of the enemy's Integrated Air Defence System (IADS), as well as indirect, stand-off support by Airborne Warning and Control Systems (AWACS) and surface-based radar operators. Furthermore, and as exemplified by Desert Storm and OAF in Kosovo, such packages will likely have to coordinate in-flight refueling support at different points in the mission. As a result, there is little likelihood that the same aircrew will all fly together as a team under the same circumstances, particularly earlier on in the campaign when the threat level requires such robust air armadas. Given the dynamic, highly temporal nature of these taskings, the requirement for aircrew interoperability is primarily limited to and concentrated within the activities of planning and executing the mission, since the team is only formed upon the publication of the daily ATO, and terminates when the mission is completed. [10]

Logically, the degree of interoperability required by this team will be determined by the mutually interdependent elements of complexity and risk, which in turn would be proportional to number of aircraft assigned to the package for a given mission. Further complexity and risk would be added when such package missions are flown at night and/or in marginal weather conditions, which was often the case for OAF since the cover of darkness protected the aircraft from some of the surface to air (SAM) threats, while the weather was often an unwelcome, debilitating factor. In the end, the tactical advantages of synchronization must be balanced with the flight safety requirements for adequate in-flight deconfliction to avoid inadvertent mid-air collisions or fratricide.

The fundamental requirements for such packages to be safely and effectively employed are common understanding and coordinated execution. In other words, each of

[10] Mark D. Mandales, Thomas C. Hone, and Sanford S. Terry, *Managing "Command and Control" in the Persian Gulf War*, p. 155.

the participating aircrew must have sufficient understanding of the details of how the specific mission will be executed, within the context of the larger air campaign plan, before they take to the air. This is achieved through theatre orientation and tactical mission planning. Next, the aircrew must be able to achieve a coordinated in-flight execution of the planned mission. Given the impossibility of adequately addressing the many variables related to enemy actions, let alone fully considering the additional contingency plans related to weather, aircraft "fallouts" or in-flight emergencies, the aircrew must rely on in-flight communications to deal with such vagaries while trying to complete the planned mission.[11]

It is in this latter realm, the in-flight component, that the greatest consideration must be given, for not only does a degradation in coordinated execution run the risk of partial or complete mission failure (ie. unable to effectively attack assigned targets), it could also result in operationally significant outcomes. Unlike during the mission planning phase, there is little time for explanation or reconciliation of misunderstandings once in the air due to the limits of inter-aircraft communications.

For the CFACC, mission failure at the tactical level may be acceptable if infrequent and inconsequential, but will certainly negatively impact the air campaign plan if such failure occurs repetitively. Conversely, for the CJFC the strategic implications of a tragic outcome such as unacceptable collateral damage (ie. mistaken targeting of a wagon train of civilians in Kosovo during OAF) may be immediate and highly consequential, resulting in a drop in public support or a breakdown in the coalition's will

[11] A "fallout" refers to the situation where an assigned aircraft is unable to participate in the tactical portion of the flight due to a breakdown prior to takeoff, or an in-flight problem that requires the aircraft to immediately return to its home airbase or an alternate airfield.

to pursue the air campaign plan in its current form.[12] While incidents of inadvertent bombings and fratricide are not new to air warfare, the expectations of the politicians and general public have changed considerably since Operation Desert Storm. The combined effects of casualty and collateral damage aversion, near-real time media coverage, and the spectacular precision of modern munitions have heightened expectations to an unrealistic level that serve to add an additional burden to commanders.[13] In the final analysis, much hangs in the balance of mission outcomes at the tactical level, and relatively junior officers bear the responsibility for achieving successful, error-free results. Consequently, a thorough understanding of the impediments of aircrew interoperability, particularly as it pertains to understanding each other and effectively coordinating their collectively in-flight actions, is essential to mitigate potential problems while seeking to improve the collective effectiveness of the disparate contributions to coalition air operations.

[12] Wesley K. Clark, *Waging Modern War*, pp. 193-220. Although General Clark was the Coalition Force Commander of Operation Allied Force, his personal views on the air campaign are quite revealing.
[13] Richard T. Reynolds and Edward C. Mann III, "Liars, Fools and Zealots – The Origins of 21st Century Command and Control," In Erlandson, Douglas L. and English, Allan (Eds.), *Air Symposium 2002 – Air Force Command and Control*, pp. 4-8.

PART 4 – FROM COMMON INTENT TO COORDINATED EXECUTION

> *To compensate for the relative lack of shared implicit intent, joint and combined operations will require greater amounts of shared explicit intent (for operations of comparable size) to achieve a given level of common intent.*[14]

Pigeau and McCann's notion of "common intent", which is defined as "…the sum of shared explicit intent plus operationally relevant shared implicit intent", was derived through a significant research endeavor to examine the concept of "command and control" in the military context, and to provide a framework of consistent definitions and constructs from an objective, scientific perspective.[15] The implications of the notion of *common intent* are fundamental to understanding the impediments to aircrew interoperability at the tactical level in coalition air operations. Although Pigeau and McCann's analysis falls short of exploring the realm of actual mission execution, their research is quite useful in going the next step.[16] It is during mission execution where the effectiveness of aircrew interoperability has its most acute impact, for this is the domain where preparation combines with action to produce outcomes. In other words, where the common intent specific to the tasking that is created during mission preparation combines with the collective battlespace awareness built upon individual aircrew situational awareness to allow for effective, coordinated execution of the mission in a dynamically changing tactical environment. The effectiveness of this coordinated action is inextricably tied to the mission results, for better or for worse. Coordinated execution will be examined closer in due course, but it's necessary to begin with pre-flight orientation and tactical mission preparation to bring

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[14] Carol McCann and Ross Pigeau, "Redefining Command and Control," In Carol McCann and Ross Pigeau (Eds.), *The Human in Command – Exploring the Modern Military Experience*, p. 173.
[15] Ross Pigeau and Carol McCann "Re-conceptualizing Command and Control," *Canadian Military Journal*, pp. 53-54. The authors relate the highly subjective interpretations that were in use for this fundamental military concept, and how this led to the derivation of a command and control model based on first principles.
[16] Carol McCann and Ross Pigeau, "Redefining Command and Control," p. 182.

attention to the impediments of aircrew interoperability that will nefariously manifest themselves in flight.

In the land environment, where the decentralized command and control framework necessitates unequivocal understanding of the theatre-level "Commander's Intent" to guide the subsequent actions of his subordinate formation commanders, significant emphasis is invested in this area as the basis for establishing *common intent*.[17] Not surprisingly for the air environment, the direct impact of the high-level *Commander's Intent* on aircrew interoperability is relatively minimal due to the centralized command and control construct of the air campaign. Although the formal intent of the CJFC will set the tone for the objectives, priorities and military end state for the coalition operation, it will be explicitly stated and very limited in content. Not withstanding the importance of the CJFC's mission intent from the perspective of the CC's in shaping their respective campaign plans, the implicit requirements will be given greater detailed direction by the CFACC in so far as its impact on the conduct of the air campaign.

In fact, very detailed orders are typically published to set the framework for the conduct of the air campaign (Operation Plan), the deconfliction of the airspace (Airspace Coordination Measures), limitations on the conduct of tactical operations (Rules of Engagement) and other detailed directives (Special Instructions). As with the CJFC's mission intent, the CFACC's orders are explicit in nature and directive in purpose to ensure the controlled application of lethal force. While the CFACC's orders must be read and understood by all aircrew, they serve primarily to orient the preparation and execution of the tactical missions assigned through the ATO. Normally there will be sufficient time for units to seek clarity on the specifics of the

[17] Peder Beausang, *The Role of Intent and the Ideal Command Concept in Military Command and Control – Canadian and Swedish Commanders' Perspectives*, pp. 21-22. In the context of contemporary discussions, the term *Commander's Intent* is applied to the planning process in shaping the commander's objective(s), the overall approach and applicable concerns/constraints that define the parameters for acceptable action.

orders, and such discussions with the CFACC's central staff will serve to build the necessary implicit understanding, however, this will only occur (if at all) for those discrepancies that are recognized. Depending on the lead nation in the coalition and the nationality of the CFACC, there will be greater discrepancies for non-traditional allies, as the CFACC's orders will be built on national and/or alliance air doctrine.

It is at the next level, tactical mission planning, that the establishment of *common intent* becomes fundamentally important as a precursor to successful mission execution. In the context of coordinating a package of coalition aircraft for an offensive air operation, aircrew interoperability will be crucial in achieving the necessary *common intent* to competently conduct the mission in a reasonably safe manner. However, while some aspects of low interoperability will be immediately apparent to the assigned package lead[18], other impediments may be more subtle thereby remaining undetected until the weight of its consequences are felt in the air. Certainly, significant differences in national doctrine will become quite obvious during the planning phase as it pertains to how the package lead will coordinate the assigned aircraft to achieve the assigned mission objectives. By definition doctrine is both the foundation for mission planning and the source of potential differences in implicit understanding of the tactical *common intent*. Defined as "…beliefs distilled through experience…codified practices on how best to employ air…power,"[19] it will shape the procedures applied to coordinate and synchronize the collective offensive actions, as well as the tactics applied to deal with enemy air threats. As

[18] Assigned by the ATO and responsible for planning, briefing and leading the mission. Sub-elements of the package will also have their respective flight leads to further plan the role specific details of their tasking within the package (ie. attack plan for a specific target).
[19] United States Air Force, *Air Force Basic Doctrine – Air Force Doctrine Document 1*, pp. 1-3. This definition was chosen in recognition of the predominant role of the United States military in any coalition operation involving NATO or a crisis of significant interest to the world community.

clearly identified by Pigeau and McCann, the development of the tactical pre-mission *common intent* will also rely heavily on implied intent.[20]

From an aircrew capabilities perspective, coalition members that have little or no experience in the chosen doctrine (procedures and tactics) will be at a tremendous disadvantage unless deliberate effort is made to bridge this gap. Fortunately, some of these differences in understanding will be quite apparent during mission planning, both to the package lead and others, given the level of detailed discussion necessary to build such complex missions. However, recalling that doctrine is built on beliefs and experience, the role of implicit intent cannot be underestimated as it pertains to how people subjectively perceive things. The source of this subjectivity can be largely attributed to childhood upbringing (native culture), but is also affected in this context by the aircrew training and experience received over the course of their military career (organizational culture).[21] To fully appreciate its influence and to find appropriate measures to minimize its negative effects, further analysis is necessary.

Research has demonstrated the impact of childhood development in influencing the way in which people interpret their world around them and how the early shaping of an individual's belief system retains a strong influence on how things are perceived throughout their adult life.[22] In infancy, a child's mind appears to develop patterns as a means to interpret stimulation of the senses into an evolving understanding of the world around them.[23] As time passes, this understanding evolves and is shaped through exposure to stimulus and experience, which contributes in turn to an expanding relational framework. While parents, teachers and others assist the child in continuously enhancing this understanding through explicit explanations and

[20] Carol McCann and Ross Pigeau, "Redefining Command and Control," p. 166.
[21] Ibid, p. 167.
[22] Robert Jervis, *Perception and Misperception In International Politics*, pp. 249-257.
[23] M.L.J. Abercrombie, *The Anatomy of Judgement – An Investigation into the process of perception and reasoning*, pp. 40-41 & 55

demonstrations, implicit understanding appears to be largely developed though informal observation of the behavior of others in varying circumstances.[24] In particular, this process of behavioral observation tends to influence not only understanding, but also subconsciously imprints values, customs and beliefs on the child.[25] A similar effect is generated for aircrew. During their early professional development within their national air force they will undergo a similar socialization that will influence their doctrinal beliefs in parallel with the training that builds their skills. The sum effect of this childhood and initial aircrew development is to imprint a belief system, in which social and culture environments factor significantly, that orients the way in which individuals perceive things, and ultimately will influence their interpretation someone's intent or events unfolding during mission execution.[26]

Unfortunately, other than for obvious differences in opinion that would surface during mission planning, or questions raised during the subsequent package briefing, unrecognized differences in implicit intent may fail to surface thereby subtly degrading the level of tactical common intent actually achieved during the mission orientation and preparation phases. But what if aircrew fail to seek further clarity? In some cultures, particularly those from the Far East, any visible display of weakness is completely unacceptable. Similarly, these same individuals might give a knowing, affirmative nod even though they don't actually fully understand. Regardless, one need only to imagine the impact of implicit differences in national interpretations of acceptable risk if a pilot tasked with escorting the tactical fighter-bombers perceived an enemy aircraft threat to be too high and avoided it thereby leaving the more

[24] Ibid, p. 57.
[25] Ibid, pp. 57-58.
[26] Ibid, pp. 143-145.

vulnerable fighter-bombers to deal with the consequences of his failure to secure local air superiority.[27]

Further compounding of the subtle, debilitating impact of differences in implied intent is caused by limited attendance at the package lead's planning session as well as the pre-mission brief. Quite often the planning of package missions are limited to only a few individuals: typically the package lead; flight leads assigned for each sub-element (ie. lead for Sweep aircraft); and a member of the standoff support team (ie. someone off the AWACS). The result is that those aircrew not present at the planning and pre-mission briefing receive their explanations second hand through the few aircrew who were directly involved.[28] The problem may be further confounded by geography as seen during OAF, during which units were operating from numerous airbases dispersed across Italy and beyond. In other circumstances, an aircrew may be assigned to the mission at the last minute with only minimal briefing, such as an unexpected change in the unit flying schedule. Given the disproportionate importance of tactical mission planning and collective briefing for establishment of tactical *common intent* prior to flying, what is the impact of unresolved misunderstandings or second-hand briefings?

While the body of available empirical evidence is limited, the results of the research by Shattuck and Woods in this area is sufficiently revealing to merit concern. Although their study

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[27] 1 Canadian Air Division, *Out of the Sun – Aerospace Doctrine for the Canadian Forces*, pp. 64-67 and Thomas Durell-Young, "Command in Coalition Operations," In *Problems and Solutions in Future Coalition Operations*, pp. 32-35. Although the Durell-Young's focus was on the nuances of command of coalition troops at the operational level, the points regarding the prevalence of national interests in influencing the employment of national forces at the tactical level is equally applicable in this context. Ideally, national contingent commanders would bring such national limits to the attention of the CFACC and his staff who would in turn manage these limitations through a careful screening of targets and mission assignments tasked through the ATO. However, if the staff are neither aware of the limits or the full implications they will have on the aircrew's subsequent actions in flight, then problems won't be evident until it's too late (ie. during mission execution).

[28] Typically, the pre-mission brief uses a combination of visual aids (maps, diagrams and flow charts depicting aircraft maneuvers in the target area as well as in response to enemy aircraft enroute) and data cards. Copies of this material would be passed on to the other aircrew not present, but would obviously lack the contextual, detailed explanations given by the flight lead that would be instrumental in building tactical common intent.

was limited to only one level of chain of command (battalion commander to company commander) and focused on the topic of *Commander's Intent*, the results revealed that this intent was only correctly applied in a third of the circumstances, as judged by the Commander issuing the intent and observing the resultant interpretation as it applied a theoretical application.[29] This is quite startling considering the difference in detail between a carefully worded yet brief mission intent statement by a senior commander, and the detailed planning instructions resulting from tactical mission planning by the package lead. Furthermore, such discrepancies in the broader understanding of the flight lead's mission intent are only further exasperated for those aircrew not directly involved in the planning or in attendance for the pre-flight package briefing. Research has demonstrated that the process of internally testing one's cognitive belief system is the means by which an individual can reject or modify existing patterns and schema of interpretation, or introduce new ones with the result being an improved capability for more accurately interpreting one's environment.[30] If left untested, such differences in interpretations of the explicit and implicit intent will manifest themselves during mission execution. If these differences are minor the impact will be negligible. Conversely, if such differences cause confusion that cannot be immediately reconciled in the heat of the moment, the consequences could result in fratricide, collateral damage, preventable loss of friendly aircraft to enemy threats, or failure to get bombs on target. Clearly the price of degraded tactical *common intent* and/or unrecognized differences in implied intent can not only lead to mission failure, the consequences could be significant at the operational level or higher.

[29] Lawrence G. Shattuck and David D. Woods, "Communication of Intent in Military Command and Control Systems," In Carol McCann and Ross Pigeau (Eds.), *The Human in Command – Exploring the Modern Military Experience*, pp. 284-287.
[30] M.L.J. Abercrombie, pp. 60-62.

Thus, while it may acceptable for some aircrew to be absent from the mission preparation phase in situations where the aircrew share common doctrine (ie. traditional NATO allies) and have benefited from enriching collective training (ie. courses such as the NATO Tactical Leadership Program and exercises such as Red Flag, Maple Flag and Blue Flag), clearly such practices are a formula for disaster in the context of coalition air operations involving non-traditional allies.[31] In fact, given the significant expansion in NATO membership in recent years from 16 to 29 countries, the inclusion of such new members in a future air campaign could lead to similar problems unless significant and deliberate effort is made train collectively using a common doctrine.[32] Furthermore, the CFACC may have to enforce attendance of all participating aircrew at the mass pre-brief for such package missions to ensure all receive the lead's mission intent first hand and can seek immediate clarity for those items that are not completely understood.

While such mass attendance may be extremely difficult when participating aircrew are dispersed amongst different airbases, the CFACC could choose to either limit participation in such high-risk missions to only traditional allies, or ensure his staff only assign aircraft that are based at the same airfield (or located in reasonable proximity). Finally, the CFACC could choose to enforce a policy that prohibits mission participation by aircrew that were not in attendance at the mass pre-brief. Regrettably, some of these measures will reduce the flexibility that the centralized command and control structure provides, and could force a reduction in the

[31] The NATO-run Tactical Leadership Program provides training to senior flight leads in the planning and leading of large package formations. Exercises Red Flag and Maple Flag permit aircrew to apply their individual and collective skills in a high-intensity training environment designed to emulate the complexity, stress and confusion that inevitably occurs in combat. Such exercises reinforce the lessons learned through the use of accurate visual recreations of the mission resulting from recording devices carried on each aircraft, as well as mass debriefs in which all participating aircrew normally attend. Exercise Blue Flag is oriented towards training future Air Component Commanders and their operations staff in a high intensity combat scenario wherein the tasking of aircraft to missions through the ATO process is a key element.
[32] North Atlantic Treaty Organization, http://www.nato.int/home.htm

overall tempo of the air campaign (to allow more mission preparation), but the benefits of such efforts to address impediments to *common understanding* could well outweigh the disadvantages when weighed against the outcomes during mission execution.

PART 5 – MISSION EXECUTION: WHERE THE IMPEDIMENTS TO EFFECTIVE AIRCREW INTEROPERABILITY EXACT THEIR PRICE

> *Differences in national doctrines, languages and cultures often meant breaches in understanding, inability to communicate on the battlefield, fratricide, and disorganization. In short, effective operations were hindered by multiple sources of friction.*[33]

The trust test of the level of tactical *common intent* established during the mission preparation phase occurs once the aircrew get airborne. As discussed, an appreciation for the subtle existence of impediments to effective common intent is the starting point for determining if it is an important factor for the mix of aircrew participating in a given coalition operation, and some measures can be taken to mitigate the negative impacts. The mix of participants can bring many positive contributions to a coalition effort including specialized skills (ie. electronic warfare) or support assets (ie. additional air-to-air refueling aircraft) that the CFACC would want to include with the least possible restrictions. Similarly, an appreciation for the subtle impediments that can undermine common understanding and coordinated execution of the mission would serve to assist the CFACC and his staff in identifying potential problems and mitigating their impact while seeking to employ the coalition aircrew with the least restrictions possible.

To begin with one must examine the notion of individual situational awareness (SA) to see its role in developing in-flight common understanding of the ever-changing situation. Defined by Vietnam Ace Randall Cunningham as "…a three-dimensional sense of awareness and feel {for} time, distance and relative motion…only if you have a feeling for what is going on around you can you take action and make correct decisions, " Spick's conclusion at the end of his research was that the mastery of situational awareness at the individual level has been the single most important contributing factor to success in aerial combat operations throughout the history of aerial warfare.[34] The sharing of individual SA amongst the aircrew within a package of aircraft allows for coordination action in response to a dynamically changing threat environment, whether

[33] Robert Ricassi, "Principles for Coalition Warfare", *Joint Forces Quarterly*, p. 60.
[34] Mike Spick, *The Ace Factor*, pp. 165 and 186-187.

it be the air superiority fighters committing on an enemy aircraft first detected as a threat to the package by an AWACS controller, or a specialized attack aircraft responding to a SAM threat that is menacing some of the tactical fighter-bombers. The *common intent* established by the package lead during mission preparation would have addressed the roles and priorities of specific aircraft within the formation, and the sharing of this individual SA permits the mission to be executed accordingly in a coordinated and effective manner.

The key enabler to developing and sustaining this common understanding of the dynamically changing environment are in-flight communications, and the interoperability of the inter-aircraft communication systems is mission-critical. However, despite the advent of improvements to inter-aircraft communication suites (ie. encryption/decryption and anti-jam capabilities, satellite communications and multiple radio sets) they remain quite limited in capacity for in-flight discussions, particularly when numerous aircraft are operating on a common frequency. Firstly, only one person can clearly transmit at a time. If a second person attempts to transmit simultaneously it will preclude this second person from hearing the remainder of the other person's transmission and will interrupt other aircrew monitoring the same radio frequency. Secondly, transmissions must be kept brief and concise. To do otherwise not only invites a possible interruption, but denies the other members of the team from providing their own inputs, y, gicand s fi

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allies, the "need for better communications" is a recurring observation coming out of the post-flight debriefs for missions that experienced difficulties with coordinated response to simulated surface and air threats.[36] An important solution has been the use of "comm brevity" words, a specialized lexicon that that has well-defined and specific meanings attached to each word.[37] The value of these words is that they have specific meaning even if devoid of a complete sentence or added context. These key words are often linked together to give brief, yet concise descriptive updates on the changing threat situation, or to direct immediate action (or reaction depending on the circumstances) to other members of the package formation.

Unfortunately, the incorrect understanding or application of these key brevity words can have immediate, unintended consequences as noted by Smith, even within the lesser challenge of joint operations within the same military.[38] Under circumstances of personal stress or when the threat situation is complex, the disciplined use of both the radio transmissions and the use of the communication brevity words can quickly deteriorate. In the context of coalition air operations, differences in doctrine, language and culture can contribute to the degradation of the inter-aircraft communications and thus, reduce the effectiveness of the coordinated execution of the mission. While additional means of information sharing amongst aircraft, typically through the data-link transmissions, has become increasingly prevalent it has its own inherent limitations as already noted.[39] For instance, the simple matter of coloring the threat aircraft red on the display might be inadvertently mistaken as friendly by former Warsaw Pact aircrew who positively associate red with communism. Regardless, data-link is not responsive enough when compared with verbal communications in dynamic situations, so the focus will remain on the latter as the

[36] Exercise Red Flag is conducted at Nellis Air Force Base in Nevada and Exercise Maple Flag is conducted at 4 Wing Cold Lake in Alberta. Typically such exercises simulate a moderate to high threat environment that inevitably infuses stressful situation into the missions and compounds the magnitude of the negative consequences as measured by the simulated losses of "friendly" aircraft during such training missions.
[37] Short for communication brevity, lists of these specialized words exist within NATO and are often supplemented by additional words and/or clarity by individual nations.
[38] Michael Smith, "Doctrine and Training: The Foundation of Effective Coalition Operation," In *Problems and Solutions in Future Coalition Operations*, pp. 71-72.
[39] Christian Rousseau, "Complexity and the Limits of Modern Battlespace Visualization," *Canadian Military Journal*, pp. 42-43.

critical enabler to aircrew interoperability in flight. But what are the impediments that are of concern to effective communications in coalition air operations?

The primary concern is related to the fact that the means by which people communicate is highly subjective in nature. The selection of words to express one's thoughts combined with the use of non-verbal communication such as gestures and tone are a matter of personal choice. In some cultures such as French, Italian and Spanish, the use of gestures is an important means of communications that cannot be underestimated. Similarly, listening is also a highly subjective process and is also influenced by many factors including the listener's own unconscious interpretation of the words chosen and the level of understanding of not only the message content and context, but also a correct interpretation of the speaker's tone and body language.[40] Recognizing the powerful influences of subjectivity as well as the absence of body language in inter-aircraft communications, it the use of communication brevity words can be extremely important to establish a reasonable common understanding. But what are the impacts of different linguistic upbringings on clear and concise communications?

When aircrew are operating in a language other than their fluent mother tongue, the risk of misunderstanding is rather likely, particularly if the aircrew are not accustomed to the communication brevity words in use for the operation, or other non-standard, potentially ambiguous words are applied to describe or direct coordinated execution.[41] Additionally, there exists the potential for mispronunciation, grammatical errors in the way the words are combined into a message or a subtle yet significant error in the translation. For example, a French fighter pilot locked onto a fast moving radar contact would describe it as a contact of *haut vitesse*. During the ensuing translation, particularly in a situation of heightened stress, this same pilot might describe the contact as "high speed" or "high fast" since the word "fast" is a commonly accepted NATO brevity word. Regardless, it is within the realm of reasonable

[40] Thomas G. Banville, *How to Listen – How to be Heard*, pp. 10-17.
[41] M.L.J. Abercrombie, pp. 106-107. In this instance, the author is describing the creation of confusion arising from the use of words of multiple connotations and alternative interpretations.

possibility that the other members of the package would take the word "high" in a different sense since it is one of four commonly used brevity words applied to discern altitude.[42]

The consequence of this seemingly benign error of translation is that the other members of the package could be mislead into focusing their radar and visual search patterns into the upper portion of the airspace. If the original radar contact was somewhere else in the sky (ie. low altitude), it is quite possible that if an enemy aircraft it could close within weapons firing range without being targeted by one of the air superiority fighters. Although only a figurative example, it serves to highlight the potential for language differences amongst coalition aircrew to inadvertently create unnecessary confusion to the collective understanding of the dynamic air picture. Even if the error is detected, the additional communications needed to correct the problem may not be possible given the increased radio use needed in rapidly evolving situations such as the prosecution of, or reaction to an enemy air threat in the immediate vicinity.

Next is the element of culture. Assuming that all the coalition aircrew are fluent in the common language being used, could differences in culture have a negative influence on the in-flight communications? Although perhaps more subtle than previous discussion about the impact of language differences, the primary impact of cultural differences is most likely to transpire within the implicit domain of communications.[43] The impact on the collective common understanding of the ever-changing air picture during an actual mission would tend to arise from the potential for differences in interpretation, and possibly even the unconscious filtering out of things that are not recognizable within the individual's cognitive framework and established belief system.[44] In the case of misinterpretation, the confusion could manifest itself both with the individual (misunderstanding of what was heard) or propagated throughout the formation (transmission of the misleading information or directives due to misinterpretation on the part of the aircrew transmitting the message). What may be perceived as significant to one member of the formation may me perceived insignificant (or less significant) by another. In the case of key elements of

[42] The other altitude descriptors being low, medium and very high.
[43] Martha E. Maurer, *Coalition Command and Control – Key Considerations*, pp. 55-63.
[44] Robert. Jervis, *Perception and Misperception In International Politics*, pp. 143-154.

a transmission failing to register (inadvertent selective hearing), depending on the circumstances, the consequences could be dramatic particularly if it occurs in proximity to a threat. Similarly, it could lead to mistaken identification of a friendly aircraft resulting in fratricide.

The final consideration is doctrine. Apart from the implicit "beliefs" that are associated with national or allied doctrine is the simple aspect of familiarity. Flying high performance aircraft within a package formation in a high threat environment is extremely demanding, pushing aircrew to their physical and mental limits. Under such circumstances of high stress, aircrew tend to revert to habit in managing the many demands of flying their aircraft, working their sensors (ie. radar, infrared targeting pods, etc) and interacting with other aircrew to achieve coordinated execution of the mission. Such habits are built on hours of training and reinforced through experiences provided in quality collective training environments (ie. Red Flag), or through previous operational experience. For coalition aircrew flying the more demanding package missions in high threat environments, unfamiliarity with the tactics and procedures associated with the doctrine in use would be analogous to an aircraft without wings. At the critical moments of mission execution when the quality of the coordinated action will significantly influence the outcome, the results could be disastrous.[45]

[45] Mark D. Mandales, Thomas C. Hone and Sanford S. Terry, p. 151.

PART 6 – ADDITIONAL CONSIDERATIONS

Victory smiles upon those who anticipate the changes in the character of war, not those who wait to adapt themselves after the changes occur.

Giulio Douhet

Clearly differences in doctrine, language and culture can degrade aircrew interoperability both during mission preparation and mission execution, but what can be done to mitigate the potential negative consequences? In the final analysis the problems come down to differences in understanding in the preparation and execution of tactical air operations. However, the associated challenges can be quite significant as noted by senior army officers in recent coalition operations.[46] While some of the problems can be adequately reconciled relatively quickly through deliberate educational efforts focused on enriched discussions, the majority require longer-term solutions.[47] Consequently, the CFACC and his staff will be faced with limited options and hard choices early on in the campaign, but may be able to improve aircrew interoperability over time. Conversely, the longer term solutions will require a crystal ball to accurately forecast the non-traditional allies that are most likely to participate with the most likely lead nation (United States) and lead alliance (NATO).

Doctrine and communications are at the heart of the matter. Doctrine provides the foundation for building tactical *common intent* and the habitual skills necessary for intense flying environments. It is unequivocally the single most important determinant affecting aircrew interoperability in joint, combined and coalition air operations.[48] Communications are the means that ideas are exchanged, challenged and reconciled, and that coordinated execution is achieved in flight. The key to successful solutions when an *ad hoc* coalition is cobbled together on short notice is for the CFACC and his staffs to make a deliberate attempt to proactively assess the likely symptoms and treat the causes before they result in tragic, unintended consequences. This paper has served to bring attention to the potential impediments to

[46] R.A. Dallaire, "Command Experiences in Rwanda," In Carol McCann and Ross Pigeau (Eds.), *The Human in Command – Exploring the Modern Military Experience*, p. 35; and Alan Ryan, "The Strong Lead-nation Model in an ad hoc Coalition of the Willing: Operation Stabilise in East Timor," *International Peacekeeping*, p. 35.
[47] Alan Ryan, p. 41.
[48] Mark D. Mandales, Thomas C. Hone and Sanford S. Terry, p. 151.

achieving effective aircrew interoperability, both in the cause and the likely symptoms. Having completed an assessment of the coalition participants to identify the potential differences in doctrine, language and culture that are likely to degrade *common intent* and coordinated execution, measures must be taken. Clearly, the criticality of the causes in the tactical outcomes will be inextricably linked to the risk inherent in the mission (complexity and/or threat level).

The issue of improving *common intent* during the mission preparation phase has already been addressed and simply comes down to taking the necessary measures to ensure a sufficient level of understanding has been achieved. This equates to ensuring that the participating aircrew are given the maximum opportunity to develop, question and reconcile their individual comprehension of the specific tactical intent for the assigned mission. It will likely necessitate a decrease in the tempo of taskings to allow more time for the crucial establishment of tactical *common intent*, and may also require limiting package participants to those aircrew based in close proximity to one another, as was done in the early stages of Desert Shield.[49] Awareness of cultural issues that could impact operations could also be adequately reconciled in relatively short order through the application of intelligent, sensitive measures (ie. discretely test the level of understanding and /or risk tolerance with individual aircrew in private settings to provide the opportunity for enriched discussions without fear of embarrassment in front of others). If the language skills of certain nations or aircrew are cause for concern, than language testing could be applied to ensure a minimum acceptable skill level is upheld. Particular benefit would accrue from conducting such tests in a simulated combat environment to evaluate competency with the communication brevity words in use (ie. simulator flight in a scenario developed, run and evaluated by someone from the lead nation of alliance involved in the coalition operation).

Additional measures could be taken in theatre to reinforce the essential elements of tactical *common intent* such as mandatory mass debriefs following each mission, conducting periodic tactics seminars, and internal circulation of lessons learned by other coalition aircrew during recent missions. The benefits of these measures would be to increase individual understanding and improve the collective

[49] Peter C. Hunt, *Coalition Warfare – Considerations for the Air Component Commander*, p. 28.

implicit intent. Research has demonstrated that the process of internally testing one's cognitive belief system is the fundamental means by which an individual can reject or modify existing beliefs or introduce new ones, with the result being an improved capability for more accurately understanding and interpreting one's environment[50] Similarly, socialization activities are instrumental to improving implicit intent.[51] Although such measures would require a reduction in operational tempo to create the necessary time for such mass debriefs and seminars, it would be an excellent investment towards improving tactical outcomes during mission execution.

Unfortunately, if the root causes are related to significant differences in doctrine, than short term solutions are limited and blunt with the most effective measures taking significant time, effort and expense. In the case of the CFLCC, the preferred decentralized command and control structure, the two-dimensional nature of the battlespace, and the low mobility of army formations lends itself to allocating quasi-independent sectors of responsibility to nations that lack the necessary capabilities and/or minimal required interoperability. Although such patchwork allocations undercut the synergistic benefits of an integrated approach, it may be the best approach when time is critical as exemplified during Operation Stabilise in East Timor.[52]

Conversely, given that integration of forces is fundamental to a centralized command and control structure, the CFACC could opt to restrict the missions assigned to nations with inadequate interoperability for high-risk offensive operations in package formations. Such an approach was taken by the CFACC during Operation Deliberate Force wherein some aircraft were assigned to roles of lower risk and/or less requirement for a higher-level capability.[53] While such decisions were based largely on technological limitations, it would be equally applicable to significant problems in aircrew interoperability. In the most extreme cases, the CFACC could either refuse participation of certain nations in air operations (as was done with the French Mirage F-1 aircraft during Desert Storm for fear of

[50] M.L.J. Abercrombie, pp. 60-62.
[51] Carol McCann and Ross Pigeau, "Redefining Command and Control," pp. 168-172.
[52] Alan Ryan, pp. 28-29.
[53] Peter C. Hunt, pp. 41-42.

potential fratricide)[54], offering them alternative means (non-flying) to contribute to the air campaign. However, if time permits, the CFACC could request additional time for collective training in-theatre to work out the aircrew interoperability issues. Although the timing of Desert Storm was decided by other strategic factors, Desert Shield provide the CFACC several valuable weeks to develop and refine the collective training of his coalition forces into a highly effective fighting force prior to the commencement of the offensive air campaign.[55]

Realistically, the solutions to significant doctrinal differences can only be properly reconciled over time through education and collective training, with particular emphasis on multinational flying exercises such as Red Flag, Maple Flag and the like. As noted by Maurer, the quest for an effective reconciliation in joint doctrine amongst the various United States armed services took many years, so the significance of the challenge cannot be underestimated.[56] However, if it's possible to accurately forecast the likely allies in future *ad hoc* coalition air operations, it's well worth the effort. While the detailed post-conflict analysis of the Gulf War strongly reinforces this conclusion, the stunning results of Operation Desert Storm speak for themselves.[57]

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[54] Ibid, p. 29.
[55] Library of Congress, "Volume II – Operations and Effects and Effectiveness," In Eliot A. Cohen,. (Director) *Gulf War Air Power Survey*.
[56] Martha E. Maurer, *Coalition Command and Control – Key Considerations*, pp. pp-103.
[57] Mark D. Mandales, Thomas C. Hone and Sanford S. Terry, p. 151, and Library of Congress, "Volume II – Operations and Effects and Effectiveness," In Eliot A. Cohen, (Director) *Gulf War Air Power Survey*. The results of the air campaign in Operation Desert Storm must be qualified by the fact that the majority of the actual combat aircraft (air superiority fighters, fighter-attack and ground-attack) came from NATO allies, and that many of the coalition aircrew from the participating Gulf states were trained in the United States and/or were flying aircraft exported from the United States. Thus, there a solid foundation of commonality in air doctrine pre-existed the war and was reinforced through in-theatre, collective training during the months preceding aerial combat operations (ie. during Operation Desert Shield).

PART 7 – CONCLUSION

…the commander must accept the fact that he has certain human material with which to work and that everything must be built around the reality of these forces…[58]

The planning and execution of an effective coalition air campaign in a modern combat theatre can be a tremendously complex challenge, particularly within the centralized command and control construct that continues to demonstrate tremendous advantages despite its clear disadvantages. Central to the disadvantages are the requirements for effective interoperability to enable the full exploitation of this integrated approach to air warfare. While the need to focus on interoperability from a technical perspective is self-evident considering the sophistication of the aircraft, munitions, and systems that are available today and under development for tomorrow, the CFACC would be well advised not to overlook the human dimension of the total air power equation.

The disproportionate role of relatively junior aircrew in the outcome of the air campaign and the overall coalition operation demands great care in evaluating the potential impediments to aircrew interoperability that will inevitably manifest themselves in multinational environments. In particular, the CFACC and his staff would be well advised to carefully evaluate the differences in doctrine, language and culture amongst the participating aircrew and to take proactive measures to mitigate the consequences of such differences while applying creative means to enhance the situation so as to retain the greatest flexibility in the application of air power. Either way, failure to address these impediments will likely sow the seeds for tragic loss of life and mission failure at the operational level.

[58] John A. Warden III, p. 129.

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