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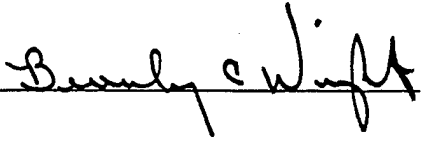
INFORMATION WARFARE: MEASURES OF EFFECTIVENESS

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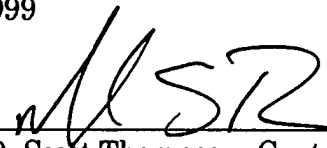
Beverly C. Wright
Lieutenant Colonel, U.S. Air Force

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D. Scott Thompson, Captain, U.S. Navy

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Abstract of

INFORMATION WARFARE: MEASURES OF EFFECTIVENESS

Information warfare (IW) has become central to the way nations fight wars and technological advances on the horizon will only increase the importance of IW to the operational commander. The growing significance of IW requires the development of measures for determining its effectiveness. This paper specifically explores measures of effectiveness for C2-attack.

Measuring the effectiveness of C2-attack actions is critical to the operational commander because effective C2-attack allows a commander to gain the initiative, thereby establishing and maintaining a primary advantage over an adversary. Since it is important to align measures of effectiveness with mission objectives or goals, possible measures of effectiveness are developed for each of the four goals of C2-attack.

Developing meaningful measures of effectiveness for C2-attack is quite a challenge due to its significant subjective content. The dilemma is how to combine objective and subjective measures so the commander has a complete picture. In many respects, objective measures can be rolled up into an overall subjective measure. Some measures, however, just don't quantify well.

As a commander plans a specific action and then implements that action, it is imperative he be able to measure the effectiveness of that action, analyze the results of that measurement, and then finally use the results of that analysis to plan the next action. Mastering this process may very well be one of the greatest challenges of command.

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*“the struggle for power changes when knowledge
about knowledge becomes the prime source of power”
Alvin Toffler*

*“what gets measured gets attention”
R. G. Eccles*

Introduction

The dawn of the Information Age has brought with it a growing belief that the effects of Information Warfare (IW) will allow the military to completely change the way it fights and wins wars. This belief has permeated every area of how the “information warrior” thinks about and wants to conduct war. In fact, some proponents of IW believe it has evolved in importance and impact to the point where it is now the fifth element of combat power.¹ Whether or not you believe this is a valid conclusion, it is commonly accepted that the role IW plays in any future adversarial confrontation will continue to grow in importance. IW is indeed a complex puzzle with many intricate pieces that are still being formed into a complete picture. As this picture is formed, one of the key issues that causes much debate is how to measure its effectiveness. The effects of IW are often subjective and are not easily developed into meaningful measurements. It is very difficult and sometimes impossible to determine to what extent IW was effective in either accomplishing or having a significant impact on a particular goal. Accordingly, developing measures that allow a commander to determine the effectiveness of a particular course of action is quite a challenge. However, it is critical for a commander to understand whether specific IW actions are effective since it is usually the commander who makes the best decisions, the quickest, that has the greatest advantage. Therefore, it is important to consider the different pieces of this puzzle called IW and then develop measures to determine how effective it is in accomplishing a particular mission.

Some of the pieces in the IW puzzle or the IW subsets are as follows:

- (1) Command-and-control warfare (C2W) (strikes against the enemy's head and neck)
- (2) Intelligence-based warfare (acquiring sufficient knowledge to dominate the battlespace)
- (3) Electronic warfare (radio-electronic or cryptographic techniques)
- (4) Psychological warfare (use of information to change the minds of friends, neutrals, and foes)
- (5) "Hacker" warfare (the attack of computer systems)
- (6) Economic information warfare (pursuing economic dominance by blocking or channeling information)
- (7) Cyberwarfare (a grab bag of futuristic scenarios)²

Since it is not feasible to explore measurements for each of these subsets, C2W was selected for specific concentration. Effective C2W denies an adversary the ability to command and control his forces (C2-attack), while protecting friendly command and control from similar attacks (C2-protection). This paper will explore potential areas within C2-attack that might lend themselves to measuring effectiveness and then propose some possible measures for these areas. For comparative purposes, previously published C2W measure of effectiveness will be discussed. Since it is difficult to determine the extent to which any piece of information warfare contributed to accomplishing a goal, this paper will present some possible problems with measuring effectiveness. Finally, some recommendations on how to develop better measures for determining the effectiveness of IW/C2W will be suggested.

IW/C2W is important to the operational commander

Information warfare has become central to the way nations fight wars, and will be critical to all US military operations in the 21st century. During the next decade, information technological advances will make dramatic changes in how this nation fights wars. These advances will significantly change the way the operational commander views the battlefield and allow him to share his vision of how to shape it down to the lowest level.³

Information warfare is the critical path to gaining information superiority. One of the key principles in Joint Vision 2010 is the emerging importance of information superiority. Information superiority as defined in Joint Vision 2010 is "the capability to collect, process, and disseminate an uninterrupted flow of information while exploiting or denying an adversary's ability to do the same."⁴ While there always will be a certain level of uncertainty associated with any battlefield environment, many believe information superiority will greatly mitigate the impact of the fog and friction of war.⁵ Accordingly, the operational level commander should exploit the many pieces of the IW puzzle as he strives to achieve information superiority. Although there are skeptics who believe information superiority is nebulous at best and much more difficult to achieve than air, sea or land superiority, striving for information superiority becomes even more critical as the commander is faced with an adversary who is radically different from adversaries of the past.⁶ As the commander gains a higher degree of information superiority, it will provide a greater understanding of the "strengths, weaknesses, and centers of gravity of an adversary's military, political, social, and economic infrastructure in order to deny, exploit, influence, corrupt or destroy those adversary information-based activities through command and control warfare and information attack."⁷

Of all the operational functions, command and control (C2) is probably the single most important function about which a commander must be concerned—his C2 and his adversary's C2. This function allows the commander to synchronize his force's activities in time, space, and purpose to achieve unity of effort with respect to strategic objectives.⁸ If a commander can effectively disrupt or deny an adversary's ability to command and control his forces, he can shape the battlefield to his advantage. The most difficult part of the equation is trying to determine whether a commander's plans to disrupt or deny an adversary's C2 capability are effective.

It is important to measure the effectiveness of C2-attack

Effective C2-attack allows a commander to gain the initiative, thereby establishing and maintaining a primary C2 advantage over an adversary. By exploiting this initiative, a commander can significantly increase his forces' ability to freely accomplish their mission and at the same time degrade or deny an adversary's ability to command and control his forces. In gaining the initiative, the commander can affect his adversary's ability to make quick and valid decisions that impact follow-on actions on the battlefield.⁹ Accordingly, it is critical for a commander to understand whether or not his C2-attack actions are effective and when possible to know the degree of effectiveness.

The importance of understanding the effectiveness of C2-attack actions is especially evident in current information operations in Yugoslavia. According to DoD press reports, more than thirty days of attacks on numerous key C2 nodes within Yugoslavia apparently have failed to significantly impact Slobodan Milosevic's ability to retain effective command and control of his forces. Based on the thousands of refugees who continued to be forced from their homes, it would appear that C2-attack actions

had yet to significantly impact Milosevic's ability to take and maintain the initiative. Additionally, when the results or effectiveness of C2-attack actions cannot be predicted, there is the risk of having the adversary commander react in some fashion that was not anticipated and therefore for which no counter action was prepared.¹⁰ This was also proven true by NATO's apparent inability to predict there would be a significant increase to ethnic cleansings in Kosovo once NATO began the air attack. Knowing the effectiveness of specific C2-attack actions are essential if the commander is going to achieve the initiative and gain an advantage over the adversary. To determine the effectiveness of C-2 attack, it is necessary to develop ways to measure it. Additionally, battle planning requires an inventory of proven C2-attack options, fully measured and found effective.

Measuring effectiveness is not easy

Determining the effectiveness of C2-attack actions is often subjective; therefore, the commander has no basis upon which to make tradeoff decisions. Effectiveness depends on many different variables, on how these variables are interrupted, and on whether a particular action was really responsible for the result, among other things. On the other hand, it is much easier to measure a function that is objective in nature.

"War effects traditionally have been fairly easy to discern; so many tanks destroyed; so many troops killed, wounded, or missing; so many bombs dropped; so much space occupied by friendly troops. These are tangible, measureable effects. When effects yield easily to quantifiable, observable means of analysis, developing meaningful methods of assessing effectiveness is straightforward. One can measure how far away a bomb hit from the intended target to determine accuracy. One can assess number of hits per try—or number of targets destroyed per mission—to develop understandable criteria for effectiveness."¹¹

Unfortunately, this is not true for determining the effectiveness of C2-attack. Counting "things" is easy, determining whether these same "things" resulted in a

desired effect or impact is a totally different matter. So, we often try to force measuring effectiveness into quantitative terms. Trying to make the effectiveness of C2-attack actions fit into quantitative measures is much like trying to force a square peg into a round hole. For example, it is relatively simple to determine the hours it took to identify an adversary's C2 targets and then to attack those same targets. However, it is quite tricky to determine the impact of these attacks and whether the attacks actually contributed to a particular outcome. Since this is a very fuzzy area, one way to develop measures of effectiveness would be to look for indicators that could suggest success or failure. These indicators would identify important details throughout each phase of an operation that could help the commander measure effectiveness.¹²

One of the most important aspects to keep in mind when developing a measure is to make sure they are aligned with the established objectives.¹³ Accordingly, when developing measures of effectiveness for C2-attack at the operational level, the first and most important point is to ensure they are aligned with operational objectives. By aligning measures with objectives, the measures will stay in focus with the commander's needs throughout a changing battlefield environment.

Some areas in which to measure the effectiveness of C2-attack and some possible measures

Developing measures of effectiveness for C2-attack is challenging because it is very difficult to assess the extent a particular action truly contributed to denying, influencing, degrading or destroying an adversary's ability to command and control his forces. Additionally, there are so many different pieces to the IW puzzle that it is also difficult to determine which focus will be of the most benefit to the operational commander. Since it is important to align measures of effectiveness with mission

objectives or goals, one way to approach this challenge is to explore possible measures for each of the four goals of C2-attack. They are as follows:

- (1) Slow the adversary's operational tempo
- (2) Disrupt adversary plans
- (3) Disrupt the adversary commander's ability to focus combat power
- (4) Influence the adversary commander's estimate of the situation

These four goals help to ensure C2-attack operations will meet the needs of the operational commander and will be successful on the battlefield.¹⁴ Therefore, measuring how effective certain actions are in accomplishing these goals would appear to give a viable option for approaching this challenge. Accordingly, each goal of C2-attack will be briefly discussed and then some possible measures of effectiveness will be presented for each goal. There is some overlapping of measures between the four categories where appropriate based on the subject area.

Slow the adversary's operational tempo: Although it is difficult to correctly predict an adversary's operational tempo, the commander can implement actions that will cause hesitation and confusion. These can slow down the adversary commander's decision making process. Slowing down the adversary's ability to quickly make accurate decisions is one way to slow down his operational tempo. C2-attack can play a critical role in slowing an adversary's decision-making ability by making his C2 functions inefficient. This can help the friendly force commander gain and maintain the initiative. Elements within C2-attack that will help a commander slow down the adversary's ability to correctly understand events and make accurate decisions quickly are operations security (OPSEC), psychological operations (PSYOP), and military deception. Additionally, electronic warfare (EW) and destruction may play an

important role when the plan is to disrupt the link between an adversary's ability to make a decision and then put that decision into action.¹⁵

The following are some possible items a commander could measure to get an indication of whether or not his plans to slow down an adversary's operational tempo are effective.

After a specific action to cause hesitation and confusion:

- What was the next operational action of the adversary?
- Was there any change to what was anticipated as the timing of the next action by the adversary? If so, what?
- Was there any change to the previous rate of movement of the adversary's forces? If so, how much?
- Were friendly forces able to take offensive action before the adversary could take the initiative?
- Were friendly forces able to maintain the initiative or did adversary forces regain the initiative? If so, how quickly?

Disrupt adversary plans: Similar to the difficulty of predicting an adversary's operational tempo, it is also very difficult, if not impossible, to predict an adversary's plans with any accuracy. However, if his plans can be interrupted or misdirected in any way, then he will be forced into a reactionary mode that will degrade the effectiveness of his plans. Two ways C2-attack can magnify degrading the effectiveness of an adversary's plans are to (1) use OPSEC and deception to achieve surprise, giving the adversary commander a situation for which he is poorly prepared, and (2) disrupt and delay his planning cycle. This will once again, slow down the adversary's decision making process and make him less effective.¹⁶

The following are some possible items a commander could measure to get an indication of whether his actions to disrupt an adversary's plans are effective:

After a specific action to interrupt or misdirect an adversary's plans:

- Was there any change to the nature of the anticipated action—from very undesirable to less undesirable action? If so, what was the change?
- Was there any change to where troop placement had been anticipated? If so, how could this change impact the adversary's plans?
- Was there any change to how the adversary resupplied or moved his logistical support? If so, what could this change imply concerning the adversary's plans?
- How much time did the adversary have before the next offensive action by friendly forces? Did timing adversely impact the planning process?
- Was there any indication the action caught the adversary by surprise? Was there any change to his anticipated action? If so, what was the change?

Disrupt the adversary commander's ability to focus combat power:

Allocating forces and resources in a timely and effective manner are critical functions for the operational level commander. By using C2-attack elements of OPSEC, PSYOP, and deception, the commander can deceive the adversary commander into believing a false "reality" of his battlefield. This can result in the adversary directing his potential combat power at the wrong time and place. Additionally, it is critical for the commander to orchestrate actions so he can predict the results of specific C2-attack actions. In other words, based on specific C2-attack actions, the adversary is manipulated into doing or not doing certain things so that the friendly commander can accurately predict his next steps. This once again, causes the adversary commander to be less effective and allows the friendly commander to maintain the initiative.¹⁷

The following are some possible items a commander could measure to get an indication of whether his actions to disrupt an adversary commander's ability to focus combat power are effective:

After a specific action to disrupt an adversary commander's ability to focus combat power:

- Was there a change in how the adversary commander had allocated his forces? If so, did the change result in his failure to deploy a force appropriately sized to successfully counter the attack?
- Was there a change in how the adversary commander had allocated his logistical resources? If so, did the change result in insufficient resources for the operation?
- Did the adversary commander allocate more combat power to secondary efforts than necessary?
- Were the adversary commander's next actions accurately predicted?

Influence the adversary commander's estimate of the situation: It is possible to influence the direction and outcome of a military operation by creating confusion and inaccuracy in the assumptions made by an adversary. By the coordinated use of OPSEC, PSYOP, and deception, the adversary can be prevented from gaining a clear and accurate picture of what is happening on the battlefield. If the adversary commander cannot accurately understand battlefield actions, he will make decisions that will cause him to plan and react poorly. Once again, this can cause the adversary to be less effective.¹⁸

The following are some possible items a commander could measure to get an indication of whether his actions to influence the adversary commander's estimate of the situation are effective:

After a specific action to influence the adversary commander's estimate of the situation:

- Did the adversary commander take actions that indicated he did not have a true picture of what was happening on the battlefield? If so, what were they and how did they impact follow-on actions?
- Was there a significant time lapse before the adversary commander took any action—either offensive or defensive in nature? If so, how did this impact actions of the friendly forces?
- Did the adversary commander give any indication he made false assumptions concerning the possible employment of friendly forces? If so, did this cause an apparent change to the anticipated deployment of his forces?

Previously published measures of effectiveness for comparative purposes

In 1995, Dynamics Research Corporation (DRC), working in conjunction with several subject matter experts from the National War College and the Army War College, published an exploratory paper that discussed measures of effectiveness in the IW/C2W arena. Although it used theater level campaigns as the focus, subsequent discussions with the authors confirm the applicability to the operational level. Its purpose was to explore some new and original thinking on measures of effectiveness since there was an increasing incorporation of IW and C2W into theater operations. The paper, Measuring Effectiveness of Theater IW/C2W Campaigns, also included techniques for selecting theater-level measures and thoughts on modeling and simulation.¹⁹

Some of the measures DRC developed are as follows:

- How well Blue reads the threat plan, to include whether the enemy's main effort was predicted and if it was predicted in a timely manner.

- Did Red reach its culminating point? Did Blue?
- Whether the Blue force commander exploited an asymmetrical advantage and denied the enemy the converse.
- Did Blue identify Red's main thrust? If so, was it identified with sufficient time to react?
- Whether the enemy center of gravity was properly identified, and successfully attacked.
- Whether the enemy was defeated, and whether the enemy was convinced of the decision.²⁰

The authors of the paper, Mr. Howard W. Clark and Ms. Sandra K. Wallfesh, conceded there were some purposes and some situations where it was appropriate to determine battle results by using forward edge of the battle area (FEBA) trace or a body count. However, they concluded it was necessary to go beyond the FEBA trace and killer-victim scoreboard mentality when conducting theater-level operations. This was necessary because there are very few quantifiable measures in this area. "Determining C2W results appears to be a fuzzy, subjective process. Thus, when considering C2W measures of effectiveness, we have to look for *indicators* that suggest success or failure."²¹ These indicators can help the commander evaluate the results of a particular C2W action and then attempt to determine how effective it was in achieving a specific outcome. Clark and Wallfesh concluded that better tools were needed to measure the theater campaign, especially as it relates to IW/C2W. They believed this to be important since the conduct of IW/C2W is becoming more difficult to isolate from other operations. "These synergistic activities are much more than EW. They are a new way of thinking about combat operations, and they require a new paradigm for the conduct

thereof."²² Accordingly, Clark and Wallfesh recommended several ideas for improvements. Two of these are as follows: (1) Derive IW/C2W objectives from the theater operation, and relate these together so the degree of their attainment can be measured, and (2) Improve and accept subjective appraisal techniques. A blend of subjective appraisal techniques is required for theater-level campaign analyses, using objective techniques when available.²³

For the most part, the exploratory paper by Clark and Wallfesh attempted to explore C2W effectiveness from a more subjective standpoint by searching for indicators that would suggest success or failure, then looking for related measures, determining what data was required for each measure and then identifying sources for the required data.²⁴ Since measurement of C2W operations requires a healthy subjective content, this appears to be a very viable way to approach the challenge.

From a slightly different perspective, tasks and measures of effectiveness for employing and integrating operational IW were published in 1996 as part of the Universal Joint Task List (UJTL), CJCSM 3500.04A.²⁵ The major tasks included:

- (1) Employing operational IW
- (2) Integrating operational IW activities with the other elements of the campaign plan and major operations and their execution
- (3) Protecting friendly C2 through a planned protection effort, integrated into subordinate campaign and major operation plans, and
- (4) Controlling C2W efforts²⁶

Some measures for each of these areas respectively are as follows:

- (1) percent of degradation of adversary air defense C4 prior to penetration operations by air; percent of adversary C2 assets have both lethal and non-

lethal attacks developed; and percent of C2W targets included in joint targeting plans

- (2) Hours to issue IW policy (after crisis onset); percent of indigenous media available to IW cell; and percent of US and Allied forces pursued common IW plans
- (3) Percent of C2W target included in joint targeting plans; percent of friendly operations carried out when and as planned; and percent of OPLANs include deception plan
- (4) Hours after identifying new enemy C2 target, target attacked; hours to change C2W plans upon receiving status updates; and percent of enemy operations delayed, disrupted, canceled, or modified.²⁷

While the measures in CJCSM 3500.04A offer more definable ways to evaluate employing and integrating operational IW and C2W, they are more quantitative in nature. Accordingly, it would be difficult for the commander to distinguish which actions were effective or not effective in accomplishing particular goals or objectives. By combining subjective measures with these objective measures, where possible, more complete and valuable information could be available to the commander to determine whether a particular action is effective.

Potential problems with measuring C2W effectiveness

As stated previously, it is quite challenging to develop meaningful measures to quantify a subjective area. At best, the commander often only gets pieces of the picture. The true dilemma is how to combine both the easy and the hard—the objective and the subjective so the commander has a complete picture. In many respects, objective measures can be rolled up into an overall subjective measure. Some measures,

however, just don't quantify well. Other problems with measuring effectiveness include how to decide what supporting data or information is really needed and then how to collect it. This is particularly formidable when the data needed pertains to the adversary. Quite often it might be impossible to know whether an action was responsible for a certain outcome. In many cases, after an attack on an adversary's C2 functions, there are more questions about the results and impact of the attack than there are answers. However, without measuring C2-attack results, how will the commander and his planners know what works? Therefore, the C2W staff must work towards providing as much effects data as possible, so that successful attacks (and defenses) can be repeated and unsuccessful ones can be avoided. A note of caution is in order though. What works in one set of conditions may not do the job in another. On the broadest level, consider Desert Storm and Kosovo, evidently Serbian C2 infrastructure is much more robust and sophisticated than Iraq's. Presumably the C2W is not the same.

Recommendations

To give the commander a more complete picture of how specific C2-attack actions are impacting the battlefield and whether or not they are effective, there needs to be a better blending of objective and subjective measurements. Of course, this is much easier said than done. Accordingly, developing IW/C2W measures of effectiveness should be included as an essential portion of wargaming exercises. By incorporating the development of these measures into the process, over time the fuzzy will be clearer.

Developing measures of effectiveness for the goals of C2-attack is one way to approach the subject that lends some credibility to the measures because they are linked to operational goals or objectives. However, this is simply an initial effort that

requires additional development. One way to start this effort would be to use the IW/C2W measures in the Universal Joint Task List, the measures in Measuring Effectiveness of Theater IW/C2W Campaigns, and the proposed measures in this paper and explore how they can be merged and further developed into measures of effectiveness for C2-attack actions.

On a final note, since it is often very difficult to measure or quantify effectiveness, an alternative way to consider this problem could be to look at it from the opposite view--ineffectiveness. It is often easier, more accurate and more beneficial to identify ineffectiveness (problems or faults) than it is to identify measures of effectiveness. In other words, an action or function would be considered to have achieved effectiveness if it is free from characteristics of ineffectiveness.²⁸ This is a different perspective that could help clarify some of the fuzzy parts of measuring C2-attack effectiveness.

Conclusion

The capabilities that IW bring to the battlefield will continue to grow in importance to the operational commander as we enter the 21st Century. Accordingly, it is imperative to develop measures to help the commander determine whether the actions he plans are effective, what C2W forces are needed, what they can do, and how much they will contribute to his battle outcome. When evaluating the effectiveness of C2-attack actions it is helpful to combine objective and subjective measures, then attempt to paint a complete picture of the battlefield for the operational level commander. Since the impact of C2-attack actions are often very subjective, a strictly quantitative measure does not give the commander enough information to determine the effectiveness of a particular action. One way to approach this challenge is to

develop measures that are aligned with the goals of C2-attack. The measures would include indicators to suggest success or failure as the commander attempts to determine the effectiveness of certain C2-attack actions. As a commander plans a specific action and then implements that action, it is imperative he be able to measure the effectiveness of that action, analyze the results of that measurement, and then finally use the results of that analysis to plan the next action. Mastering this process may very well be one of the greatest challenges of command.

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