Effects-Based Operations:
A Guide for Practitioners

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Abstract

The literature on Effects–Based Operations (EBO) continues to be dominated by theory, with limited evidence of (successful) practical application reported. This situation is entirely acceptable in the early formative stages of any new concept, as first hesitant steps are taken and the authority of a shared idea gradually develops. EBO is now a global phenomenon. The effects must have primacy in shaping the actions that are taken. EBO practitioners need those hands-on executable actions that can be taken to solve problems in the real world. The paper offers that a systems approach that includes a *problem space*, a *solution space* and a *design space* may bring the necessary totality to the subject, guarding against premature use of means that appear to fit well with the context – a fixation with *efficiency* rather than *effect*iveness. The paper argues that an examination of the systemic interactions amongst factors may deepen planners' or policy-makers' understanding of *why* a region or area of interest behaves the way it does, before they attempt to change it. A method is detailed that couples effects statements and means and highlights capability requirements. A case study example is provided using North Korea. Use of this method in Australia recently won a Prime Minister's Award for Excellence in Business Community Partnerships.

Introduction

Current approaches to operations planning focus on defeating the enemy plan.[1] Strategic objectives are declared; planning staffs build a picture of adversary strengths, weaknesses, dispositions and intentions; commanders, with their assigned forces' own strengths, weaknesses and dispositions craft their carefully sequenced response – their *counter* intentions – and an attrition contest commences. The commander who employs force(s) *efficiently*, using neither too much nor too little, will usually succeed. Wherein lies the true origin of every RMA – the search for asymmetry in a clash of wills. The effects, beyond the immediate adversary, that these actions are in pursuit of are rarely considered; indeed, planning processes do not demand these be explicitly stated before means are formulated and sequenced.

Within this simplified picture any incidence of an *Effects*-Based Operation (EBO) could only be claimed at the tactical level, where the actions of single engagements might sufficiently bend the will of a local adversary to cease hostilities, or otherwise cause their actions to become *inefficient*. The cumulative effect of these many engagements does not constitute an EBO at higher levels. The point of origin for determining these higher effects begins outside of this planning–action/engagement context.

Many claim, however, that actions have *always* been aligned with objectives and there is little that is new in EBO planning and execution. Why then does successful implementation of EBO continue to elude strategists and planners? How can EBO be made to succeed within a whole-of-nation orientation? How can a military (operational) success contribute decisively to a strategic success? Most importantly, where do the effects come from that the plan is harnessed to?

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[1] An example of this can be found in an early JFCOM EBO White Paper hypothesis, wherein: "if we can anticipate with any degree of certainty how an intelligent adversary should, can, or could act and react to compensate for our actions; and if we can plan, execute, assess and adapt our actions in terms of the effects we desire, then we can identify and execute the most effective course of action in bringing about the desired change in the adversary's behavior (JFCOM Effects Based Operations Draft, 2001, p.1).

As stated in the sub–title the paper offers 'a guide for EBO practitioners' and, whilst some EBO theory and planning doctrine is included, the content is more attentive to the applied and practical – 'things that can be done', rather than further expressions of 'this is a good idea and why'.[2] The method presented combines a problem space, solution space and a design space and is indifferent to the presence of an adversary, giving greater application to EBO within a whole–of–nation orientation; avoids the need for 'defeat' as a primary measure of success, or *effect*iveness; guards against premature consideration of the means, what is often described as a platform–centric approach; generates effects that are harnessed directly to the area of interest; and informs the involvement and synchronisation of all elements of national power within an expanded EBO.[3]

Begin with the End in Mind

Military operations, regardless of type, scale or intensity, are undertaken to achieve a desired end–state; that is, they are (supposed to be) *purposeful*.[4] Checkland & Scholes offer a valuable insight into the term 'purposeful' wherein "they [humans] can take *purposeful action* in response to their experience of the world. By purposeful action we mean deliberate, decided, willed action, whether by an individual or by a group …. [adding the caution that] it would seem to be a good idea if purposeful action deriving from intentions were also based on knowledge rather than consisting of random thrashing about – though observation suggests that there may be no shortage of that in human affairs! [emphasis in original]" (Checkland & Scholes, 1990, p. 2). Although these authors were not concerned with national security, 'thrashing about' seems to be an apt characterization of many contemporary military operations. Certainly the 'post–hostility' military operations in Iraq are a vivid example of ends, ways and means being somewhat out of alignment and signal a possible lack of knowledge in the formulation of plans.[5]

EBO has been heralded as providing this deepened understanding and knowledge, such that when plans are formulated they are mindful of the effects that actions are in pursuit of. Indeed, a true effects–based approach would <u>demand</u> that these effects, or "what are we trying to make happen?", be declared at the outset and be harnessed directly to a detailed comprehension of the area of interest. How else could operations be *effects-based*?

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[2] Steblin, in his quest "to find out more about how to implement an effects based strategy … sadly discovered that there is actually very little written on the subject except as simple statements of the *utility of effects* [emphasis in original]" (Steblin, 1997, p. vi).

[3] 'Platform–centric' is a term that often causes lively debate. Let me offer this: I hold a spoon in my right hand and a spade in my left hand and I ask "which one do you want?" Everyone who is asked that simple question would pause and then most likely ask "what do you want me to do with it"? This response is natural, spontaneous and highlights the centrality of *purpose*. Without knowing what you are being asked to do, there can be no decision.

[4] Although reinforced throughout the paper, 'operations' includes warfighting and <u>all</u> other military activities. Many articles exploring the subject of EBO focus on warfighting operations and activities, often within the airpower discipline.

[5] An interview with Jay Garner in Jane's Intelligence Review (Vol 16, No 1, January 2004, p. 30–33) details many knowledge gaps, policy failures and inter-agency rivalry that clouded not only planning efforts but also undermined the later execution of plans.

The End–State

Within planning doctrine, the *end–state* retains primacy; it is what all actions are in pursuit of. End–states have been described at both the national and military levels.

Australian military doctrine defines end–state as:

> "… the set of desired *conditions*, incorporating the elements of national power, that will achieve the national objectives [emphasis added]" at the national strategic level; and defines the military strategic end–state as "the set of desired *conditions* beyond which the use of military force is no longer required to achieve national objectives [emphasis added]" (Australian Defence Doctrine Publication, 3.0 Operations, 1998, p. 3–2; or Australian Defence Doctrine Publication, 5.0 Planning, 2002, p. 1–6).

Furthermore, United States military doctrine recognises that the:

> "end–state incorporates the required *conditions* that, when achieved, attain the strategic objectives, or pass the main effort to other instruments of national power to attain the final strategic end–state [emphasis added]" (FM–100 Operations, 1993).

A more recent definition from the United States offers end–state as:

> "what the President of the United States and Secretary of Defense want the situation to be when operations conclude - both military operations as well as those where the military is in support of other instruments of national power. (JFCOM website, http://www.jfcom.mil/about/glossary.htm#E, accessed Mar 04).

The presence of the word 'conditions' in assisting to define end–states affords it a central role in the determination of effects. Similarly, the United States' 'situation' could be specified with reference to the 'conditions' in the Australian definition.

Finally, United Kingdom doctrine defines:

> the "end-state is *that state of affairs* which needs to be achieved at the end of the campaign to either terminate or resolve the conflict on favorable terms [emphasis added]" (Operations, 1994).[6]

For the purpose of this paper it is accepted that 'state of affairs' in UK doctrine is synonymous with 'conditions' and 'situation'. Essentially we are talking about the same thing.[7]

There is a circularity to these definitions above, as the achievement of conditions constitute the end-state and the end-state is defined by the establishment of conditions. In any event, it is clear that the desired conditions are not in place and the military would be directed to see that these conditions *are* put in place, whilst adhering to a range of international laws, conventions

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[6] The author was unable to locate a more recent reference through open sources. Any later versions would be appreciated.

[7] The Macquarie Concise Dictionary defines 'situation' as: "condition, the state of affairs, and combination of circumstances".

and articles.[8] But what are these 'conditions'? Where do they come from? How are they formulated? It is giving more substance to these 'conditions' that is of primary interest here (even to the point of asking how they can be represented, as our effects are used to reset the conditions). As shown later, these conditions play a crucial role in the formulation of effects.

In considering what is meant by 'conditions', we are drawn into a recognition that, at some earlier point, before the decision was made to take action or at least become more acutely interested in specific events) the prevailing 'conditions' were not sufficiently troubling to warrant attention or action. Therefore, it is reasonable to assume that there is a threshold beyond which the 'conditions' have moved to invite action. Those 'conditions' spoken of in doctrine then must become the point of origin for the 'effects' in an *Effects*–Based Operation. In seeking to *reset* the conditions, possibly back to pre-concern/action levels, planners would be guided by the need to impose effects that are anchored to the movement of specific conditions in specific directions.[9]

This need flows through to every tactical action, as evidenced in Warden's recognition "… as a planner or commander, you ought to be able to tell what each bomb has got to do with the peace that you want to follow the war. If you can't tell how a given bomb relates to the peace that's going to follow, then you probably haven't done your homework well and you probably shouldn't drop that particular bomb" (Warden, 1998, p. 84-85). As shown later, the current fixation with effects that are tied to targeting and air power, along with a preoccupation with the use of force, is delaying a more inclusive consideration and comprehension of EBO at the national level. Coupled with this is the fact that "it is apparent that what we want, our ends, influences our *choice* of means. Not so apparent is the fact the available means influence our *choice* of ends" (Rainey, Tryon, Friedman, & Bloser, 2002, p. 7).

A Systems Approach

The systems approach offered here comprises a problem space – "what are the systemic interactions that cause the situation to exist?"; a solution space – "what *could* I do as part of an orchestrated campaign to bring about a more favorable situation?"; and a design space – "what am I *going* to do to alter the prevailing conditions to those that comprise my desired end–state"?

The solution space contains all those actions (diplomatic, military, economic, judicial, social, commercial, psychological, …) that could make a contribution towards changing the prevailing conditions. For the Department of Defense, this solution space justifies the possession and performance of military capability and exercising military response options on behalf of the National Command Authority.

The design space combines those carefully selected elements of power, from within the solution space, with the problem space to set up more purposeful actions; actions whose Measures of *Effect*iveness (MOE) have been derived directly from the effects that were determined to be

[8] This is Clausewitz's 'impose our will' and as demonstrated later has equal applicability across all operation types, including humanitarian and disaster relief. Ultimately we are about resetting conditions and the will can be applied as effectively for starvation, disease, drug importation, natural disasters or any non–adversary situation.
[9] Although not specifically dealt with in this paper the model presented later can drive an area of interest into failure or collapse if that is deemed appropriate.

instrumental in resetting the conditions. Within the military this is the domain of the J3 branch that assembles a JTF that, collectively, possesses the ability to impose the specified effects.

The result of this systems approach is a clearer appreciation of the factors and conditions that combine to raise concern in policy-makers. A direct link is established between the prevailing conditions – "this is bad, we need to do something"; and the desired conditions – "this is what good looks like, this is what I want the area of interest to look like once successful actions have been completed".[10]

The Problem Space

This section commences our discussion of the *problem space* – "there is something here that concerns me enough to want to change it". Firstly, some definitions for what is acknowledged as a global phenomenon. As stated by Davis "it is undeniable that an EBO movement is well under way and is influential" (Davis, 2001, p. 1) and "there are growing signals that EBO has truly come of age in the first decade of the 21st century" (Cook, 2003, p. 52).

Definitions

Definitions can be tedious and frustrating. Anyone who has tried unsuccessfully to capture the essence of a complex subject in the fewest words would attest to this. Nevertheless, we users of definitions would struggle to communicate were it not for the agreed meanings embodied within a single word. Although EBO has yet to benefit from an agreed definition, there are many examples:

> "the application of military and other capabilities to realise specific, desired operational and strategic outcomes in peace and war. In an Effects–Based Operation, our planning focuses on the effects that we are trying to achieve, which allows us to plan our capabilities and operations more flexibly".
> (FORCE 2020, Australian Defence Force, 2002, p. 22).

> "the planning and conduct of operations in such a way as to achieve a desired effect on the target".
> (Australian Defence Doctrine Publication, 3.13 Information Operations, 2002, Glossary, p. 6).

> "a process for obtaining a desired strategic outcome or 'effect' on the enemy, through the synergistic, multiplicative, and cumulative application of the full range of military and non–military capabilities at the tactical, operational, and strategic levels".
> (Joint Forces Command, Glossary)

> "operations conceived and planned in a systems framework that considers the full range of direct, indirect and cascading effects which may – with different degrees of probability – be achieved by the application of military, diplomatic, psychological and economic instruments".
> (Davis, 2001, p. 7).

[10] These are the very ideas embodied within the United States definition for end–state presented earlier.

> "effects–based targeting is identifying and engaging an adversary's key capabilities in the most efficient manner to produce a specific effect consistent with the commander's objectives".[11]
> (Beagle, 2000, p. 5).

> "are coordinated sets of actions directed at shaping the behavior of friends, foes and neutrals in peace crisis and war".
> (Smith, 2002, p. xiv).

> "the basic premise of effects–based operations [is] focusing on the conditions desired – the effects – to achieve assigned objectives".
> (Mann, Endersby & Searle, n.d.).

Finally, Effects–Based Planing (EBP) has been defined as:

> "an operational planning process to conduct EBO within RDO.[12] EBP is results-based vice attrition-based. EBP closely mirrors the current joint planning process, yet focuses upon the linkage of actions to effects to objectives. EBP changes the way we view the enemy, ourselves, and what is included and emphasized in the planning process. EBP uses a flexibly-structured battle rhythm that leverages a collaborative knowledge environment and capitalizes on the use of fewer formal joint boards. It employs virtual, near-simultaneous planning at all echelons of command" (JFCOM Glossary).

All these are useful and important definitions and together they cage the subject reasonably well. However, the repeated references to 'targeting', 'adversary', 'enemy' and 'commander' give them a decidedly military flavor and a preoccupation with conflict and the use of force; very unhelpful additions in these days of terrorism, transnational crime, peacekeeping, sanctions enforcement and many other non-warlike operations that seem to be occurring with increasing frequency.

Despite these faults, there is consensus that at some point the physical actions undertaken (whatever they might be) must transfer into a measurable, behavioral outcome (whatever that might be) – there is a *purposefulness* that can be exposed through some form of Measures of Effectiveness (MOE).[13] Additionally, there is the more important inference that candidate actions are *informed* by effects; the actions should not, in an effects–based approach, be selected first and then paired with a hastily concocted set of effects that deal more with the efficient employment of the means and less with the extent to which they contribute towards the achievement of the end–state.[14]

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[11] Targeting here is used in the more general sense, rather than the matching of ordnance with a grid reference.
[12] Rapid Decisive Operations.
[13] MOE is another area that has eluded a satisfactory definition. It is (also) the subject of frequent misuse and confusion with 'measures of performance' and 'efficiency'. Additional complications result from the 'intangibility' of cause–effect relationships into behavior, evident within MOE examinations for Information Operations (see Avruch, Narel & Siegel, 200, p. 93 and p. 160). Whilst MOE is associated with EBO, it is not dealt with beyond these brief comments. Detailed articles examining military MOE can be obtained from the author upon request.
[14] This fact is equally applicable in areas outside of national security, with Tomkins (1987, p. 51) stating that "effectiveness may be defined as how well a program or activity is achieving its stated objectives, its defined goals

The definition by Davis, from an EBO purist's perspective, is more suited to the arguments presented in this paper with its inclusion of a systems framework and multiple elements of power acting in concert. In any event, terms such as 'adversary' should be excluded as they foreclose an enormous range of issues that EBO has a primary role within. These being operations other than war and the need for military actions to bring forward outcomes beyond the immediate contest between two opposing forces.[15]

The principal failing with the application of EBO, is that planning processes do not encourage an *effects–based* approach, nor do they invite attention to the prevailing *conditions* or the desired *conditions* that actions are informed by.[16] Doctrine is at fault. This is very much a predicament of "you can't get there from here". There is something appealing about the idea that before you attempt to change something you should understand it and you should also have a clear picture of what it looks like once you have finished. Planning processes do not clearly distinguish between these or sequence the steps that guide the planner's thoughts.

Current approaches to operations planning (and processes such as JOPES and JMAP) focus on defeating the enemy plan.[17] As stated in the introduction: strategic objectives are defined; planning staffs build a picture of adversary strengths, weaknesses, dispositions and intentions – the Intelligence Preparation of the Battlefield (IPB) stage; … Courses of Action (COA) are developed, plans are executed, one force collides with another and an attrition contest commences that is more attentive to efficiency than effectiveness.

As EBO practitioners, we must ensure that our *effects* are sufficiently elevated and lofty that they do not become too tightly bound to the warfighting level. As demonstrated later, a pure EBO method is indifferent to the presence or absence of an adversary.

Clausewitz identified that:

> One can go on tracing the effects that a cause produces so long as it seems worthwhile. In the same way, a means may be evaluated, not merely with respect to its immediate end: that end should be appraised as a means for the next highest one; and thus we can follow a chain of sequential objectives until we reach one that requires no justification, because its necessity is self-evident. In many cases, particularly those involving great and decisive actions, the analysis must extend to the *ultimate objective*, which is to bring about peace [emphasis in original] (Clausewitz, 1832, Howard & Paret trans. p. 158-159).

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or other intended *effects* [emphasis added]. He further states in the same section that "the trouble with that definition is that it … assumes that we know what effectiveness is; otherwise, the objectives and goals could not have been set.

[15] An excellent account of the failure to gain a strategic success from an operational/military success in Iraq, along with the reasons for that failure, is available in Janes Intelligence Review, January 2004, Vol 16, No 1.

[16] "There are currently no formally established procedures in the EBO methodology and very few formally defined EBO terms" (Air Combat Command, Draft EBO White Paper, January 2002, p. iii). Similar mistakes are made in Australian doctrine for IO (ADDP 3.13, Information Operations, September 2002, p. 5A1-5) wherein the determination of effects is inside the Course of Action phase – effects must be informed by what you are trying to make happen without concerns of 'how', rather than what actions are being considered.

[17] Joint Operations Planning and Execution System and Joint Military Appreciation Process.

These ideas are illustrated in Figure 1 below, wherein a strategic effect ("what are we trying to make happen?") of, for example: *Convince Saddam Hussein to abandon possession of WMD*, is supported by the two means of *Expose violations* and *Exert diplomatic pressure*; which are themselves enabled by the capability to *Compile evidence* and *Build a coalition* respectively. At the operational level the effects (again, "what are we trying to make happen?") could be the strategic means, with the strategic capabilities becoming the operational means (note the whole–of–nation orientation in that *Compile evidence* and *Build a coalition* invite involvement from the appropriate elements of national power). A new set of operational capability statements have been elevated from the tactical means to give our operational capabilities of *Detect transgressions* and *Foster international disapproval*.

Note also that these statements, aside from the strategic effect, are sufficiently generic that they have equal application within, for example, a Bosnian or Rwandan theatre.

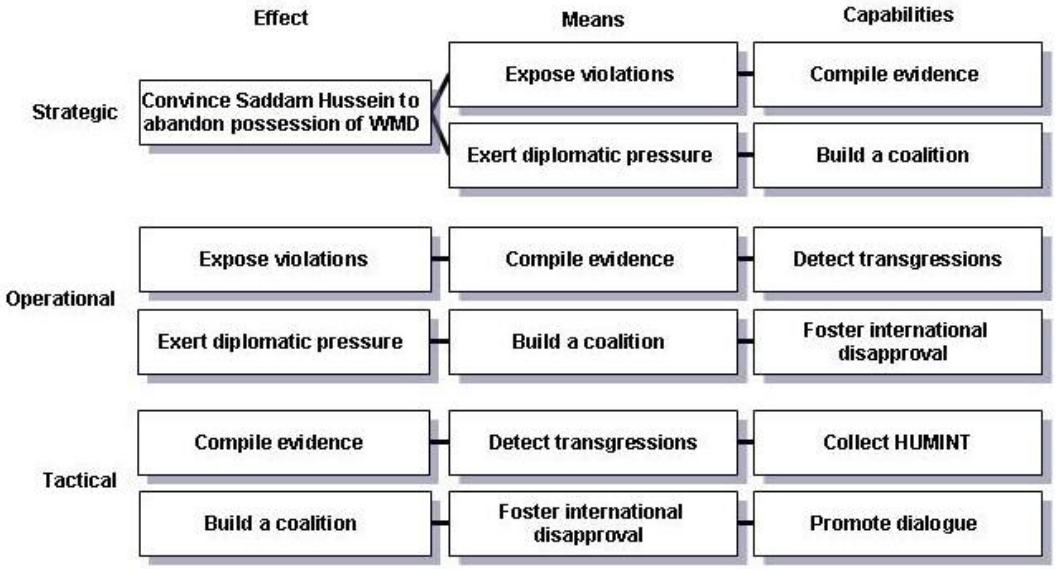

Figure 1. The interchangability of Effects and Means

The model could be utilised in either direction, beginning at the tactical level with a capability to *Collect HUMINT* making a contribution to *Detect transgressions* which assists in the effect of *Compile evidence*.

Hart's description is also apt in that "the real target in war is the mind of the enemy [and his political] command, not the bodies of his troops. If we operate on his troops it is fundamentally for the effect that action will produce on the mind and will of the commander" (Hart, 1944, p. 48). Determining the ultimate effect legitimizes all subordinate effects and actions.

Additional complications arise in that "[for example] strategic precision engagement rests on three necessary assumptions regarding uncertainties in the decision process: the ability to define discriminate effects at the strategic level of war, the ability to trace the desired discriminate effects back to a triggering action, and the ability to ensure the *actual* effects generated by that action are only the discriminate ones being sought [emphasis in original]" (Sakulich, 2001, p.11). If EBO practitioners are unable to progress beyond the first two assumptions above, it is

unlikely that the third will ever cause difficulties! The conventional model of operational planning and execution will, therefore, remain unchallenged and any desired strategic effects will be coincidental to actions, not because of them.

Field Anomaly Relaxation

Whether we are concerned with issues of national security, continuing problems in Iraq, the overcrowding of public hospitals or the graffiti problem at the local school, it is likely that the area of interest is exhibiting systemic behaviors. The systemic behaviors form the interactions between factors that shift the prevailing conditions (the same conditions outlined earlier in our examination of definitions for end–state). It is *un*likely that the graffiti situation exists because of one rebellious student or a single apathetic teacher. Similarly, the prevailing conditions in Iraq cannot be attributed solely to the presence (or absence) of Saddam Hussein any more that the United States can be singularly characterised by Presidents Clinton, Carter or Nixon. There are larger forces that must be comprehended.

These forces can be comprehended and presented with the aid of a scenario planning method developed by Russell Rhyne in the 1960s (Rhyne, 1974, 1981, 1995, 1998 and 2003) and popularised in several articles by Geoff Coyle (Coyle, 1984, 1985, 1994, 1995, 1996 and 1997). The method, known as Field Anomaly Relaxation, involves a four–step process as illustrated below in **Figure 2**.

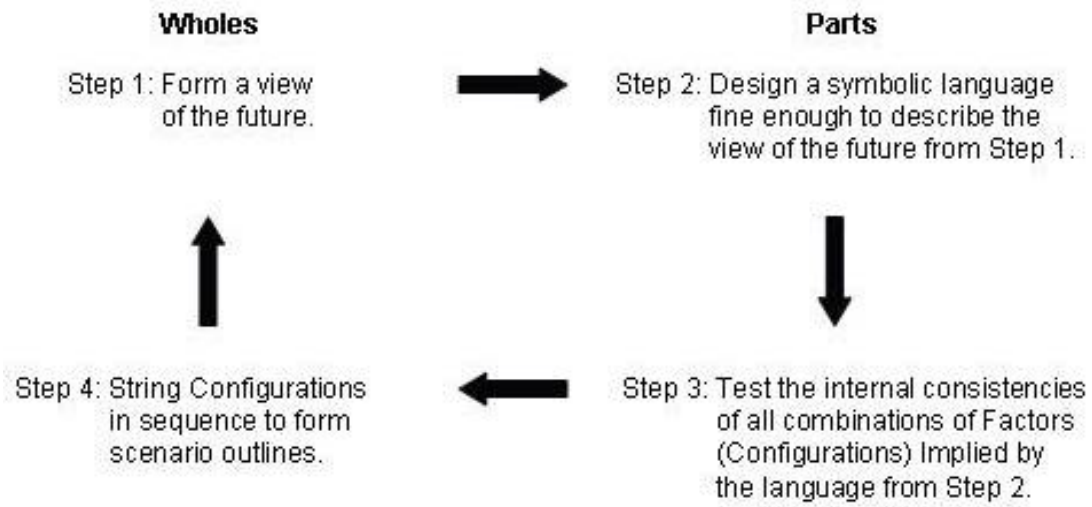

Figure 2. Rhyne's four–step process

Although this method belongs in the scenario planning/futures discipline, its stages and outputs at various times mirror the intelligence cycle and, therefore, it forms a strong companion to military operations planning. As stated earlier, the aim of the problem space is to inform decision–making – before you attempt to change it, know what makes it 'tick'.

Before any attempt is made to bring about a desirable change, all facets of the prevailing situation within an area of interest must be thoroughly comprehended and appreciated. There should be no preoccupation or inclination at this early stage with attempting to bring about any changes or even contemplating how these changes may be brought about. Obviously there

would be some expectation that, say, North Korea would change and that this change would take on a particular form and pace – this sets the motivation for the analysis. Knowing what factors could conspire within North Korea to shape every facet of the country provides valuable indicators of what an achievable end-state could look like and must form the initial first step in deriving the possible effects that could be imposed.

Step 1

As offered by Rhyne, this step "is a visualisation and brief recording of initial ideas as to the structure and general content of the entire set of plausible future alternatives that a prudent planner should consider" (Rhyne, 1971, p. 25) and "its essence lies in comprehending viscerally a large and diversified mass of information" (Rhyne, 1971, p. 26). At the start it is likely that the view will be coarse, but subsequent cycles deepen the rudimentary early understanding.

Step 2

Whereas Step 1 provides a gestalt awareness, it "is difficult to retain clearly within one's own mind, difficult to explain to others and is difficult to adjust … unless it is given some structure" (Rhyne, 1971, p. 30). This step builds a symbolic language that is "sufficiently rich and discriminatory to at least describe the patterns visualised in step 1" (Rhyne, 1995, p. 90). It is helpful here if a question is posed, such as: "what are the factors that influence the level of unrest and violence within Iraq?" or "what are the factors that influence the adoption of tobacco smoking amongst juveniles?" This step results in a factors–conditions matrix that can accommodate all the possible configurations that the area of interest could exist in – its *current* configuration is but one of these.

An earlier project examining North Korea produced the factors–conditions matrix shown at Table 1 below:[18]

[18] This project was conducted for the US DoD in 2002. Permission has been granted for inclusion in this paper. Security requirements preclude presentation of the EBO component included towards the end of this paper. A generic account of the method is presented that illustrates the steps.

Table 1. Factor–Condition array for North Korea

S	U	P	R	E	M
Societal Latitudes	**U**nification	**P**olitical Orientation	International **R**elations	**E**conomic Performance	**M**ilitary Emphasis
S_1: Open permissive	U_1: Unified-democratic	P_1: Democratic pluralist and open	R_1: Friendly engaged open dialogue	E_1: Integrated globalized and prosperous	M_1: Defensive, balanced and supportive
S_2:Open prescriptive	U_2: Divided-cooperative	P_2: Benevolent dictatorship/ monarchy	R_2: Unilateralist	E_2: Regionally engaged and robust	M_2: All consuming fixation for modernisation
S_3: Restricted	U_3: Divided-adversarial	P_3: Centrally controlled and closed	R_3: Deceitful and dishonest	E_3: Self sustaining	M_3: Projected and aggressive
S_4:Closed prescriptive	U_4: Unified-Communist	P_4: Non-benevolent dictatorship/ monarchy	R_4: Hostile and adversarial	E_4: Reliant on external providers	
		P_5: Demigod		E_5: Failure ridden and closed system	

As this factor–conditions array makes clear, North Korea is not North Korea solely because of Kim Jong Il, it is a complex arrangement of reinforcing factors and underlying conditions that combine to shape that nation and predispose it to a certain set of behaviors that may cause difficulties for it and neighboring countries.[19] Similarly, these same factors and underlying conditions have a configuration that predisposes it to produce stability, security, cooperation and prosperity. The question posed to form this Factors–Conditions array was: "what are the principal factors that shape North Korea?"[20] Each of the six column headings can then be considered in terms of: "what is the most favorable condition that we could imagine for this factor?" and "what is the most unfavorable?" finally, "what conditions could exist between these extremes?" We are aiming here to "uniquely designate a plausible, alternative condition" (Rhyne, 1995, p. 96) within a portion of our comprehension of the area of interest.

The six factors (column headings) contain three to five conditions and result in a set of patterns, or individual configurations, that number 4800 (4x4x5x4x5x3), with the most favorable characterised by a conditions pattern set at $S_1U_1P_1R_1E_1M_1$ and the most unfavorable at $S_4U_4P_5R_4E_5M_3$.[21]

[19] Rhyne's description of the method uses Sectors–the column headings and Factors—the rows. To align with planning doctrine and the very specific use of the term conditions as part of the end–state I have found Factors and Conditions to be more useful.

[20] For reasons of psychology and mathematics the Factors should be held at seven or fewer. This is regarded as the upper limit of the mind in holding disparate ideas at the same time; and multiplying the columns together creates a bewildering number of possible configurations that must be dealt with in later steps. The six illustrated here were derived from a factors list numbering in excess of 50.

[21] The acronym guards against assigning greater importance to one or more of the factors and aids recall. Phonetic spelling is helpful, with other projects using PASENGR – Public Transport; PRCTISE – Workplace Safety; and SPECIFY – Public Policy.

I cannot claim to be an expert on North Korea, but there are many others who can and publish authoritatively on the subject. In his article titled North Korea and the End of the Agreed Framework, Pollock (2003, pp. 11–49) made several key observations under the heading Understanding the North Korean System:[22]

- "The North continues to adhere to a national mythology reinforced by a dynastic succession from father to son".
- "It is the world's sole surviving Stalinist state, with an undiminished cult of personality surrounding Kim Jong Il".
- "North Korea is also the world's most militarised regime".
- "North Korea is also a society experiencing acute internal privation".
- "The North's dysfunctional economic policies led to a horrific famine and humanitarian crisis in the mid–1990s".

These five bullet points could be effortlessly located at a point in the conditions column under each of the six factors in Table 1 above to give a sense of the prevailing conditions. The validity of the table is tested using this approach in Step Three.[23] Rhyne offers a Rip van Winkle parable to demonstrate the value gained even at this early point in the process, suggesting we imagine that "a shaggy looking character comes down off the mountain, collars you, and says, "l seem to have gotten out of touch. What are things like now? But please don't tell me more than maybe a half-dozen different things, and don't spend more than about five minutes on each one" concluding that "the aspects of the local scene that one chooses in describing it to Rip would make good [Factors] in a FAR taxonomy" (Rhyne, 1995, p. 95).

Any conditional changes that leaders sought to impose through a national/international Effects-Based approach would need to take account of these prevailing conditions and the factors that they help to define; the very issues dealt with in the definition of end–state. Again from Rhyne "when the future arrives, it may differ from the present in detail, but it will resemble the existing pattern in a few major respects" (1971, p. 2).

Step Three

The aim of this step is to reduce the total number of configurations to a manageable set that includes only those configurations that are deemed *plausible*; 4800 discrete configurations are *possible* in this North Korea example, but many are unlikely to occur and can be 'relaxed' from further detailed analysis.[24] The internal consistencies are tested through a mechanical process that allows planners to rate each condition pair derived from Step Two.

For any given configuration involving the six factors there are 15 different condition pairs to be considered, all of which must be able to co-exist for that configuration to survive as a whole.

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[22] The article can be viewed on–line at: http://www.nwc.navy.mil/press/Review/2003/Summer/rtoc-su3.htm Accessed 17 Mar 04.
[23] This is further explained in a Step 4 where plausible futures for North Korea are plotted.
[24] Hence the term Field Anomaly *Relaxation.*

The question posed to the group of military planners was:

> *"For each of the condition pairs within the table, what is the likelihood that each could plausibly coexist?"*

Each pair was rated, within an overall understanding of North Korea, on a scale of:

- 'definitely',
- 'probably',
- 'possibly',
- 'doubtful', or
- 'no way'.

The aim is to find out whether that particular pair under examination might be found as part of some plausible situation within the North Korean system. For example, the factor-conditions array set out earlier (Table 1) is plausible at $S_1U_1P_1R_1E_1M_1$, equally plausible at $S_2U_1P_1R_1E_1M_1$, but begins to appear less likely at $S_3U_1P_1R_1E_1M_1$, and difficult to imagine at $S_4U_1P_1R_1E_1M_1$. Certainly the single pair of S_4P_1 are most unlikely partners. These judgments must be completed across all six columns.

To illustrate this further, a pattern picked at random of $S_4U_3P_1R_1E_3M_2$ would have to be scored as 'possibly' or better within all 15 pairs below to survive this filter:

S_4U_3				
S_4P_1	U_3P_1			
S_4R_1	U_3R_1	P_1R_1		
S_4E_3	U_3E_3	P_1E_3	R_1E_3	
S_4M_2	U_3M_2	P_1M_2	R_1M_2	E_3M_2

If, for example, the second pair of S_4P_1 was judged to be so implausible that it could never appear in any whole field configuration, its removal would carry with it 1920 other configurations that contained all plausible pairs, but for that one. The results of this pairwise comparison are at Appendix 1. At what point to apply the threshold for inclusion is determined by the manageability of the results, too many and the raw material for scenarios is overwhelming, too few and only a skeletal framework can be developed. 'Possibly' has found to be a useful initial filter, with subsequent cycles through the four-step process allowing refinement.

Software can remove much of the burden of capturing which pairs ought to be retained. Figure 3 illustrates the scoring form where these pairwise comparisons are made.

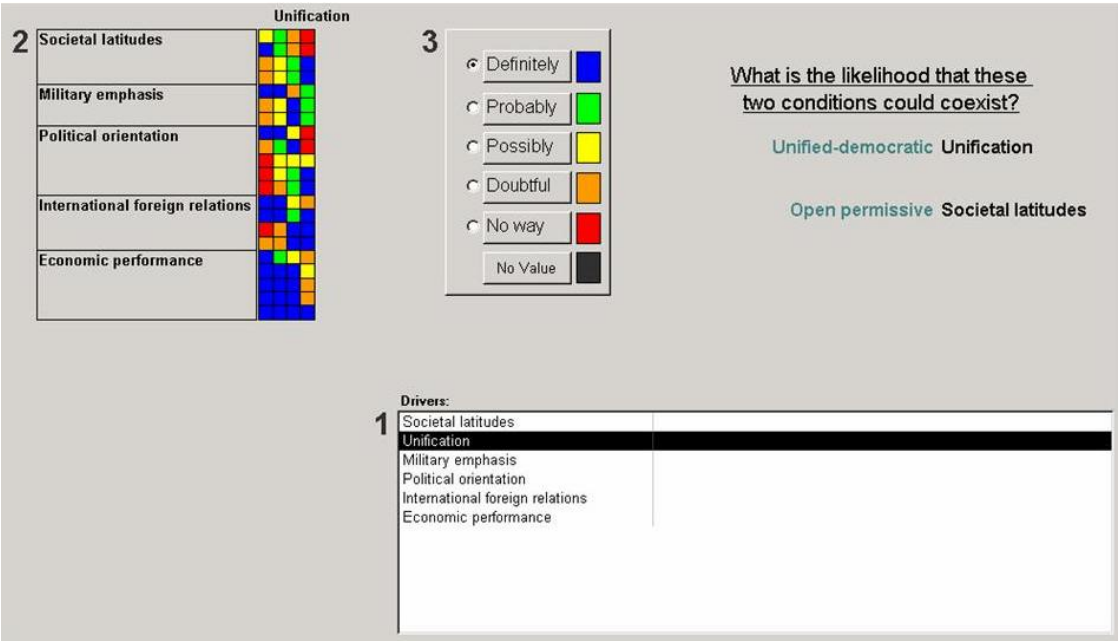

Figure 3 Pairwise comparison scoring

Recall that the aim of this exercise is to deepen the planner's understanding of a particular area of interest. This specification of the full range of *possible* conditions has moved us a considerable way towards being able to specify an end–state. Having tagged the illogical pairs, the software can quickly determine those configurations that are *plausible*.[25] The results of the pairwise comparison are presented at Appendix 2. A selection of the changing patterns that extend from the best to the worst is displayed at Figure 4 below. The amber background in the 'SUPREM' row in the upper–right signifies this as being the previously identified prevailing conditions for North Korea.

[25] Recall the earlier example of graffiti at the local school or overcrowding at the hospital that each have systemic contributors or factors. If we focus only on one factor and bring the right effects to bear we would see a marginal improvement in that one area, but the implausibility of the now improved condition pairing with others that have not benefited from any action would halt any further improvement.

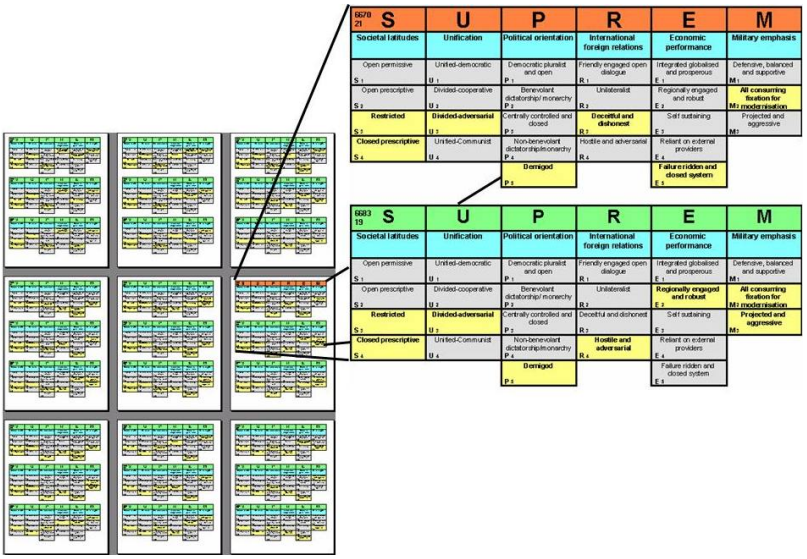

Figure 4 Sample reports of North Korea conditions

Step Four

The final step sees the raw material of all plausible factor–condition configurations laid out to form plausible futures. The current configuration is set down on a large flat surface or stuck to a wall, in this example it is condition pattern $S_{3\text{-}4}U_3P_5R_3E_5M_2$ and is one of 124 that has survived the pairing at Step 3.[26] The best set of conditions is positioned at the upper right and the worst at the upper left. The remaining patterns form the transitions, of which there are only six:

- good getting better,
- good holding,
- good getting worse,
- bad getting better,
- bad holding, and
- bad getting worse.

Transitions that track towards the upper right represent good getting better, towards the upper left represent bad getting worse, the right centre indicates good holding, left centre is bad holding. Good getting worse and bad getting better would track towards the centre. The bold lines represent the conditional changes that would result from the successful imposition of our effects. These are shown below in Figure 5.[27]

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[26] Note also that the software allows an earlier specification of individual prevailing conditions. A complete configuration representing the combined individual prevailing conditions should emerge with all other plausible patterns.

[27] Finding the first few patterns beyond the present is a relatively straightforward exercise of determining which of the factors is likely to undergo an early conditional improvement. Consideration is also given to which of the other factors might need to accompany that improvement. Stepping outside of this whole–of–nation context for a moment, our personal health and well being could also be characterised by a set of conditions that may dissatisfy us. Gaining immediate improvement may involve a change in only one lifestyle factor. Gaining more significant improvement involves being attentive to <u>all</u> factors.

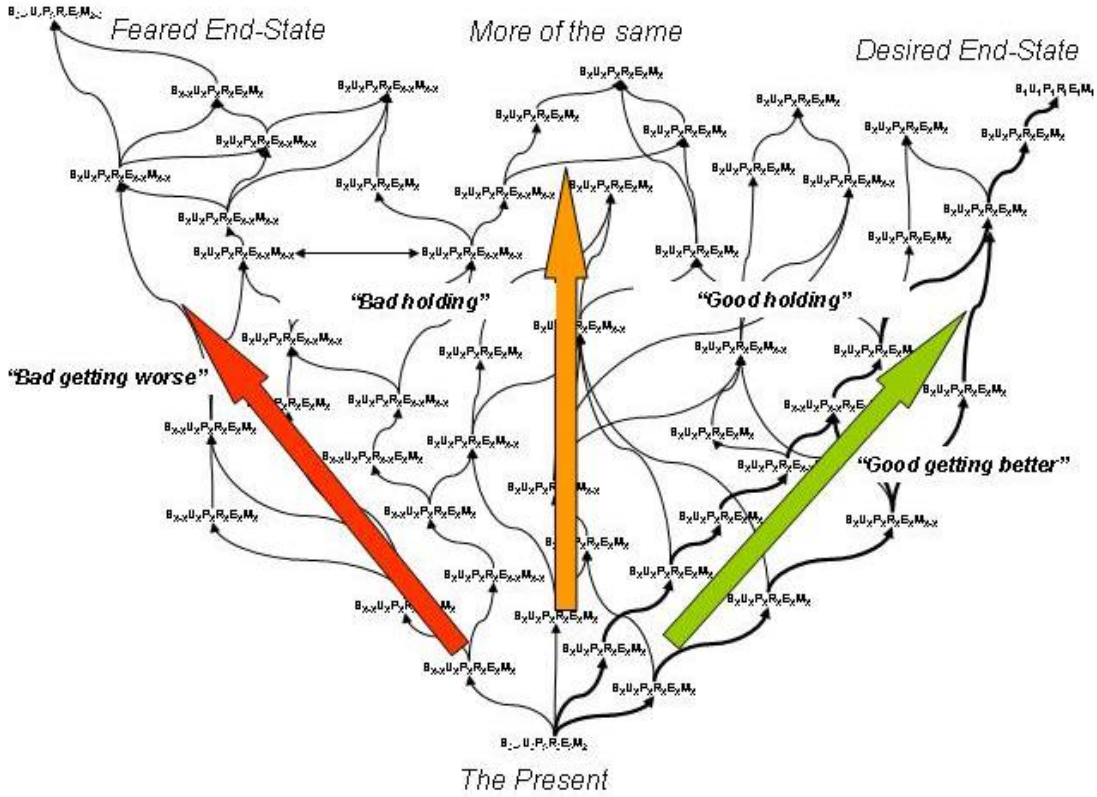

Figure 5. Futures tree for North Korea

It may seem at this point that a lot of effort is being expended to develop the factors shaping the area of interest, determine the range of conditions for each, specify the prevailing conditions, declare an end–state, set out the transitions through which the system might be advanced towards that end–state (whether it chose to cooperate or not), …. What are the alternatives? Building a plan that is <u>not</u> founded upon a deep understanding of the area of interest, is mindful of the varying conditions and has a clear declaration of an end–state is in defiance of the principles of Effects–Based Operations?[28] Yes, this takes time and effort; without country experts the time is usually only a few days, the effort is limited to thinking. Hours spent staring at the CIA Factbook will not produce the same understanding of an area. This time and effort is a worthwhile investment, makes the generation of effects much easier and delivers an end–state that is expressed in the 'conditions' offered in the definitions presented earlier.

The Solution Space

Okay, we now know what makes our area of interest behave the way it does. It causes us concern, why else would we have embarked on this exercise? We want to change it, or at least examine the prospects for change. We know what we want it to look like once we have finished – our end–state. **<u>We will change it by imposing a set of effects</u>**. These effects are what we *could* make happen, they are building our *solution space*. Our *design space* is where

[28] As shown in the next section the *effects* are imposed on the *factors* to force the *conditional* changes. The means whereby these effects could be imposed should not be considered at this stage.

we craft a plan that is to be authorised and executed, what we are *going* to make happen with an identified set of means.

Returning to our futures tree at Figure 5, that could just as easily represent overcrowding in a public hospital or the graffiti problem at the local school, we have our sequenced conditional changes. Against each one of the factors the question is asked: "what effects could be imposed to make this factor improve its condition"?

Each of the factors is taken in turn (six in this example with North Korea) to create a list of effects that could quite reasonably number in the hundreds, particularly if the same question is posed to many departments (State, Justice, Agriculture, Defense, Transportation, Energy, …). If the effects are kept reasonably generic, other factors can also be improved through application of the same effect.

Security requirements prevent disclosure of any effects related to North Korea from this point forward; however, the process is identical regardless of the nature or scale of the issue at hand. Earlier examinations of the recent operations in East Timor have revealed some interesting effects that can be discussed.

Some of the effects that emerged are:

Empower local functionaries
Deny freedom of action
Foment discontent

Note the use of the very precise verb in the active voice. It speaks directly to the subject and conveys a definite meaning. Equally useful effects statements can contain a verb in the passive voice, for example: freedom of action is denied, so long as there is consistency throughout.

The process continues until each of the factors has a large enough set of effects that it could be claimed with some confidence "if we were to impose these effects, then the conditions would improve and there is no part of the system that has been neglected". Each of the effects is then examined in turn to determine what means could be employed to impose that particular effect. Returning to 'deny freedom of action', an infantry battalion would certainly make that happen, but you get everything that goes with that. Equally, NGO could contribute to 'deny freedom of action' as could large numbers of journalists. Note that we are not concerned at this point with the *extent* to which each of the means can impose the desired effect, only that they can.

Once this is complete a many–to–many relationship structure between effects and means has been completed. With the aid of software this can be rendered as shown in Figure 6.

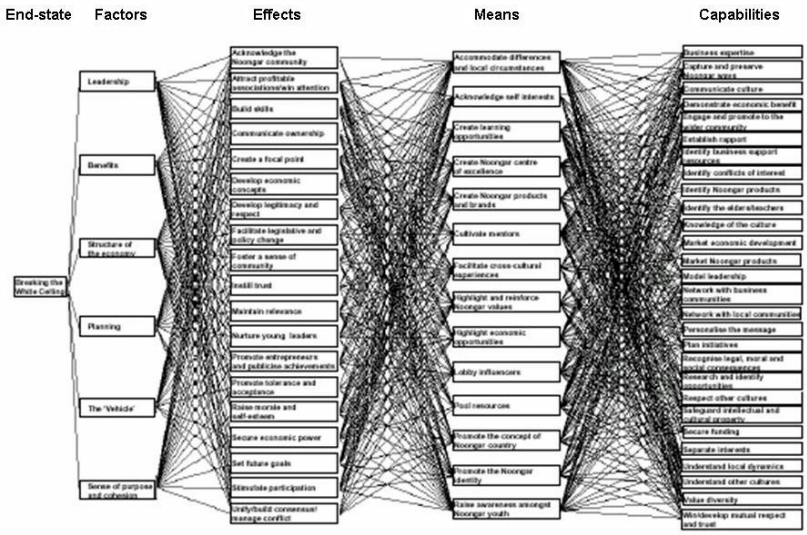

Figure 6 Many–to–many relationships

The most interesting area, within EBO, is the linkages between effects and means. If a rating is applied to differentiate between each pair, that essentially have now become a mission statement: "do x (means) in *order to* make y (effect) happen", say, on immediacy, permanency, totality, cultural specificity, … then a planner can test the appropriateness of each pair for any given situation. These have also been rendered graphically with the aid of EBO software, as shown below in Figure 7.

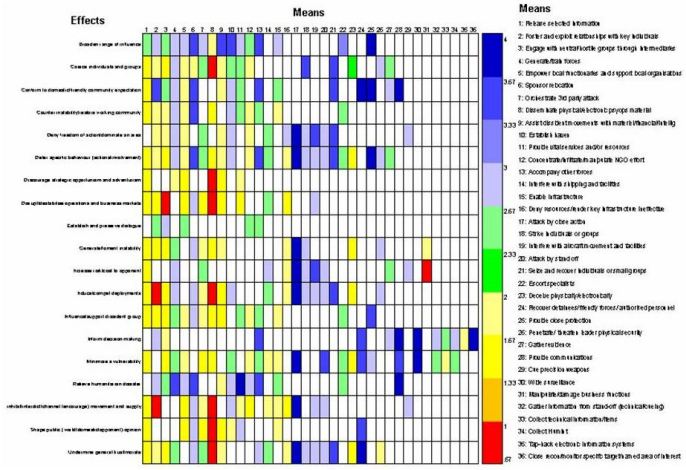

Figure 7 Differentiating effect–means pairs across single criteria

The effects are displayed on the vertical axis, whilst the means are displayed on the horizontal with a numbered legend on the right. In this example every line (indicating a relationship) between the effects column and the means column in Figure 6 is now represented by a colored rectangle. The color indicates the degree of permanency, or whatever criterion is being examined on a four–point scale: blue is high (enduring effects – do it once), red is low (fleeting effects – repeats required). An ordering process has also been applied that moves the means with the most links (and therefore greatest utility) to the left, and the fewest to the right (least

utility).[29] Corresponding panels in other criteria would contain the same arrangement of filled rectangles, however the color scheme would alter to accommodate the new criteria.

The relationships between each of the means and the contributing capabilities can also be represented, as shown below in Figure 8.

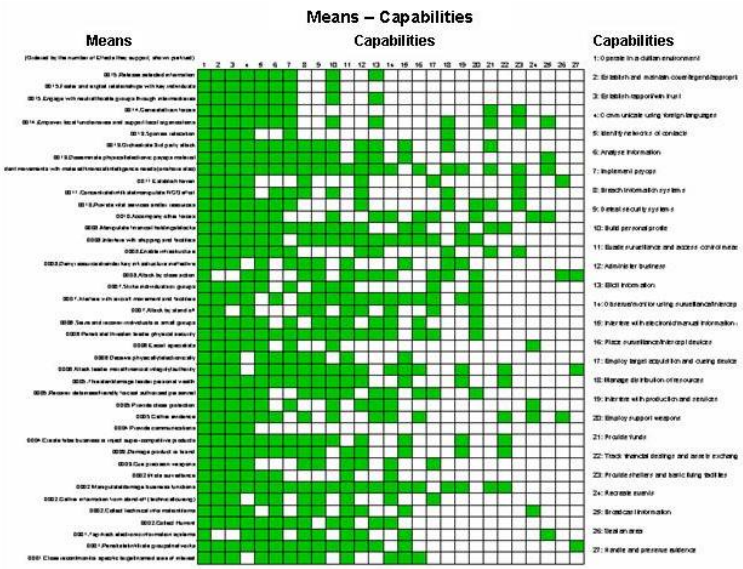

Figure 8. Relationships between means and capabilities

In this example, the capabilities have also been ordered from left to right, hence the density of green squares towards the left of the chart. Capability management and development priorities would need to be guided by this understanding of utility.

At the final layer there are the fundamental inputs to capability.[30] The utility and extent of contribution towards capability is illustrated below in Figure 9. As shown, capability B and C each comprise a 'bundle' of fundamental inputs to capability with many identical elements. Capability C combines with capability D to enable means #5, whereas capability B combines with A and C to enable means #2. In this example, C is a high value capability and raises issues of concurrency not evident within A, B or D. Any performance assessments made at the individual DOTMLPF level combine at the capability level. These judgements are carried into capabilities and converge at the means. The means, with all these strengths and weaknesses are what determine the likelihood of success in imposing the desired effects.

[29] A 'capability to undertake' assessment would be expected to indicate capability strengths in those used most frequently.

[30] Within the Australian Defence Force these are: People, Organisation, Major Systems, Collective Training, Command and Management, Supplies, Support and Facilities. The United States employs a DOTMLPF acronym representing similar categories.

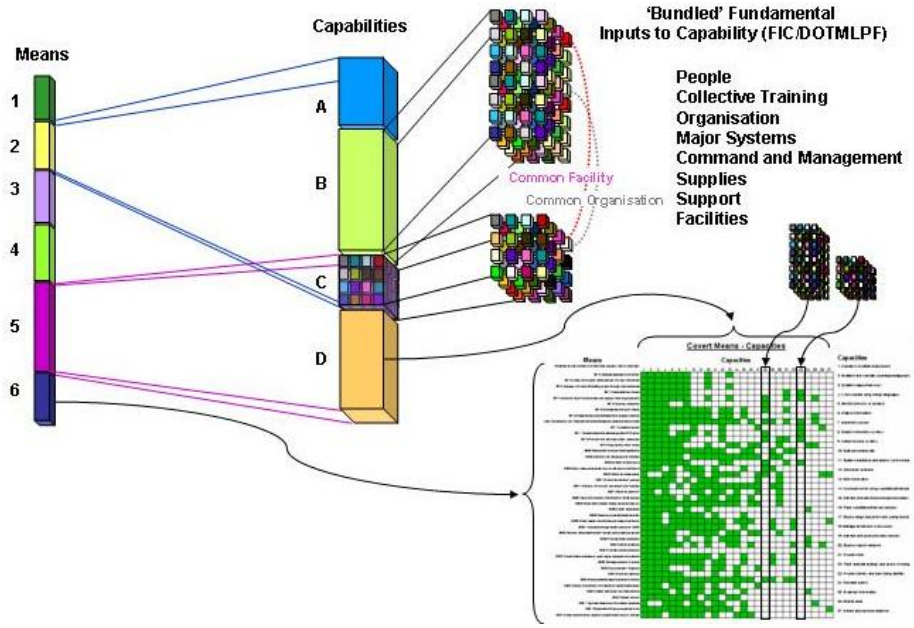

Figure 9. The fundamental inputs to capability 'bundles'

Having reached this point we now understand our area of interest, we know what the end–state looks like and we can express it to others using the same factors and conditions that characterise the present. We have crafted a set of effects that give good coverage over the factors so that we can bring sufficient change into the system. We have developed a set of means that can deliver these effects and we have differentiated them across a range of criteria. We are now only left with the design space, wherein a limited number of effects will be imposed as part of an orchestrated and sequenced campaign.

The Design Space

Given that we would not seek to impose all the effects simultaneously, those that possess the greatest utility in the given situation would become stronger candidates, combined with favorable criteria ratings. Several effects, that are tied to the chosen factors from our problem space, are selected and examined across the row of means to determine where the most blues are: *high* permanency, *high* immediacy, *low* cultural specificity (these means can be employed across different cultures/nationalities and deliver the same effect). When all these ratings are plotted a view of the efficacy of a single effect–means pair can be contrasted with all others (Figure 10). In this example the first effect has been chosen and the first top scorer on 'immediacy' is circled in the bottom–left panel, accommodating decision–makers requirement for a fast result. As can be seen on the next panel 'permanency' is low, indicating that this is not a one–shot action; however, 'cultural specificity' is low, as are totality, risk, probability of nth order effects. Cost has been included as a final panel as there may be occasions where real financial issues need to be exposed.

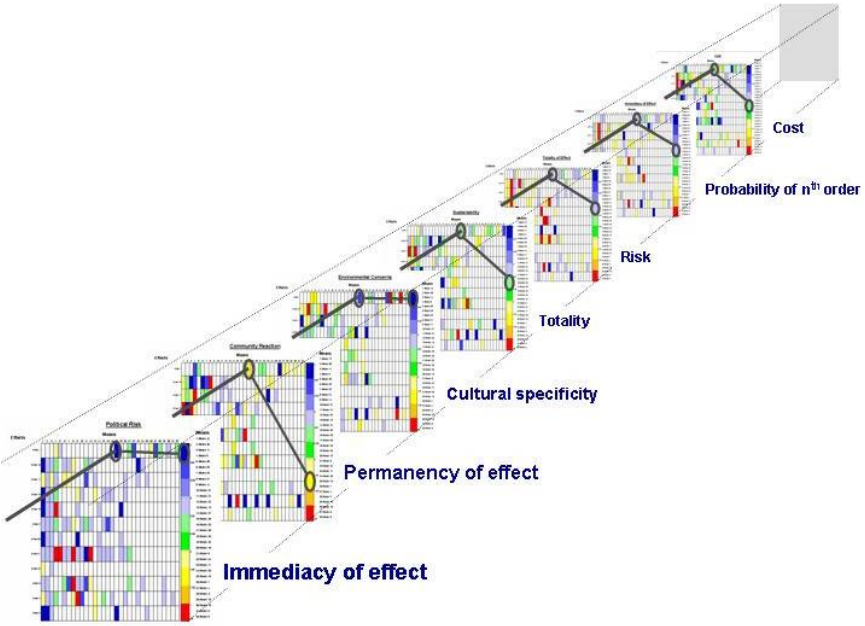

Figure 10 Effect–Mean pair across multiple criteria

Final Comments

A deep appreciation of EBO reveals that the consideration of means must be delayed for as long as possible; at least until the problem has been comprehended in all its detail. Significant resources have been poured into understanding the intricacies of achieving target destruction, [a fixation with the means–1st order effect relationship and thereby efficiency] but often without actually knowing what precise … [nth order] effects are … [desired].[31] As cited by Clarke (1999, p. 127) in "reviewing literally thousands of planning documents ... I found innumerable studies of how forces would be applied to destroy a given target set but no document, at any level of government, of more than a page to explain how destroying the target was supposed to activate mechanisms (popular revolt, coup, social disintegration, strategic paralysis, or even thwarting enemy military strategy) which would lead to the desired political change. Given the vast availability of classified documents, I can only conclude that they do not exist".

In EBO we are also dealing with the behavioral and cognitive more than the physical. Although physical means are always employed there is a message inside our actions that must be interpreted and reacted to for success to be claimed – *communication* must occur. Some insights from psychological operations doctrine is helpful as:

[31] Considerable confusion (and misuse of the term 'effects') is seen in many air power articles, whereby an effect is claimed to be 'air superiority' and progress towards the achievement of this effect is measured in terms of, for example, 'enemy sorties flown'. The ability to transit unchallenged through a particular air space is not an objective that would attract spectacular interest within the political domain. Clearly this is a 'means', it enables other more useful, higher objectives to be secured at reduced risk. Clausewitz has previously dismissed the dominance of such items as charcoal, saltpetre, copper and tin; recognizing that it is their effects (what they make happen) that possess value (Clausewitz, 1832, Rapoport trans. p. 195).

> "successful communications … stem from the use of proven techniques [and should be]:
>
> - based on information which is, to the audience, credible truth;
> - presented in a form which will attract and excite the audience;
> - designed to exploit psychological or physiological needs; and
> - suggestive of a course of action which seems to provide an effective method of satisfying those needs. (Australian Defence Force Publication 25, 1995, p. 2–5).

As planners, these four bullet–points could apply equally to the characteristics of our understanding of the problem space before we set out on our actions to alter the conditions.

Conclusion

This paper has sought to provide a practitioner's guide to EBO, detailing a scenario planning to understand more deeply the problem space. A software application has been illustrated that allows manipulation of the effects and means. The method presented has also facilitated precise specification of the prevailing conditions ("this is what bad looks like"), enabling planners and policy–makers to declare the desired conditions, or end–state ("this is what good looks like, this is what I want the area of interest to be like once you have finished"). It has ensured that the effects to be imposed are harnessed directly to the area of interest and are purposeful. The evaluation criteria have tested each of the means–effects pairs to determine the degree of fit. The plan that results and the operations conducted should be *effects–based*.

About the author:

Dr. Guy Duczynski is a national security professional with 25 years service with Special Operations, including two operational tours in the counter terrorism unit of the Australian Special Air Service (SAS). He has served in operations, plans, training and development branches before retiring from full-time service in 2002. In addition to a Doctor of Philosophy, he holds a Master of Business Administration and a Master of Education. He is currently employed in the defense contracting industry and continues research in Effects-Based Operations, planning, information operations, capability development and special operations.

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Appendix 1 – Results of Pairwise Comparison

At the intersection point between each the possible pairs is an indication of 'Y' – there is a likelihood that these could co-exist, or 'N' – we cannot see a situation where this could occur. As stated in the main body of the paper, the threshold for inclusion was at 'probably', with 'doubtful and 'no way' relaxed.

Table 2. Results of pairwise comparison

	S_1	S_2	S_3	S_4	U_1	U_2	U_3	U_4	P_1	P_2	P_3	P_4	P_5	R_1	R_2	R_3	R_4	E_1	E_2	E_3	E_4	E_5	M_1	M_2	M_3
Societal Latitudes																									
S_1: Open permissive					Y	Y	N	N	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N
S_2: Open prescriptive					Y	Y	N	N	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	N	N
S_3: Restricted					N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
S_4: Closed					N	Y	Y	Y	N	N	N	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Unification																									
U_1: Unified–Democratic									Y	N	N	N	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y	N	N
U_2: Divided–Cooperative									Y	Y	Y	Y	N	Y	Y	N	N	Y	Y	Y	Y	Y	Y	Y	Y
U_3: Divided–Adversarial									Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y	Y
U_4: Unified–Communist									N	N	Y	Y	Y	N	Y	Y	Y	N	Y	N	N	N	Y	Y	Y
Political Orientation																									
P_1: Democratic pluralist and open														Y	Y	Y	N	Y	Y	Y	Y	N	Y	N	N
P_2: Benevolent dictatorship/ monarchy														Y	Y	N	Y	Y	Y	Y	Y	Y	Y	N	Y
P_3: Centrally controlled and closed														Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	N	Y
P_4: Non-benevolent dictatorship/ monarchy														N	Y	Y	Y	N	Y	Y	Y	Y	Y	Y	Y
P_5: Demigod																									
International Relations																									
R_1: Friendly engaged open dialogue																		Y	Y	Y	Y	N	Y	N	N
R_2: Unilateralist																		Y	Y	Y	Y	Y	Y	N	N
R_3: Deceitful and dishonest																		N	N	N	Y	Y	Y	Y	Y
R_4: Hostile and adversarial																		N	Y	Y	Y	Y	Y	Y	Y
Economic Performance																									
E_1: Integrated globalized and prosperous																							Y	N	N
E_2: Regionally engaged and robust																							Y	Y	Y
E_3: Self sustaining																							Y	Y	Y
E_4: Reliant on external providers																							Y	N	Y
E_5: Failure ridden and closed system																							Y	Y	Y

Military Emphasis

M_1: Defensive, balanced and supportive
M_2: All consuming fixation for modernisation
M_3: Projected and aggressive

Appendix 2 – Surviving Configurations

The table below illustrates the surviving conditions. The prevailing conditions are highlighted in bold at pattern #6670. The best are at pattern #1,the worst are at pattern #7675.

Table 3 Surviving configurations

1	$S_1U_1P_1R_1E_1M_1$	2409	$S_2U_2P_1R_1E_3M_1$	5425	$S_{3\text{-}4}U_2P_4R_2E_1M_1$
5	$S_1U_1P_1R_1E_2M_1$	2414	$S_2U_2P_1R_1E_4M_1$	5433	$S_{3\text{-}4}U_2P_4R_2E_2M_1$
9	$S_1U_1P_1R_1E_3M_1$	2425	$S_2U_2P_1R_2E_1M_1$	5441	$S_{3\text{-}4}U_2P_4R_2E_3M_1$
14	$S_1U_1P_1R_1E_4M_1$	2429	$S_2U_2P_1R_2E_2M_1$	5449	$S_{3\text{-}4}U_2P_4R_2E_{4\text{-}5}M_1$
25	$S_1U_1P_1R_2E_1M_1$	2433	$S_2U_2P_1R_2E_3M_1$	6304	$S_3U_3P_3R_4E_2M_3$
29	$S_1U_1P_1R_2E_2M_1$	2438	$S_2U_2P_1R_2E_4M_1$	6312	$S_3U_3P_3R_4E_3M_3$
33	$S_1U_1P_1R_2E_3M_1$	2497	$S_2U_2P_2R_1E_1M_1$	6327	$S_3U_3P_3R_4E_{4\text{-}5}M_3$
38	$S_1U_1P_1R_2E_4M_1$	2501	$S_2U_2P_2R_1E_2M_1$	6478	$S_{3\text{-}4}U_3P_4R_3E_5M_2$
481	$S_1U_2P_1R_1E_1M_1$	2505	$S_2U_2P_2R_1E_3M_1$	6491	$S_{3\text{-}4}U_3P_4R_4E_2M_{2\text{-}3}$
485	$S_1U_2P_1R_1E_2M_1$	2510	$S_2U_2P_2R_1E_4M_1$	6499	$S_{3\text{-}4}U_3P_4R_4E_3M_{2\text{-}3}$
489	$S_1U_2P_1R_1E_3M_1$	2521	$S_2U_2P_2R_2E_1M_1$	6517	$S_{3\text{-}4}U_3P_4R_4E_{4\text{-}5}M_3$
494	$S_1U_2P_1R_1E_4M_1$	2525	$S_2U_2P_2R_2E_2M_1$	6523	$S_{3\text{-}4}U_3P_4R_4E_5M_{2\text{-}3}$
505	$S_1U_2P_1R_2E_1M_1$	2529	$S_2U_2P_2R_2E_3M_1$	**6670**	$\mathbf{S_{3\text{-}4}U_3P_5R_3E_5M_2}$
509	$S_1U_2P_1R_2E_2M_1$	2534	$S_2U_2P_2R_2E_4M_1$	6683	$S_{3\text{-}4}U_3P_5R_4E_2M_{2\text{-}3}$
513	$S_1U_2P_1R_2E_3M_1$	2593	$S_2U_2P_3R_1E_1M_1$	6691	$S_{3\text{-}4}U_3P_5R_4E_3M_{2\text{-}3}$
518	$S_1U_2P_1R_2E_4M_1$	2597	$S_2U_2P_3R_1E_2M_1$	6709	$S_{3\text{-}4}U_3P_5R_4E_{4\text{-}5}M_3$
577	$S_1U_2P_2R_1E_1M_1$	2601	$S_2U_2P_3R_1E_3M_1$	6715	$S_{3\text{-}4}U_3P_5R_4E_5M_{2\text{-}3}$
581	$S_1U_2P_2R_1E_2M_1$	2606	$S_2U_2P_3R_1E_4M_1$	7162	$S_3U_4P_3R_2E_2M_1$
585	$S_1U_2P_2R_1E_3M_1$	2617	$S_2U_2P_3R_2E_1M_1$	7194	$S_3U_4P_3R_2E_5M_1$
590	$S_1U_2P_2R_1E_4M_1$	2621	$S_2U_2P_3R_2E_2M_1$	7242	$S_3U_4P_3R_3E_5M_1$
601	$S_1U_2P_2R_2E_1M_1$	2625	$S_2U_2P_3R_2E_3M_1$	7258	$S_3U_4P_3R_4E_2M_1$
605	$S_1U_2P_2R_2E_2M_1$	2630	$S_2U_2P_3R_2E_4M_1$	7264	$S_3U_4P_3R_4E_2M_3$
609	$S_1U_2P_2R_2E_3M_1$	4994	$S_3U_2P_2R_1E_1M_1$	7290	$S_3U_4P_3R_4E_5M_1$
614	$S_1U_2P_2R_2E_4M_1$	5002	$S_3U_2P_2R_1E_2M_1$	7296	$S_3U_4P_3R_4E_5M_3$
673	$S_1U_2P_3R_1E_1M_1$	5010	$S_3U_2P_2R_1E_3M_1$	7353	$S_{3\text{-}4}U_4P_4R_2E_2M_1$
677	$S_1U_2P_3R_1E_2M_1$	5018	$S_3U_2P_2R_1E_4M_1$	7385	$S_{3\text{-}4}U_4P_4R_2E_5M_1$
681	$S_1U_2P_3R_1E_3M_1$	5042	$S_3U_2P_2R_2E_1M_1$	7433	$S_{3\text{-}4}U_4P_4R_3E_5M_1$
686	$S_1U_2P_3R_1E_4M_1$	5050	$S_3U_2P_2R_2E_2M_1$	7438	$S_{3\text{-}4}U_4P_4R_3E_5M_2$
697	$S_1U_2P_3R_2E_1M_1$	5058	$S_3U_2P_2R_2E_3M_1$	7449	$S_{3\text{-}4}U_4P_4R_4E_2M_1$
701	$S_1U_2P_3R_2E_2M_1$	5067	$S_3U_2P_2R_2E_{4\text{-}5}M_1$	7451	$S_{3\text{-}4}U_4P_4R_4E_2M_{2\text{-}3}$
705	$S_1U_2P_3R_2E_3M_1$	5186	$S_3U_2P_3R_1E_1M_1$	7481	$S_{3\text{-}4}U_4P_4R_4E_5M_1$
710	$S_1U_2P_3R_2E_4M_1$	5194	$S_3U_2P_3R_1E_2M_1$	7483	$S_{3\text{-}4}U_4P_4R_4E_5M_{2\text{-}3}$
1921	$S_2U_1P_1R_1E_1M_1$	5202	$S_3U_2P_3R_1E_3M_1$	7545	$S_{3\text{-}4}U_4P_5R_2E_2M_1$
1925	$S_2U_1P_1R_1E_2M_1$	5210	$S_3U_2P_3R_1E_4M_1$	7577	$S_{3\text{-}4}U_4P_5R_2E_5M_1$
1929	$S_2U_1P_1R_1E_3M_1$	5234	$S_3U_2P_3R_2E_1M_1$	7625	$S_{3\text{-}4}U_4P_5R_3E_5M_1$
1934	$S_2U_1P_1R_1E_4M_1$	5242	$S_3U_2P_3R_2E_2M_1$	7630	$S_{3\text{-}4}U_4P_5R_3E_5M_2$
1945	$S_2U_1P_1R_2E_1M_1$	5250	$S_3U_2P_3R_2E_3M_1$	7641	$S_{3\text{-}4}U_4P_5R_4E_2M_1$
1949	$S_2U_1P_1R_2E_2M_1$	5259	$S_3U_2P_3R_2E_{4\text{-}5}M_1$	7643	$S_{3\text{-}4}U_4P_5R_4E_2M_{2\text{-}3}$
1953	$S_2U_1P_1R_2E_3M_1$	5377	$S_{3\text{-}4}U_2P_4R_1E_1M_1$	7673	$S_{3\text{-}4}U_4P_5R_4E_5M_1$
1958	$S_2U_1P_1R_2E_4M_1$	5385	$S_{3\text{-}4}U_2P_4R_1E_2M_1$	7675	$S_{3\text{-}4}U_4P_5R_4E_5M_{2\text{-}3}$
2401	$S_2U_2P_1R_1E_1M_1$	5393	$S_{3\text{-}4}U_2P_4R_1E_3M_1$		
2405	$S_2U_2P_1R_1E_2M_1$	5404	$S_{3\text{-}4}U_2P_4R_1E_4M_1$		