

## A Model of 21<sup>st</sup> Century Counterinsurgency Warfare

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The insurgency warfare being practiced by global terrorists in the 21<sup>st</sup> Century is put in a historical context and modeled mathematically. The most widely known insurgency model is the “fish in the sea” formulation attributed to Mao Tse-tung. Fundamentally, it is a phased attrition model that can be described by variations of the Lanchester equations. In a collective sense, much of the Vietnam War fits that formulation. However, the 21<sup>st</sup> Century has featured a different type of insurgency where attrition is not the decisive factor on either side. Today’s insurgencies are psychological wars of political endurance, not attrition. They require different mathematics.

The mathematical formulation of 21<sup>st</sup> Century counterinsurgency warfare contains two stochastic time series, the first dealing with defeat and the second success. The defeat portion deals with the likelihood of precipitous troop withdrawals permitting terrorist insurgents to declare victory in a *de facto* sense. The defeat probability roughly mirrors public opinion polls. Public opinion polls are probabilistic because they are heavily influenced by short-term unpredictable events, some detrimental to the war effort and some supporting it. In a sense, this is similar to the fluctuations of the stock market or exchange rate variations. They are also influenced by the duration of the war and accumulated casualties, both in a negative sense. Consequently, the defeat probability trends upward asymptotically toward unity over time although the instantaneous values cluster above and below the trend curve. In a democracy, decision makers or funding bodies can resist adverse polls but not indefinitely. If war support polls are heavily negative, it is probable that decision makers will eventually move to cut their losses and pull out.

The second portion of the model independently deals with success by counterinsurgency forces; i.e., a level of stability and security that permits at least a partial, phased troop draw down. It is based on estimates of the strength and quality of the host country military and police forces, the level of insurgent-initiated violence, the state of the host country economy, the services provided by the host government, and the willingness of the host government to address the insurgency in an even-handed manner. The success model resembles the Hamlet Evaluation System used during the Vietnam War. The instantaneous measures of success fluctuate above and below the trend curve with a variance that can be small, approaching determinacy. The success model has fixed, predetermined benchmarks that can but may not be achieved depending on the level of effort relative to the insurgent opposition.

Both parts of the model deal with counterinsurgent troop withdrawals, one precipitous and one gradual and phased. In neither of the cases considered, *de facto* defeat or phased withdrawal, does the model deal with “military” defeat or victory. If the

type of insurgencies encountered in the 21<sup>st</sup> Century become the norm, military defeat and victory are irrelevant.

**Keywords:** 21st Century counterinsurgency, Lanchester Theory, COIN victory, defeat criteria

## 1. Introduction

Guerrilla-led insurgencies have been practiced for thousands of years but since the middle of the 20<sup>th</sup> century they have been identified with the model created by Mao Tse-tung [1] following his victory over the Chinese Nationalists. He postulated 3 phases of insurgency. The first two phases were characterized by small-force ground-yielding insurgent operations but overall military superiority on the part of the counterinsurgents. Phase I visualized guerrilla activity using terrorist tactics; i.e., mine warfare and use of explosives on a small scale, sniping against counterinsurgent (COIN) forces, and terror against non-sympathetic elements of the public. In Phase II, insurgent operations became increasingly military and their weapons more sophisticated. However, they continued to be small-force guerrilla activities that caused the defense to fragment and the engagements to be localized and relatively isolated. In Phase III, the insurgents took the strategic offensive and operated with larger, more conventional forces.

The Mao model also characterized insurgent forces as similar to fish swimming in the sea. The sea is the general population, and just as fish do, the insurgents must draw sustenance from the population sea. In the COIN context, this leads to the “hearts and minds” strategy of winning popular support of the host country.

In every insurgency that has been waged since Mao’s pamphlet was published, the attempt has been made to force fit the conflict to his model. In Malaysia, for example, the insurgency never got out of Phase I. The insurgents failed in their “fish in the sea sustenance” attempt and the British defeated them in detail with police action. In Northern Ireland, the insurgency remained terrorist style small-unit activity for half a century. The same was true of Palestinians fighting Israelis in several distinct stages but each essentially a Phase I insurgency. In North Vietnam, after several years of Phase I & II, the Viet Minh defeated the French in classic Phase III warfare at Dien Bien Phu.

In the South Vietnamese insurgency, Phases I & II were waged for more than 10 years against several successive governments and COIN coalitions in increasing intensity, and finally erupted into Phase III warfare in the form of the 1968 Tet Offensive. The insurgents were decisively defeated during Tet and the warfare was driven back to a Phase I level. However, the insurgents, now increasingly North Vietnamese regular forces, stumbled onto a winning strategy. Mounting US casualties (exceeding 55,000 killed) energized a hostile press and other media, and eventually caused the public to turn against the war. As it emerged that America and its allies were reducing their effort, it became only necessary to negotiate an in-place ceasefire while awaiting the withdrawal. In the event, America not only withdrew its military but it withheld logistical support from the South Vietnamese forces. North Vietnam then assaulted the South in classic Phase III fashion and took over the government. 21<sup>st</sup> Century insurgents have learned that lesson well.

The methodology of this essay compares 21<sup>st</sup> Century terrorist-inspired insurgencies to the Vietnam experience, initially using Lanchester theory. A principal insight is that the traditional

military measure of merit, attrition, is not the dominant feature of success. Instead, each side is attacking the resolve of the other to pursue the war. The insurgents focus on war weariness and intimidation while the counterinsurgents focus on security, stability and “hearts and minds.”

## 2. Vietnam Insurgency and Lanchester Theory

The original Lanchester equations [2] can be expressed as:

$$(1) \quad dm/dt = -F_n(m,n); \quad dn/dt = -F_m(m,n)$$

$F_n$  and  $F_m$  are functions of the force levels  $n$  and  $m$ . Upon integration, the ancient combat version,  $F_n = k_n mn$ ,  $F_m = k_m mn$  leads to the linear law whereas the modern combat version,  $F_n = k_n n$ ,  $F_m = k_m m$  leads to the square law. The linear law implies area fire and the square law aimed fire.

In a 1968 paper [3], the author applied Lanchester theory to the mathematics of the Vietnam War. A generalized model was formulated that included time-dependent weapon efficiencies and which allowed for battlefield desertions, surrenders, and supporting weaponry such as artillery or airpower. The general model was then specialized for three cases: skirmishes, ambushes, and siege, and appropriate modifications of the original equations introduced. The most significant of these concepts was the ambush model; it demonstrated that ambusher weapon efficiencies ( $k_m$ ) were an order of magnitude higher than those of the ambushed side ( $k_n$ ) permitting the ambusher to operate with smaller forces and to minimize his casualties. The ambusher weapon efficiency is higher because individual targets are less exposed than they are for the ambushed. That situation pertains until suitable protective cover is achieved, a process that can take perhaps 5 minutes. The net result is that the ambusher has a great advantage per unit of firepower.

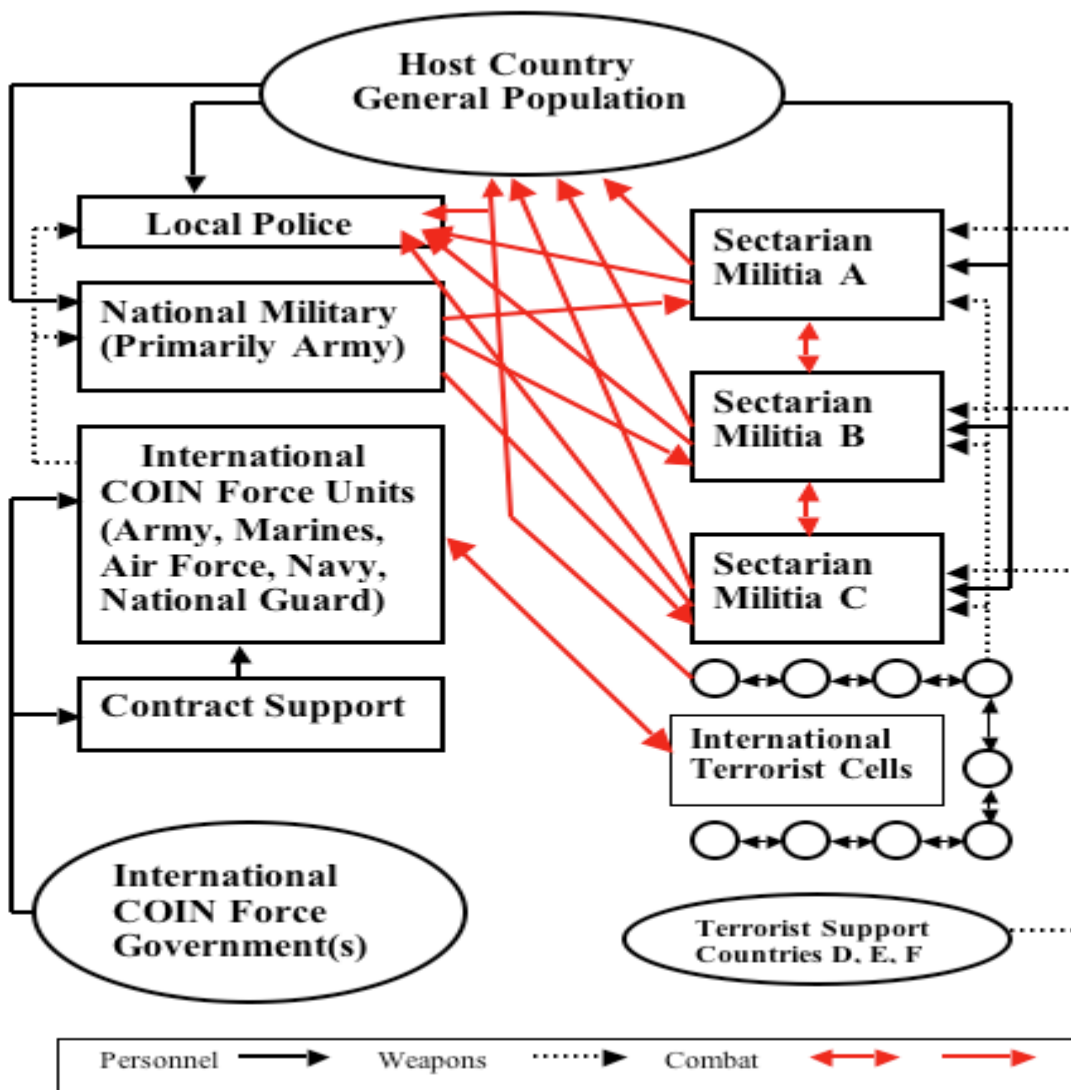
The author additionally gathered data covering a large number of military incidents for purposes of analyzing Vietnam ground conflict. Two startling facts emerged: (1) The bulk of the insurgent-initiated conflict had efficiency characteristics similar to those of ambushes; i.e., the Viet Cong were an order of magnitude more efficient than their opposition when they chose the time and terrain, and (2) insurgent casualties per unit of initial force were dramatically lower than those of counter-insurgent forces. The use of artillery or airpower reinforcement amplified that result; i.e., when COIN reinforcements were used, the insurgents departed the battlefield rather than take casualties.

Current-day insurgents look for similar advantages. They employ improvised explosive devices as land mines, and suicide bombers as a means of inflicting multiple casualties against both military and civilian targets. The detonation scenes then often double as ambush sites when COIN forces and medical personnel rush to the scene. However, the insurgent objectives are basically for psychological effect and not for attrition *per se*. Their real target is the resolve of the governments and general population of the host and expeditionary force countries.

## 3. Comparison of 21<sup>st</sup> Century Insurgency to Vietnam

Let us first characterize modern insurgencies in general terms. Bi-passing the opening phases of warfare, we focus on steady-state conflict with traditional forces on one side and terrorist guerrilla insurgents on the other. As the war proceeds, counterinsurgent forces are replenished

by fresh troops and weaponry, and reinforced by indigenous military and police recruited by the host country. The insurgents are a mixed bag of indigenous irregulars who are engaged in guerrilla-type civil war both against the host government and against competing anti-government militias. They deem themselves “freedom fighters” but they use brutal terrorist tactics often focusing on the civilian population. The indigenous insurgents are infiltrated by criminal elements and by global terrorists who attempt to co-opt and manipulate the insurgency for their own purposes. They get sufficient reinforcement from these sources and the local population to maintain their ranks, the numbers of which are relatively small in any case. The bulk of the weaponry used by the insurgents is smuggled into the country overland.



**Figure 1 – Schematic of 21<sup>st</sup> Century Counterinsurgency Operations**

A block diagram describing generalized insurgencies is provided in Figure 1. The complex schematic is patterned after and reflects events in Iraq, but it is possible to envision at least portions to be applicable to Lebanon, Afghanistan, Somalia, and the Palestinian pseudo-state conflicts. The key idea is that there are a number of competing tribal or sectarian militias who terrorize each other as well as the general civilian population with the long-term objective of seizing control of the government and imposing their own brand of cultural values and practices. They are clearly not relying on winning “hearts and minds”; they have substituted intimidation, blackmail, kidnapping for ransom, and all the techniques usually associated with criminal gangs. Each is infiltrated by and supported by international terrorist elements, and all are funded and supplied by external countries that have safe haven status.

The war in Vietnam was larger but simpler. There were fewer entities and attrition assumed major significance. Indigenous COIN participants were South Vietnamese regular army (ARVN), regional forces (RF) and popular forces (PF) supplemented by relatively small air force (RVNAF) and naval (RVNN) units. Collectively, they numbered considerably more than 500,000. However, most of the fighting was done by US army, marine, navy and air forces, supplemented by Australian and South Korean expeditionary units. At the peak of the conflict in 1969, there were more than 550,000 expeditionary COIN forces in the theater. By the end of the US war in 1973, America had suffered about 57,000 killed. The South Vietnamese military lost 250,000, and 300,000 civilians were killed as well. [4]

Insurgent forces in Vietnam consisted of about 150,000 Viet Cong southerners, supplemented by about ten North Vietnamese regular army divisions. All told, the combined level of insurgent forces probably never exceeded 250,000 at any one time. They suffered 660,000 casualties. How did they survive, much less succeed, in their military mission? Their longevity hinged on highly efficient hit and run ambush tactics that permitted them to outlast the USA/GVN enemy.

American forces in Vietnam waged a misguided war of attrition. They employed search and destroy operations on the ground and massive air bombing campaigns in a futile attempt to reduce insurgent forces and supplies to an ineffective level. It was only in 1968 during the Tet Offensive that COIN forces achieved the effectiveness against the insurgents envisioned by their tactics. At that stage of the war, the insurgents undertook a classic Phase III assault against militarily superior COIN forces and they paid the price. During earlier warfare, the insurgents had employed hit and run ambush tactics and they achieved a ten-fold advantage in combat efficiency. Nevertheless, and despite the Tet aberration, the only chance the insurgents ever had for victory was through war-weariness on the part of the COIN forces.

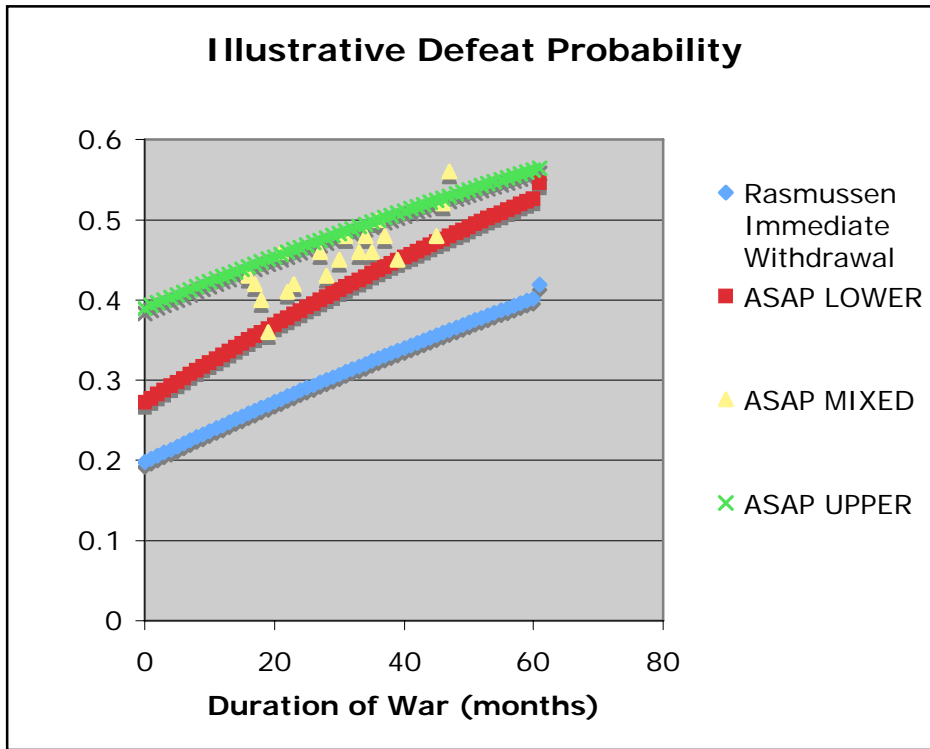
Can we apply those insights to a mathematical description of insurgency conflict in the 21<sup>st</sup> Century? The war in Vietnam was a war of attrition. Current insurgencies are not; they are wars of political endurance, the crucibles being the patience of the expeditionary force general populations.

#### **4. Model of 21<sup>st</sup> Century Insurgency**

In this formulation, the probability that COIN forces “lose” is modeled by an exponential with two constant parameters,  $\alpha$  and  $\beta$

$$(2) \quad P_L = 1 - e^{-(\alpha + \beta t)} \quad \text{where “t” is time.}$$

The probability of defeat trends upward with time because of war weariness deriving from casualties, alleged war crimes, economic costs, etc. Extensive coverage by the media emphasizing these negative factors exacerbates the



**Figure 2 – Illustrative Defeat Probability**

weariness and makes withdrawal a topic of national debate.  $P_L$  roughly mirrors polls taken of the US public on their preference for troop withdrawals. Counter-intuitively, we observe that  $1-P_L$  does not denote the probability of a counterinsurgent victory; it is the probability that the war continues until resolved one way or the other.

To illustrate the dynamics of the defeat model, we draw on an example from the Iraq War. Figure 2 displays relevant poll data [5] that includes sampling by Pew, NBC, and Rasmussen Reports. The extensive Pew and NBC data deal with withdrawal of troops as soon as possible, while the much sparser Rasmussen data deals with immediate troop withdrawal. Our judgment is that the true defeat probability lies between these two sets of data; we place it on the lower bound of the scatter for withdrawal as soon as possible. Therefore, after about 4 ½ years of warfare,  $P_L$  is about 0.5.

It is emphasized that the values for  $\varrho$  and  $\beta$  in the example are empirical estimates for the Iraq War and not analytically derived. Conceptually,  $\varrho$  reflects the level of public opposition to the war at its initiation. In a democracy, there is always (usually vocal) opposition to foreign wars, so  $\varrho$  is never zero. For the Iraq War, we put it at about 0.3. The value of  $\varrho$  for the Afghanistan War is estimated to be lower being perhaps of the order of 0.1.

The parameter  $\beta$ , on the other hand, is more heavily influenced by the news media (including insurgent media) emphasizing casualty rates, atrocity incidents, tactical victories and

defeats, etc. Media reporting on the Afghanistan War appears to stimulate lower values of  $\beta$  than it does for the Iraq War.

The model for victory (or insurgency defeat) is also stochastic albeit with instantaneous values that can have a very small variance relative to the trend curve. The prospects for success may or may not increase with time, and in fact they may decrease. Since COIN forces are generally much stronger militarily, it is certainly plausible that success prospects *can* increase with time. Clearly, a viable plan for executing COIN strategy is needed for success. However, insurgents attempt to negate that plan by infiltrating and co-opting the host government's military and police forces. If they are successful, prospects for victory may actually decrease over time.

We describe the victory trend curve in terms of a slightly different exponential, again with two constants " $\gamma$ " and " $\sigma$ ". It centers on the formation of a stable government, capable host country military and police forces, damping down of the daily terrorist and violent sectarian acts to a rate that the media no longer considers headline news, infrastructure utilities operating at least at a pre-war rate, and economic prosperity, all of which can conceptually permit a reduction of expeditionary forces to perhaps 10% of its peak level. The measure of COIN success is taken to be the variable " $S$ " which assumes values between 0 and 1. It is stochastic because instantaneous values fluctuate above and below the trend curve. However, it depends on fixed goals that are measured by empirical non-fluctuating benchmarks. The instantaneous success levels are time-dependent and relatively predictable.

A reasonable formulation for the time dependency of the  $S$  trend curve is the 2-parameter exponential depicted in equation (3). This exponential form is chosen because it permits a flexible model that encompasses a range of possible realities.

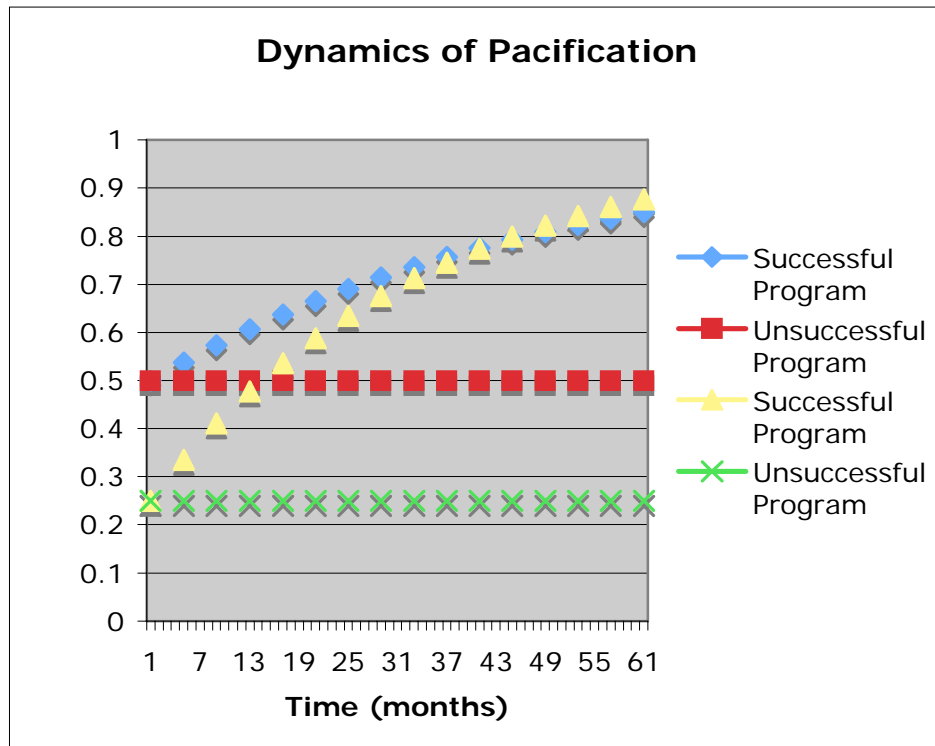
$$(3) \quad S = 1 - \sigma e^{-\gamma t}$$

The constant " $\gamma$ " depends on the viability of the COIN plan. If  $\gamma > 0$ , the plan is working and  $S$  increases from  $1 - \sigma$  toward a high plateau. However, if  $\gamma = 0$ ,  $S$  is constant at  $1 - \sigma$  and there are no prospects for success. In practice, even if  $\gamma > 0$  the plan may not be working if it is small. The increasing defeat probability may co-opt the possibility of a successful outcome. Note that in principle  $\gamma$  could be negative in which case  $S$  would actually decrease over time. Since  $\gamma$  is constant, the implication is that both the relative insurgent and counter-insurgent effort levels are unchanging. Its value depends on the level of applied counterinsurgent resources and the insurgent effort to degrade it.

The dynamics of the success measure is illustrated in Figure 3. Four cases are displayed, two successful and two unsuccessful. The successful cases trend upward over time. The upper successful curve starts from a value of  $(1 - \sigma) = 0.5$ , a relatively benign environment, and trends above 0.8 after 50 months. The lower successful curve starts from 0.25, a more hostile environment, but also exceeds 0.8 after 50 months. The two unsuccessful cases remain at their initial values of  $S$  without improvement.

Examples of counterinsurgencies where the COIN plans were successful are the 1948-1960 Malayan emergency, and the still ongoing Afghanistan War. In the Malayan case, the initial environment was somewhat benign and  $\sigma$  could be construed in the neighborhood of 0.5. In the Afghanistan War case, in contrast, the initial environment was severely unfriendly and  $\sigma$  was closer to unity. A similar example could be offered for the Russian counterinsurgency in Chechnya.

Examples of counterinsurgencies where the COIN plan was (or is) unsuccessful are numerous: the several Israeli occupations of southern Lebanon, the “peacekeeping” operations in Sudan, the US intervention in Somalia, the Soviet operations in Afghanistan, etc. Another is the US counterinsurgency in Vietnam from 1965 to the Tet Offensive in 1968. From 1968 to 1971, the COIN plan in Vietnam was very successful, following which it deteriorated to the point of defeat.



**Figure 3 – Typical Success Score Variations**

The measure of success,  $S$ , is actually the average of both geographical and type variations. The formulation is similar to the Hamlet Evaluation System (HES) score used in Vietnam.[6] The HES used 18 measures of progress in several thousand hamlets. Half were security measures and half were development measures. In general, where the bulk of the host population is urban, we suggest that 5 or 6 measures in 5 or 6 cities are adequate. For a specific location, the average  $S_{x,y}$  would be a linear (or suitably weighted) average such as

$$(4) \quad S_{x,y} = (S_{p|x,y} + S_{i|x,y} + S_{u|x,y} + S_{m|x,y} + S_{e|x,y} + \dots)/n,$$

$n$  being the number of measures.

Illustratively,  $S_p$  is the performance of local police,  $S_i$  measures the relative frequency of terrorist incidents,  $S_u$  is the quality of local utility service,  $S_m$  is the quality and quantity of local medical and educational services, and  $S_e$  is the robustness of the local economy. All the type-based  $S$  variables assume values between  $(1 - \sigma)$  and 1. The overall  $S$  is the weighted

geographical average of the  $S_{x,y}$ . A suitable weighting scheme should reflect the census population.

Operational statistics for the  $S_{x,y}$  could be collected periodically by interviewing imbedded COIN personnel or by relying on unbiased outside observers. Victory can be declared, for example, when  $S > 0.8$  for 6 months running provided that none of the  $S_{x,y} < 0.7$ . At that point, a rational argument could be made for reducing COIN forces significantly. Note that the  $S_{x,y}$  could be described by equations similar to (3) implying an underlying independent plan for their improvement. Some, however, may be partially derived from other success measures, typically security measures. All the  $S_{x,y}$  are stochastic but they do not fluctuate appreciably.

For illustrative purposes, let the  $S_{p,i,u,m,e}$  equal the values below corresponding to 4 years of war:  $S_p = 0.6$ ,  $S_i = 0.7$ ,  $S_u = 0.8$ ,  $S_m = 0.95$ ,  $S_e = 0.95$ . The average  $S$  for  $t=4$  is then 0.8 yielding a value of “ $\gamma$ ” of 0.4 (assuming  $\sigma=1$ ). Further, assume the lowest value of  $S_{x,y}$  is 90% of the average or 0.72. Then “ $\gamma$  (low)” is 0.32. Figure 5 displays these values.

In the example, the values of “ $S$ ” and “ $S$  (low)” first reach their objective levels after 4 years of warfare; troop reductions could then begin within 6 months. In that time frame, the value of P-Defeat is around 0.5 so with that scenario and those criteria, the outcome of that war would be chancy but winnable. On the other hand, if “ $\gamma$ ” was lower by 25%, the success criteria would not be achieved for more than seven years and the defeat probability might not be manageable.

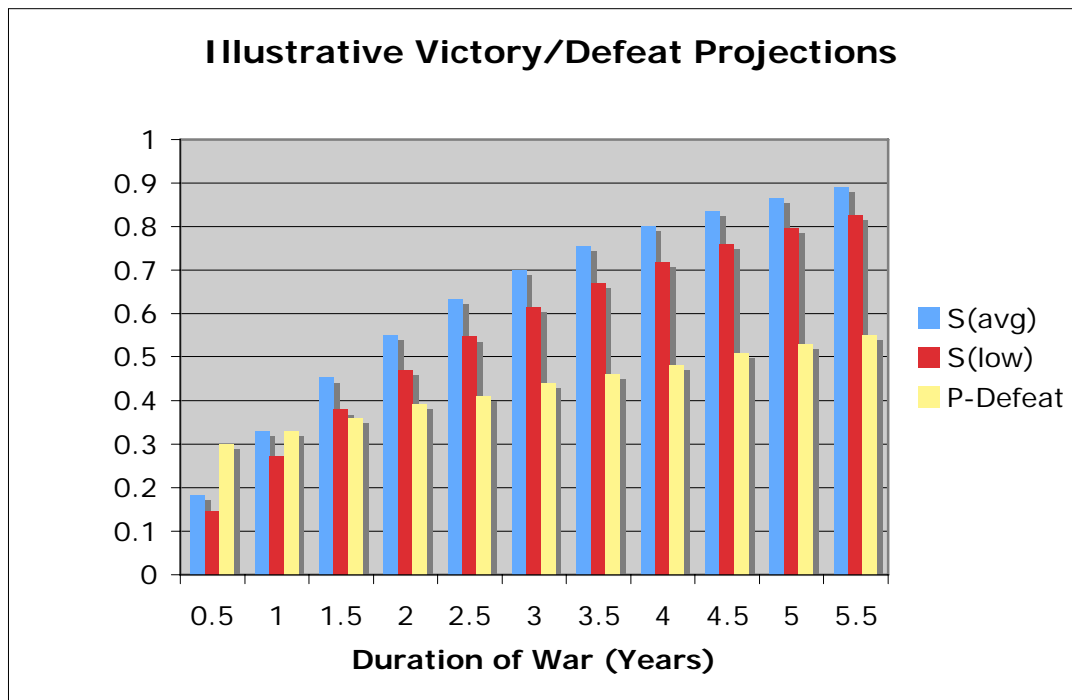


Figure 5 – Illustrative Victory/Defeat

## 5. Conclusions

A common sense conclusion is that for wars being fought against insurgents employing guerrilla terrorist tactics, victory must be achieved in timely fashion. Otherwise, the general population of

the expeditionary force country will lose patience and force a precipitous withdrawal amounting to defeat. The key to success is the rapid empowerment of the host country militarily, politically and economically. The military emphasis of the expeditionary force should be on training and equipping the host country security forces and not on achieving high attrition casualties against the insurgents. This will help in two ways. It will shorten the war; i.e., decrease the time for the host country forces and economy to become effective, and it will keep the expeditionary force casualties to a minimum. If expeditionary counterinsurgencies become the norm in coming decades, the strategic model described in this paper should provide a useful framework for force design and tactical emphases. The most likely beneficiaries would be service “think tanks” such as the Army and Navy War Colleges in Carlisle Barracks, PA, Fort Leavenworth, KA, and Newport, R.I.

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## Author Biography

**Marvin Baker Schaffer** has been associated with the RAND Corporation for more than 30 years. Currently adjunct staff; his specialties include Lanchester Theory, COIN Warfare, counter-terrorism, and weapons analysis. His work is widely published on all four subjects. He is the recipient of several professional awards including the US Army Meritorious Civilian Service Award. He has a Master's Degree in Chemical Engineering from New Jersey Institute of Technology and a Bachelor of Chemical Engineering from Cooper Union.