



# Analysis of System Contribution to Effects Based Approach

Summary of CAWG workshops conducted in 2006

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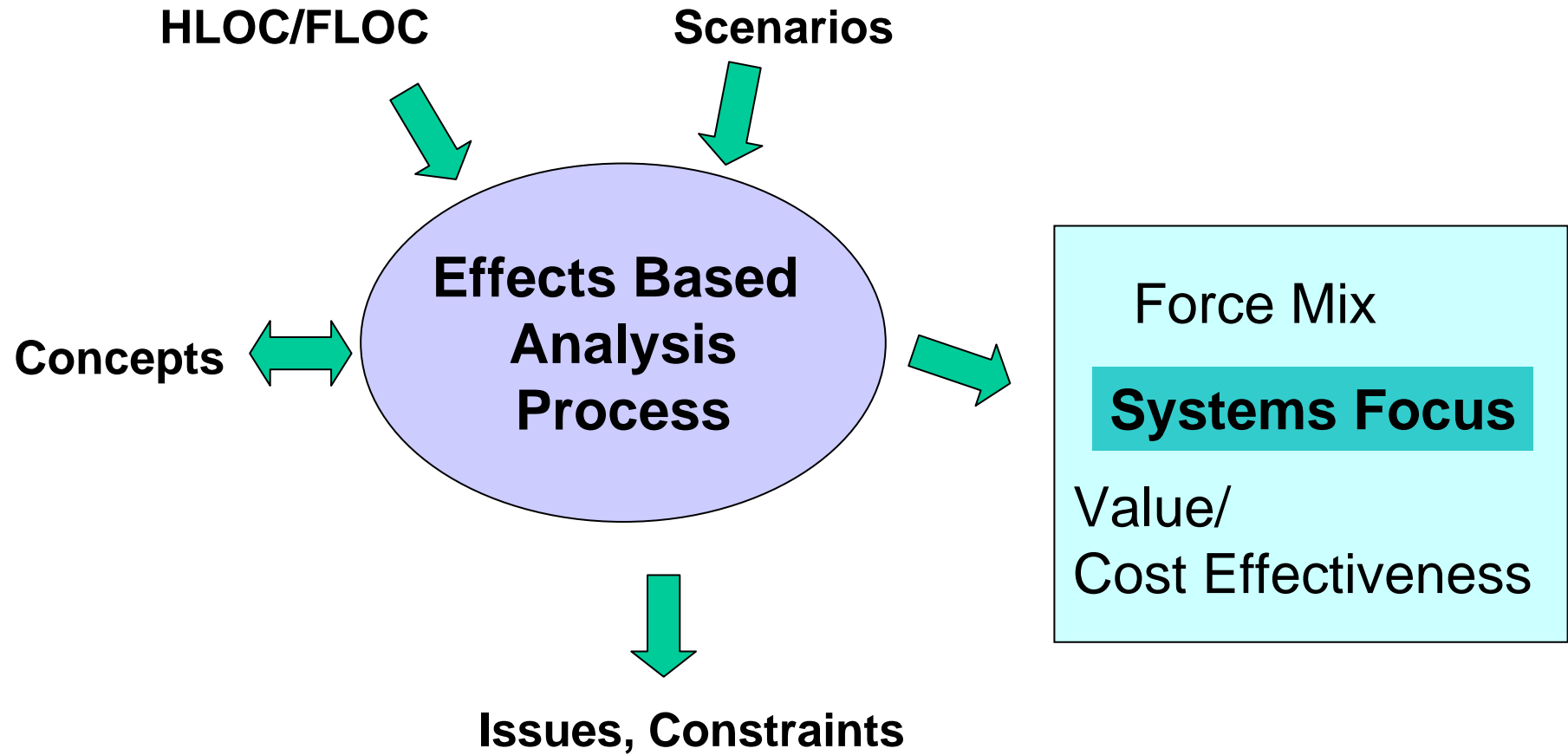
- Defence Analysis Council (DAC)
  - Coordinating body for the OA groups of BAE SYSTEMS and its JVs
  - Sharing information and disseminating best practice
- Capability Analysis Working Group (CAWG)
  - To derive pragmatic guidance for conducting Capability Analysis
  - Think tank on methods and hot topics for the DAC
  - Broader membership



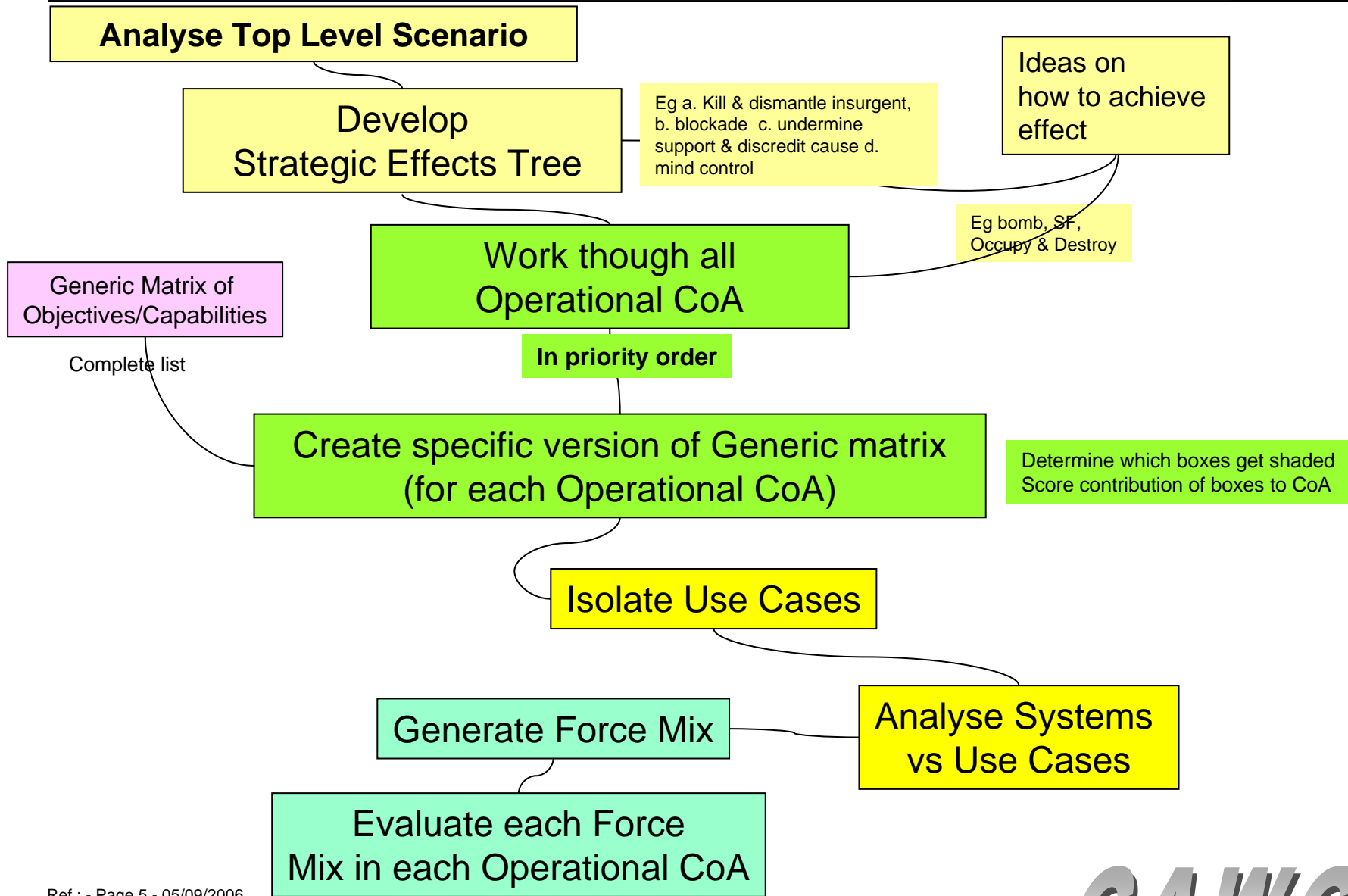
# Objectives of EBA Analysis Activity

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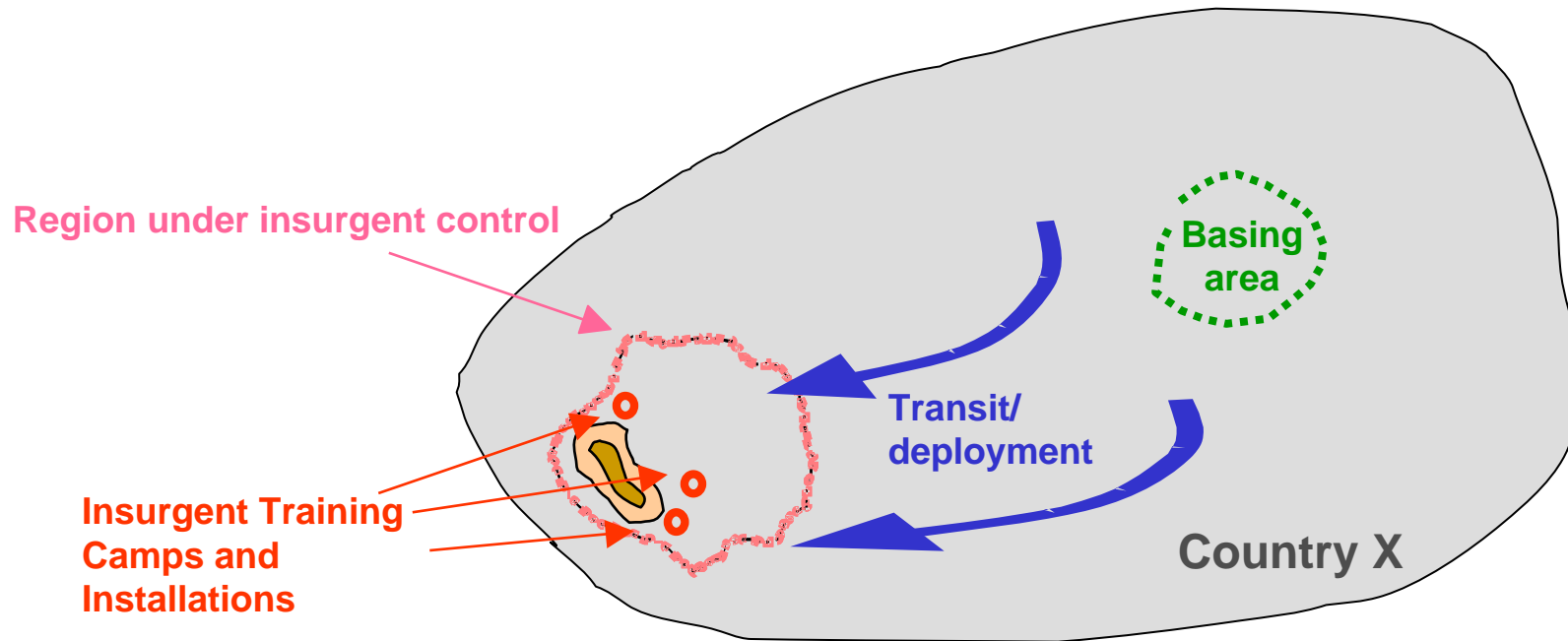
- Understand how the Effects Based Approach impacts our business
  - What is EBA?
    - Input from ISMOR 22, TEEMAC EBO workshop and other military sources
  - What new analytical methods are required?
    - Can industry do the analysis?
  - How does it affect
    - Equipment design and characteristics?
    - Force mix/ balance between types of equipment?
- Approach adopted
  - Problem exploration to scope and derive key analytical steps
  - Preliminary analysis of likely trends & major impacts
  - Practical within limited resources and timescales



# Overall Process



# Scenario - loosely based on UK MoD example



- Strategic objective = Stabilise Country/Area
  - kill insurgent leader & destroy organisation / infrastructure

# Strategic effect options contributing to strategic objective



- Objective - Stabilise Country
  - 1 Kill/capture
    - Bomb
    - SF
    - Ground Force Deployment - Occupy/Destroy
  - 2 Blockade
    - Wall
    - Patrol
    - Road Block
    - Air Surv & Interdict
  - 3 Undermine support and discredit cause
    - Police
    - Education
    - Build Infrastructure
    - International Pressure
    - Media
    - Aid
    - Interdict Funding
    - Interdict External Supplies
  - 4 Mind Control

Prob of Success

**HIGH**

**LOW**

**MED**

**HIGH**

**CAWG**

# Operational CoA

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- Mount air strike
  - Supporting action = find him .....
  - Target Information
  - Local basing/flightpath clearance
  - .....
  
- SF raid
  - Locate area
  - Secure routes/bases
  - Monitor
  - Deploy force
  - .....
  
- All arms occupation
  - Secure routes
  - Build forces
  - Deploy forces to theatre
  - Tactical operations
  - Occupation
  - .....
  
- .....





# Generic matrix



Overall Objective	Sub Objectives		Generic Core Objectives
Stabilise country	Capture/Kill Insurgent Ldr	Monitor	Know where Insurgent Ldr is
	Destroy/Secure Installations	Inform	Have knowledge of terrain of interest
		Intel	Have timely knowledge of enemy capabilities and dispositions
		Plan	Have a plan to capture/kill him
		Security & Protection	Have secure ports / airfields
		Project	Have sufficient forces in theatre to execute plan
		Monitor	Maintain knowledge of Insurgent Ldr's location
		Sustain	Be able to sustain the force
		Security & Protection	Have secure routes to objectives - Land
		Security & Protection	Have secure routes to objectives - Sea
		Security & Protection	Have secure routes to objectives - Air
		Deploy	Have sufficient resources at tactical objectives to execute plan
		Recce	Get detailed knowledge of routes and En locations
		Shape	Interdict escape routes
	Shape & Fix	Shape the battlespace - JOINT fire support	
	Strike	Attack Installations	
	Strike	Destroy En forces	
		Secure Insurgent Ldr	
		Secure Installations	
		Withdraw ?	
	Prevent Insurgent training/recruiting		

High Level Objective

Generic Core Objectives

Sub Objectives

# Generic matrix

Overall Objective	Sub Objectives	Generic Core Objectives	Possible Supporting Objectives						
Stabilise country	Capture/Kill Insurgent Ldr	Monitor	Know where Insurgent Ldr is	Home location	alternate locations	Habits	Contacts	Routes	modes of transport
	Destroy/Secure Installations	Inform	Have knowledge of terrain of interest	knowledge of relief	knowledge of services infrastructure	knowledge of population	knowledge of climate and weather	knowledge of transport infrastructure	Knowledge of routes through area of ops
		Intel	Have timely knowledge of enemy capabilities and dispositions	knowledge of enemy	knowledge of enemy weapons	knowledge of enemy numbers and organisation			
		Plan	Have a plan to capture/kill him	resources available	assess courses of action	preferred course of action	constraints (morale, etc)	formulate lower level plan	
		Security & Protection	Have secure ports / airfields	Co-operate with local Govt forces	Establish port / airbase	deploy security forces to ports / airfields	build security facilities at ports / airfields	discourage enemy interference on air/sea lines of communication	monitor routes to discover enemy interference
		Project	Have sufficient forces in theatre to execute plan	deliver forces by air	deliver forces by sea	deliver forces by Rail transport	focus call deploy to theatre		
		Monitor	Maintain knowledge of Insurgent Ldr's location	monitor locations	monitor contacts	monitor routes	monitor communications	monitor movements	
		Sustain	Be able to sustain the force	Build logistic stockpile	Mobility for Logs	Security for Logs stockpile	Security for Logs Mobility		
		Security & Protection	Have secure routes to objectives - Land	discourage enemy interference	monitor routes to discover enemy interference	win over local populace	cooperate with local police and armed forces		
		Security & Protection	Have secure routes to objectives - Sea	discourage enemy interference	monitor routes to discover enemy interference	cooperate with local agencies			
		Security & Protection	Have secure routes to objectives - Air	discourage enemy interference	monitor routes to discover enemy interference	cooperate with local armed forces			
		Deploy	Have sufficient resources at tactical objectives to execute plan	know routes to attack points	move forces to attack points	deploy CSS to support forces			
		Recce	Get detailed knowledge of routes and En locations	know route information	locate enemy	monitor enemy			
		Shape	Interdict escape routes	identify escape routes	identify enemy on routes	monitor all traffic on routes			
		Shape & Fix	Shape the battlespace - JOINT fire support	target location	target engagement	determine effects achieved			
		Strike	Attack Installations	identify installations	manoeuvre to battle positions	deliver destructive effect	assess damage	manoeuvre between fire points	
		Strike	Destroy En forces	identify enemy forces	locate enemy forces	manoeuvre to engagement locations	prevent enemy from engaging	engage enemy forces	cause casualties
			Secure Insurgent Ldr	identify AF	monitor AF	prevent AF escape	manoeuvre to AF location	engage enemy	capture AF
			Secure Installations	occupy installations	remove en from installations	ensure enemy unable to reoccupy			
			Withdraw ?						
	Prevent Insurgent training/recruiting								

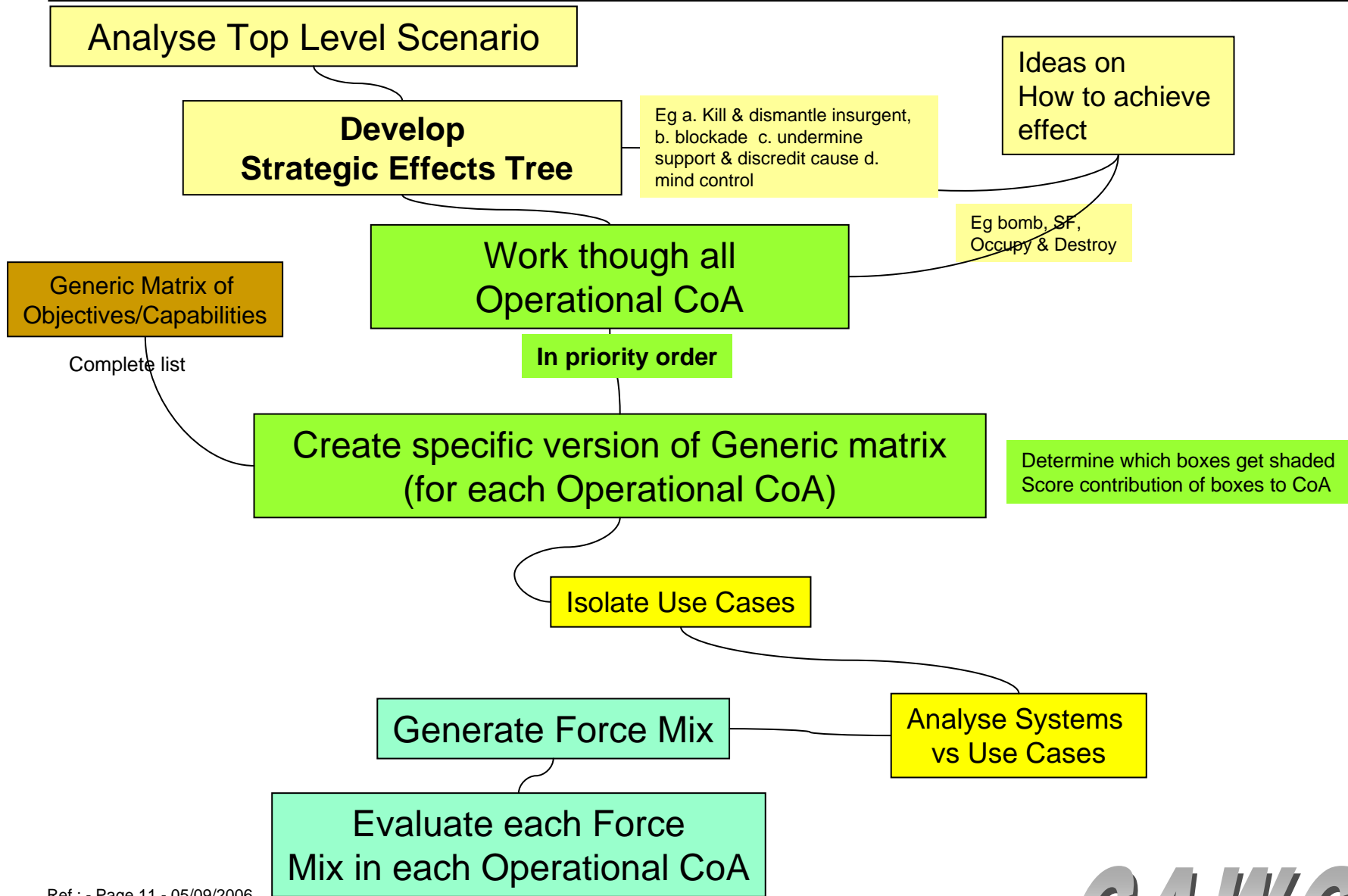
Possible Supporting Objectives

All (High level through to supporting) objectives

Generated by team -discussion/verification -with SME



# Overall Process



# Specific Matrix

Sub Objectives		Generic Core Objectives	Possible Supporting Objectives					
Capture/Kill Insurgent Ldr	<b>Monitor</b>	Know where Insurgents are	Home location	alternate locations	Habits	Contacts	Routes	modes of transport
Destroy/Secure Installations	<b>Inform</b>	Have knowledge of terrain of interest	knowledge of relief	knowledge of services infrastructure	knowledge of population	knowledge of climate and weather	knowledge of transport infrastructure	Knowledge of routes through area of ops
	<b>Intel</b>	Have timely knowledge of enemy capabilities and dispositions	knowledge of enemy	knowledge of enemy weapons	knowledge of enemy numbers and organisations			
	<b>Plan</b>	Have a plan to capture/kill him	resources available	assess courses of action	preferred course of action	constraints (moral, legal, etc)	formulate lower level plans	
	<b>Security &amp; Protection</b>	Have secure ports / airfields	Co-operate with local Govt forces	Establish port / airbase	deploy security forces to ports / airfields	build security facilities at ports / airfields	discourage enemy interference on air/sea lines of communication	monitor routes to discover enemy interference
	<b>Project</b>	Have sufficient forces in theatre to execute plan	deliver forces by air	deliver forces by sea	deliver forces by Rail transport	forces self deploy to theatre		
	<b>Monitor</b>	Maintain knowledge of Al Farrah's location	monitor locations	monitor contacts	monitor routes	monitor communications	monitor movements	
	<b>Sustain</b>	Be able to sustain the force	Build logistic stockpile	Mobility for Logs	Security for Logs stockpile	Security for Logs Mobility		
	<b>Security &amp; Protection</b>	Have secure routes to objectives - Land	discourage enemy interference	monitor routes to discover enemy interference	win over local populace	cooperate with local police and armed forces		
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	<b>Deploy</b>	Have sufficient resources at tactical objectives to execute plan	know routes to attack posns	move forces to attack posns	deploy CSS to support forces			
	<b>Recce</b>	Get detailed knowledge of routes and En locations	know route information	locate enemy	monitor enemy			
	<b>Shape</b>	Interdict escape routes	identify escape routes	identify enemy on routes	monitor all traffic on routes	block routes to movement	attack enemy on routes	
	<b>Shape &amp; Fix</b>	Shape the battlespace - JOINT fire support	target location	target engagement	determine effects achieved			
	<b>Strike</b>	Attack Installations	identify installations	manoeuvre to battle positions	deliver destructive effect	assess damage	manoeuvre between fire posns	
	<b>Strike</b>	Destroy En forces	identify enemy forces	locate enemy forces	manoeuvre to engagement locations	prevent enemy from engaging	engage enemy forces	cause casualties
		Secure Insurgent Ldr	identify Insurgent	monitor Insurgent	prevent Insurgent escape	manoeuvre to Insurgent location	engage enemy	capture Insurgent
		Secure Installations	occupy installations	remove en from installations	ensure enemy unable to reoccupy			

Ref.: - P

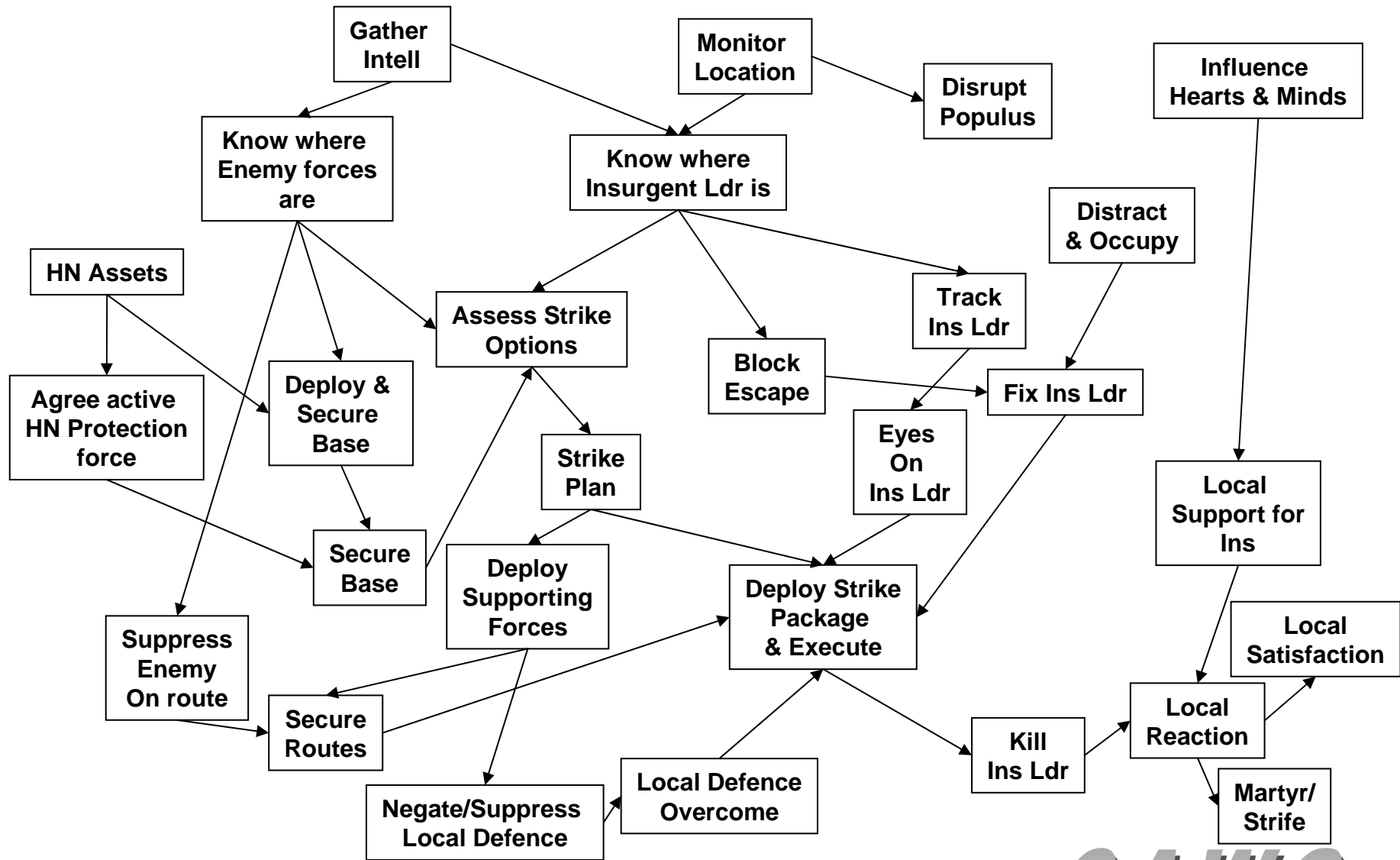
## Specific Matrix Variant for one CoA



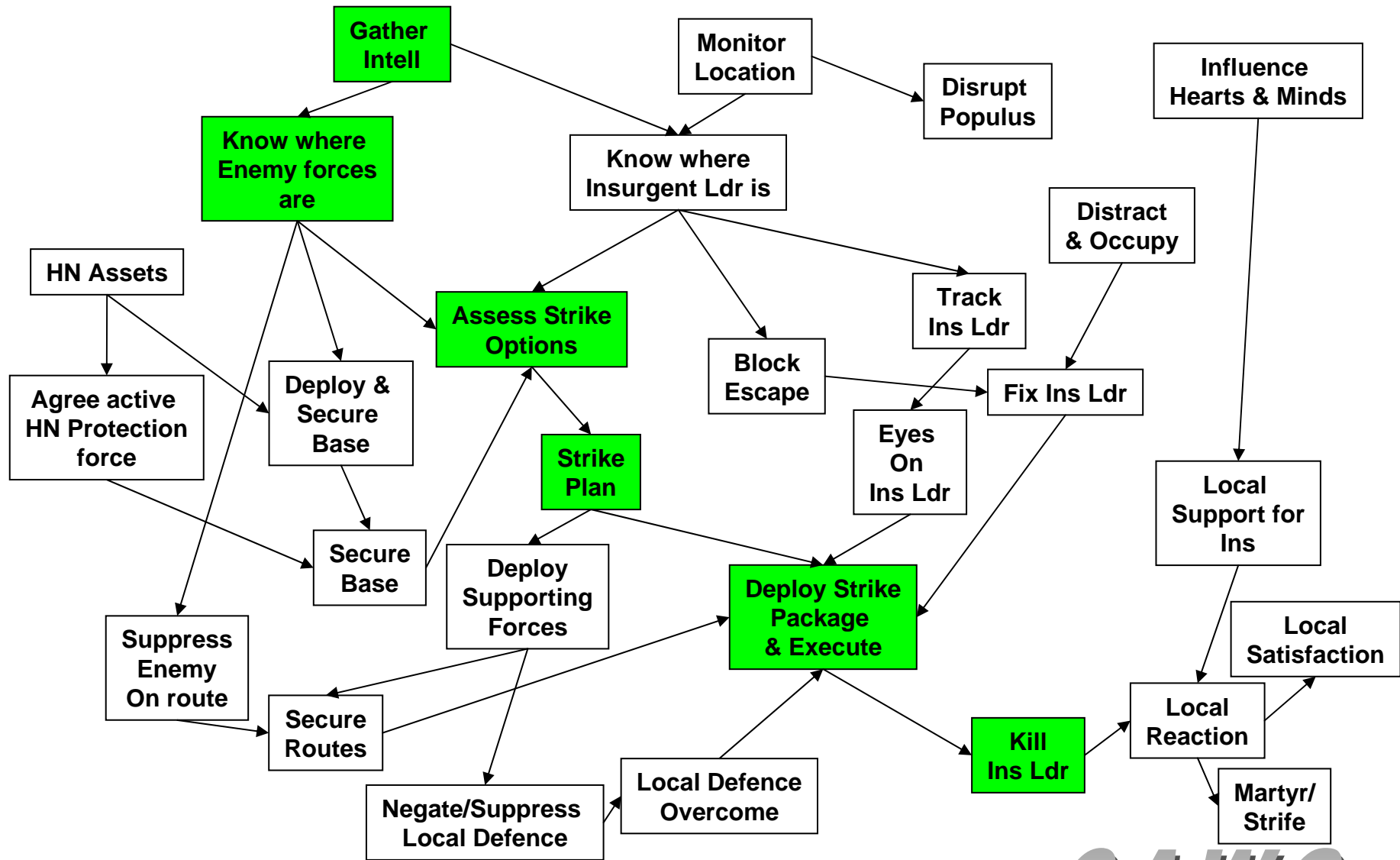


- Derive Influence Diagram from Matrix
- Separate effects(outcomes) and actions (activities)
- Limit the level of detail so that each diagram fits on a page
- Decompose to lower levels on more detailed diagrams covering only part of the problem

# Influence Diagram



# Influence Diagram – example of a chain

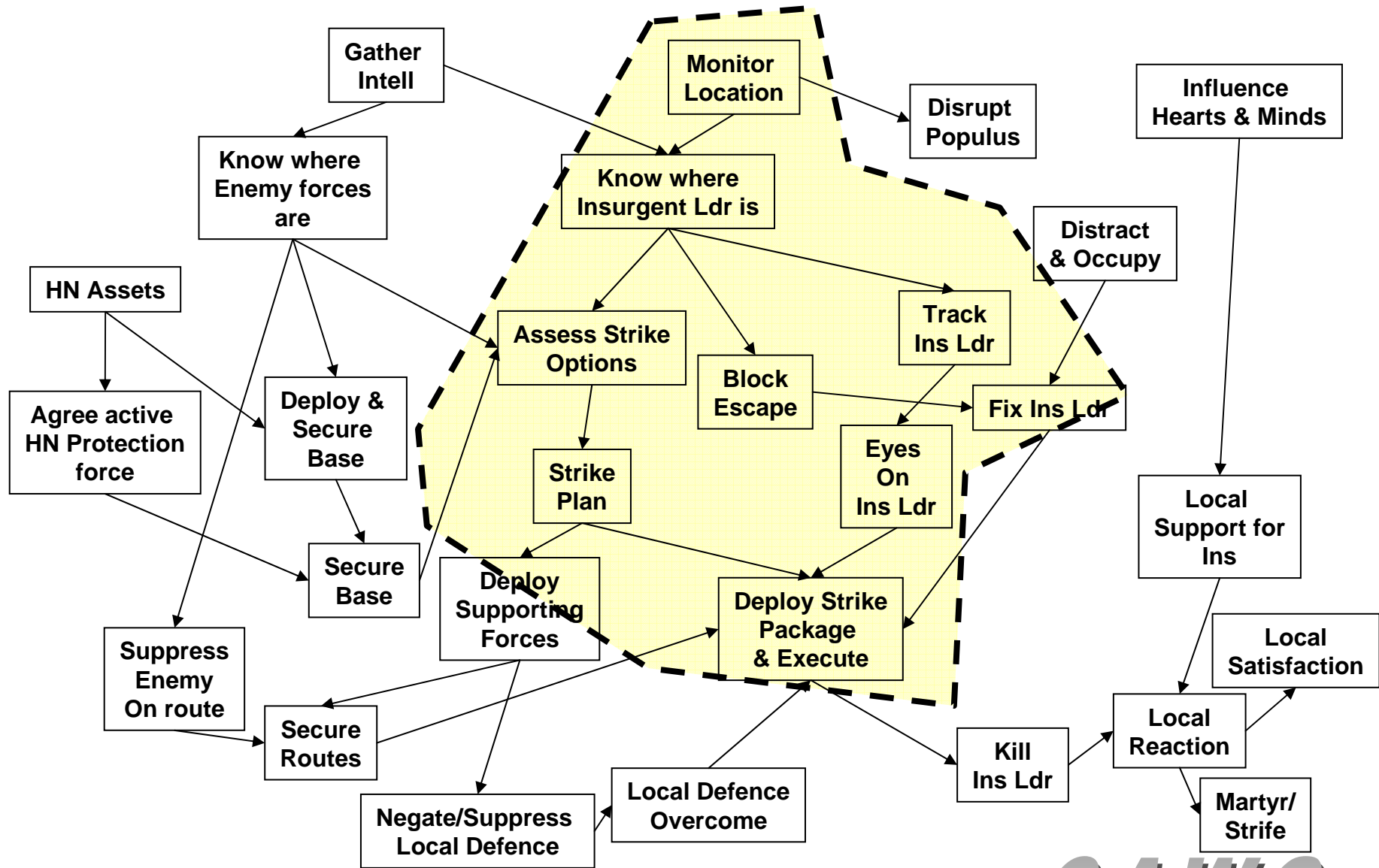




- Use Cases defined from examination of ID
  - Use cases allow detailed evaluation of systems
  - Construct use cases for the key steps in the functional chain
    - Leading to better evaluation – more justified evaluation – of forces in this CoA
  - Define Use Cases as a connected set of threads (the most tightly coupled)
- Draw the influence of the other parties as separate diagrams
  - (what they are trying to achieve)
  - then evaluate the interaction between the different diagrams
  - Assists in identifying
    - non intended/ adverse effects, especially those that can be exploited
    - what outcomes will trigger a response from the enemy



# Influence Diagram to Use cases



## Use Case parameters – mix of generic and scenario specific

- Dynamic parameters (from influence diagram)
  - Enemy forces
  - Size of tactical region to be searched
  - Civilian population (collateral and active players)
  - Leader immediate environment (cave, vehicle etc.)
  - Latency of information/ intelligence
- Other parameters
  - Terrain
  - Weather
  - Day/ night

} Factors affecting human behaviour
- Factors/ functions to be considered in bounding the Use Case
  - Enemy leader behaviour & locations database/ predictions (background intell)
  - Surveillance (looking over a defined area)
  - Target Location (finding a prece position to start targeting process)
  - Target Acquisition (immediately prior to actual strike, could be by autonomous weapon)

# Use Case – example analysis

- Dynamic parameters (from influence diagram)
  - Enemy forces = company of infantry with 2 MANPADS & RPG7, all in 4x4s
  - Village
  - 200 Civilian population (collateral)
  - Leader in 4x4 in market place
  - Humint suggesting meeting in village lasting 1 hour
- Other parameters
  - Terrain - mountainous
  - Weather - clear
  - Night – under the moon light with Bing Crosby crooning in the background
- Plan A
  - UAV can find all 4X4s but which one?
    - Keep all under surveillance and watch for give away behaviour
  - SF in village – grid ref or laser designate or send in marker nano robot
  - Tactical option 1 – wait till leader leaves and strike in clear
    - Risk = changes vehicle/ stays in village
  - Tactical option 2 – positively confirm location in village and use precision strike

## Process

- 1) chose a likely base case
- 2) do analysis to identify main options
- 3) pick another case, look for deltas



- Generate candidate force mixes corresponding to the principal Courses of Action
  - Example - focused intervention at small scale
  - Case 1 – Special Force strike package plus FRES Battle Group plus supporting air and artillery
  
- Choose the weaponry
  - Force Package 1 – traditional weapons
  - Force Package 2 – novel weapons (EM warheads, combined ISTAR/ weapons UAVs)
  
- But what do we value?

- **Force Packaging – efficiency and robustness – thresholds?**
  - **Logistic load (deployment)**
  - **Time to deploy (responsiveness)**
  - Logistic load (sustainment)
  - In theatre logistics (munitions load out, spares, rations, fuel etc.)
  - **Manpower (drives other factors)**
  - **Procurement cost of force package**
  - Operating cost of force package
  - Robustness to mission creep
  - Resilience to extended duration
  - Proportionality
  - Impact on concurrent capability
  - **Flexibility to pursue different CoAs**
  - Ease of recovery / withdrawal
  - Force Protection
- **Effect delivery – effectiveness**
  - Speed of effect
  - Duration of effect
  - **Confidence in outcome**
    - **Robustness to uncertainties**
  - **Confidence of minimal collateral effect**
  - Resources employed
  - Resources consumed (munitions)
  - **Casualties (people & equipment)**
- **Design stage**
  - **Growth capability**
    - **Technology insertion**
  - **Robustness to threat evolution**

**Overall robustness and flexibility**

# Force Mix scoring process



- Key principle = want good enough result for least analytical effort
- Score force mix options against the Courses of Action
  - A) analyse how much of use case space is covered by proposed approach/ systems
  - B) definition of specific use cases and then evaluation of each of them
  - C) analysis of risk of undesired effects
- Aggregate back up into overall score for all force mixes in this scenario/CoA

Force mix	CoA1	CoA 2	CoA 3
Mix 1	6	5	4
Mix 2	4	5	5
Mix 3	3	8	2

- Consider different scenarios – minimum spanning set from SAG
  - Re-use the use case analysis if appropriate





- Analysis was rapid and fit for our purpose
  - Process can generate understanding of problem and generate concepts, and plans
  - Method uses a complementary set of viewpoints and approaches
    - Elements suitable/were validated by external military review
  - Tractable with a mixture of military and engineering judgement
    - Panel of 4-6 people over 2-3 single day sessions plus some offline preparation
  - Needs more work on the scoring and aggregation aspects
- Further example cases should be examined

- Different effects at the tactical level can potentially effect system design
  - e.g. “capture/ immobilise and snatch” versus “kill”
  - Leads to an “action/ effect” audit – what can / can’t we do?
- EBA requires more rounded analysis
  - of the impact of achieving effect
  - and how it is achieved due to immediate collateral effects and perceptions
- Pursuing different effects at higher levels is likely to select different targets or select different means of action at higher levels
  - This generates Force mix / BoI issues
  - Interacts with design mainly through creating more approaches/ courses of action