# The Dynamics of ISIS: An Emerging-State Actor

By

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## Abstract:

This paper explains how the Islamic State grew rapidly, answering a question of "what is" the Islamic State? A review of existing literature on simulation modeling of insurgencies identifies several gaps, as existing theories of non-state actors and insurgencies are inadequate to explain ISIS's performance. Additionally, there are few mathematical simulation models of insurgent behavior that can reproduce ISIS results. Finally, what models exist are not detailed enough either to conduct detailed experiments testing proposed explanations of ISIS, or evaluate policy responses aimed at containing or mitigating ISIS.

The paper offers several contributions. First it proposes a dynamic hypothesis that the Islamic State (ISIS) is an emerging-state actor, a new form of actor that differs from traditional non-state actors and insurgencies. Propositions are constructed and presented as an overall theory of emerging-state actor behavior. These propositions are then simulated as experiments within a detailed model parameterized with conditions very similar to what ISIS faced in Iraq and Syria 2013. The model is then run from 2013-2020, and experiment results confirm evidence of emerging-state actor behavior and allow refinement of model boundary assumptions.

Second, an initial set of intervention policies are tested in a variety of conditions: best case, operationally constrained, isolated, combined, and at different timing intervals. Analysis of the results yields key dynamic insights. These insights aid policy makers in understanding the challenges posed by emerging state actors.

Finally, the detailed simulation model used to test the propositions and policy analysis, including a novel approach to combat simulation with endogenous geospatial feedback, is provided in full detail in two Appendices. Appendix A provides a sector-by-sector view of model structure and equations. Appendix B provides more discussion, analysis and sources used to develop model structure, establish parameter values and determine equations for the simulation. Due to length and other considerations, Appendix B is available only upon request. The detailed simulation model can be used to refine non-state actor theories (configured for insurgencies, emerging-state actors, or other scenarios). The model can be loaded with other scenarios to simulate other actors in other geospatial terrain: ISIS in Libya, Boko Haram in Nigeria, the returning Taliban in Afghanistan, etc.

Keywords: ISIS, ISIL, DAESH, insurgency, conflict, security, non-state actor, emerging-state actor, combat simulator, geospatial, national security.

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# Introduction

The rapid rise of ISIS and its staying power created great uncertainty in terms of regional stability. Although it's predecessor Al-Queda in Iraq presented a strong threat via a traditional insurgency, ISIS appears to operate in an entirely different manner. In under two years ISIS managed to capture two-thirds of Iraq and a third of Syria. Even when confronted with a five-front war, including interventions by regional and global powers such as Iran, Russia, and the United States, ISIS shows remarkable staying power. Calling ISIS an insurgency is difficult because they operate openly. Likewise, explanations that ISIS is a messianic religious cult or some form of mafia discounts how ISIS actually governed and sought to establish civic institutions in territory it controls. So what is ISIS? How can it be contained or defeated? Does it represent a new form of conflict that is a threat to regional stability? Can the ISIS phenomena be replicated elsewhere?

This paper proposes a hypothesis that ISIS represents a new form of conflict arising from an emerging-state actor. Emerging-state actors operate in fundamentally different modes than a traditional insurgency, and this difference helps explain the rapid growth of ISIS and why other insurgencies might shift to this mode of conflict. First, the problem of explaining ISIS's growth is presented, followed by a review of relevant literature concerning the simulation modeling of insurgencies. Then the theory of emerging-state actors as it applies to ISIS is developed within the existing theories of insurgencies. The hypothesis of an emerging-state actor is then synthesized through a series of logical statements connected in a causal-loop diagram. Experiments are conducted on the hypothesis using a detailed system dynamics simulation (explained fully in Appendix B) to build confidence in the hypothesis. Incremental knowledge gained by the experiments is presented, followed by a conclusion summarizing the findings and presenting options for future development. Finally, intervention policies are analyzed. Individual "best-case" policies are evaluated against the baseline performance, followed by a discussion

of insights generated from these tests. Then the policies are tested in a combined portfolio and at different timing intervals. The paper finishes with a conclusion that summarizes the insights, discusses limitations, and identifies future opportunities for research such as creating a 'flight-simulator' version of the simulator for fuller policy analysis.

## Detailed Problem Description

In 2003, approximately one year after the U.S. invasion of Iraq, Al-Queda Iraq (AQI) emerged as a potent threat to stability operations. At its peak, AQI influenced a population of nearly one million Iraqis through both criminal activities (extortion, car thefts, kidnappings) and guerrilla activities (recruiting, intimidation, military attacks). However, AQI never governed openly in the territory it influenced. Instead AQI conducted a classical guerrilla insurgency via clandestine means avoiding direct exposure and confrontation with Coalition Forces.

The strength of AQI peaked in 2006 before declining as the result of three circumstances: a troop surge of US Forces, a Suuni-Shia civil war that AQI helped spark, and the indigenous resistance to AQI growing out of the Anbar Awakening. From 2008-2012 the organization almost declined to the point of non-existence.

However, in 2013 the Islamic State of Iraq and Syria (ISIS) took control of Ar-Raqqah, a medium sized city in eastern Syria with an estimated 13,200 militants.[1] In a departure from AQI practices, ISIS began actively governing Ar-Raqqah. This initiated a transition of the population from being controlled by coercive power to governed by legitimacy that will be expanded upon later. By late 2014, ISIS had grown to between 50,000-80,000 militants strong, taken control of nearly thirty per cent of the territory in Syria and Iraq, and threatened regional stability. This brief history is depicted quantitatively across key measures in Figure 1.

[1] All size estimates for ISIS are taken from the Department of State. The Office of Website Management, "Country Reports on Terrorism." The entity now known as the Islamic State first appears in Country Reports on Terrorism in 2004 under the name Tanzim Qa'idat al-Jihad fi Bilad al-Rafidayn.

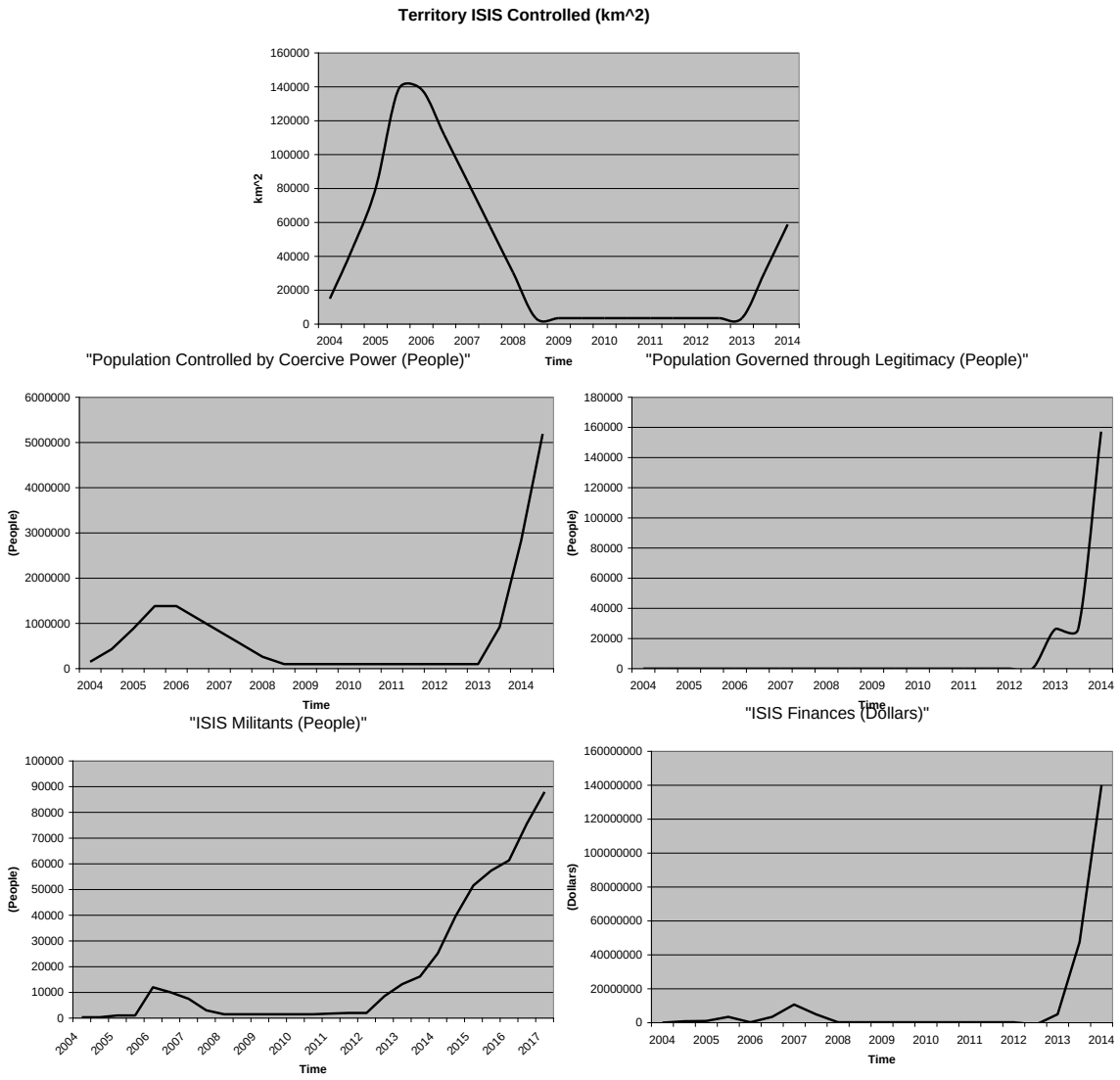


**Figure 1: AQI & ISIS Performance 2004-2014**

The rapid growth of ISIS represented by the final years in Figure 1 represents a problem in the study of insurgencies and how to contain them. How did ISIS grow so quickly between 2013 and 2014? Would that growth continue? Insurgencies by existing definitions operate clandestinely through the means of guerrilla warfare, their energy arising from local grievances. Often, the territory of an insurgency and at least nominal government control overlay one another. The insurgency may compete with the government, but it does not seek to expel it completely from the territory it operates in. These

premises underpin much of the literature and corresponding simulations models which create both growth and behavior modes. But ISIS does not operate from the same premise and thus its behavior modes differed significantly. At times ISIS operates openly, almost like a conventional army capturing territory, establishing sovereign control, and operating openly within their territory. How can this new kind of entity, whatever it is, be depicted in models that allow simulation to test theories to explain its rapid growth?

## Literature Review

Although the literature on insurgencies is extensive, in 2009 Kilcullen argued that Cartesian or reductionist quantitative analysis to model insurgencies may not be the best approach, and instead complexity theory and systems theory approaches may be more practical. Furthermore, the existence of cross-country multi-polar flows of interaction between insurgencies means many classical counter-insurgency theories focusing only on a binary conflict of an insurgent against the government may no longer apply.[2] There are only a handful of quantitative system dynamic efforts dealing with insurgencies or irregular warfare in the manner described by Kilcullen. An early multi-polar examination of conditions that give rise to internal violence in developing economies was conducted by Khalid Saeed in 1983. The paper analyzed how social and political factors determined long term growth. Instability in the form of dissidence and subversive activities were modeled, but not explicitly as a violent insurgency or with resources becoming controlled by the dissidents. [3] In 2010 Turnley et. al. specifically modeled an irregular warfare environment to provide a computational representation of the interdependence between kinetic and non-kinetic aspects of a battlefield. This approach focused not on individual actors but on groups representing different sets of socially constructed norms. Turnley's model aggregates three groups: Foreign Fighters, Coalition (which may represent both foreign and domestic government

[2] Kilcullen, David, *Counterinsurgency*.
[3] Saeedd, "Economic Growth and Political Instability in the Developing Countries: A System View."

forces), and Local Population, and models the dynamics between them. The model highlights the interaction of latent structure as it is affected by kinetic activity, but Turnley does not model the organization of the insurgency itself as a key factor in the dynamics of how it operates. Also Turnley's report explicitly makes clear terminology and frames of reference by incorporating U.S. military definitions—a practice adopted later in this paper.[4]

In 2011 Anderson used actual data from the Anglo–Irish War of 1919-1921 to model insurgency and counterinsurgency theories indicating potential gaps in the theory when compared to simulation results. However Anderson specifically did not model financial funding, a key element in explaining ISIS's behavior, nor the global linkages as described by Kilcullen. Finally, Anderson's model is largely built on the theories and perspectives of *Counterinsurgency* (U.S. Army Field Manual 3-24, also referred to as FM 3-24), which precedes the rise of ISIS as a force that can operates both openly and clandestinely. The focus on intelligence gathering implicitly indicates an insurgency operating in a guerrilla or unconventional manner, as the IRA did. However, the IRA was never able to seize and hold territory with this approach and may not best represent the dynamics of an actor like ISIS which seizes territory to the exclusion of all other actors.[5]

In 2013 Saeed et. al. developed a generic structure to model political conflict which could include insurgencies.[6] Aimed at understanding the structure of a political economy consisting of three populations: farmers, bandits and soldiers (thus giving the name to the model) and the flow of members between these populations. The model, like Turnley, focuses on decision-making and choices of the population rather than the explicit structure of how an insurgency like ISIS might operate.

[4] Turnley et al., "COIN 2.0 Formulation."
[5] Anderson Jr., Edward J., "Modeling Insurgencies and Counterinsurgencies."
[6] Saeed, Pavlov, Oleg V., and Skorinko, Jeanine, "Farmers, Bandits and Soldiers: A Generic System for Addressing Peace Agendas."

In 2014 Aamir presented a paper on modeling terrorist organizations using existing system dynamic models of business entities. This approach was built off a basis of literature that indicated parallels between the managerial challenges of a business firm as being similar to those of terrorist organizations. This approach divided sectors into the "functions" of a terrorist or insurgent activity including Territory/Capital Management, Financial Resources, Population Support, Supply Management , Human Resources and Attacks & Agency (which determines the timing and frequency of insurgent attacks). However, except for Attacks & Agency the models Aamir used were from existing system dynamics literature on business models, built generically, rather than aiming to model the performance of any one insurgent group.[7]

This paper seeks to build upon the work of this existing literature by proposing a dynamic hypothesis that ISIS represents a new form of insurgency created by an "emerging-state" actor. In this effort I will adopt Turnley's approach of using U.S. military definition of terms, the aspects of modeling ISIS as a firm or state from Aamir, and pay close attention to the causal mechanisms (financing, recruiting, gaining equipment) that allows ISIS to operate and achieve its goals missing from the theoretical structure of Anderson and the generic structure of Saeed.

My contribution to the literature lies in three main areas. The first is in establishing a series of propositions based on causal logic that together form the dynamic hypothesis that ISIS is an emerging-state actor, a form of conflict that can be located in the continuum of military classifications and clearly distinguished from other forms of conflict. Second, the propositions of the dynamic hypothesis can be tested in simulation experiments to see whether they are valid within the context of the model boundaries or not, and validate those boundaries. Finally, I hope to contribute a richly detailed simulation model that can simulate the performance of either an emerging-state or insurgent actor, compare performance between the two as well as each against a set of intervention policies. The model

[7] Aamir, "Applying Existing System Dynamics Business Formulations to Model Terror Organizations."

contains a detailed combat simulator and can also be configured via scenarios that include ethno-social and geo-spatial data to model different environments and starting conditions. All of this serves as a platform for conducting a portfolio of policy tests to understand both the behavior of an emerging-state actor versus an insurgent non-state actor, but also to conduct policy tests on interventions against the actors.

## Hypothesis Development: What is ISIS?

Developing a hypothesis that ISIS is an emerging-state actor first requires identifying the existing perspectives on terrorism, insurgencies and irregular warfare. Then locating ISIS within this constellation of non-state actors. Part of that effort involves making explicit the modeling boundaries and how the problem is being sliced. This section concludes with the proposed hypothesis of ISIS as an emerging state actor.[8]

From a theoretical perspective the question "what is the Islamic State?" represents a challenge of definition. Part of the confusion arises when terms often do not distinguish between tactics used by a non-state actor and threat to the state by a non-state actor. The two figures below, Figure 2 and Figure 3, both represent continuums along axes. Beginning with "tactics," a continuum of the methods of operations employed in furthering an agenda by non-state actors can be notionally established using terms and definitions from the U.S. Military. In Figure 2, at the left of the continuum, are non-state actors who seek to achieve their agenda through unconventional warfare defined as "…operating through or with an underground, auxiliary, and guerrilla force in a denied area."[9]

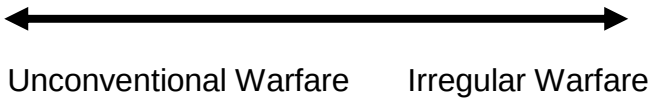


**Figure 2: Tactics Continuum**

[8] Turnley, "Where Is the Method in the Madness? Questions for Systems Dynamics Modeling Teams."
[9] "Joint Publication 1-02: Dictionary of Military and Associated Terms," 261.

On the right side of the continuum are those non-state actors who further their agenda through a "…violent struggle among state and non-state actors for legitimacy and influence over the relevant population(s),"[10] the key distinction being to what extent the non-state actors are operating in a clandestine or more open fashion and seeking legitimacy over the local population. The continuum ends at irregular warfare excluding conventional full-spectrum operations and nuclear war as being beyond the reach of non-state actors.

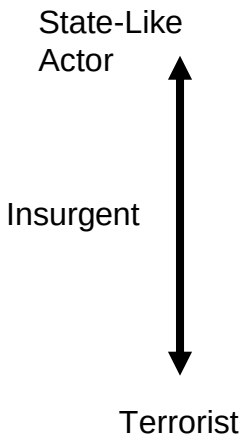


**Figure 3: Threat to the State**

Figure 3: "Threat to the State" represents the extent to which the agenda of a non-state actor represents an existential threat to the survival and continuance of a state. Agendas which seek change in government policy, release of prisoners, or financial demands are fundamentally different from agendas with goals to remove or replace current leadership or violently overthrow the state itself. Kilcullen distinguishes between "terrorist" and "insurgent" based on the question of how much of a threat to the state does the non-state actor pose. He describes how in "Western popular culture the conception of terrorism became that of disembodied cells of radicalized, nihilistic individuals [who]…could not and did not tap into a mass base that drew its legitimacy from popular grievances, as traditional

[10] Ibid.

insurgents."[11] But many insurgencies, Kilcullen continues, especially those of the 21st Century, operate in a conflict where the insurgents "challenge the state by making it impossible for the government to perform its functions, or by usurping those functions—most commonly, local-level political legitimacy; the rule of law; monopoly on the use of force; taxation; control of movement; and regulation of the economy."[12] So insurgencies differ from terrorism in their intent of challenging the state, however most insurgencies still operate in a clandestine fashion. This is because an insurgency does not yet have a monopoly on the activities within the territory they occupy, so the non-state actor can neither operate nor govern openly. This territorial control leading to open-governing distinction is vital amongst the non-state actors. Once an insurgency has begun controlling a territory to the exclusion of any other force and begins establishing and enforcing law, commerce, and social activity, they have evolved to something more than an insurgency. In 2007 the United States military published the Joint Operating Concept on Irregular Warfare in order to guide future joint force commanders on a wide variety of types of irregular warfare. However, the Joint Operating Concept briefly treats this concept of insurgencies acting in sovereign fashion in a footnote "[s]tate-like adversaries refer to non-traditional adversaries that have evolved to the point of attaining state-like power, authority, and influence over a population" and later acknowledging that "these adaptive actors may possess some of the power of states and adopt state-like structures."[13] This final definition allows the creation of a vertical continuum of the threat to the state. At the bottom, small groups of individuals pursue policy change but have little chance of disrupting state function, whereas an insurgency is beginning to not only threaten but to disrupt the governing of the state. Finally when an insurgency begins capturing territory and governing openly, they have become a state-like actor and perhaps the only difference remaining from a state-like actor and a state is international recognition.

[11] Kilcullen, David, *Counterinsurgency*. Location 3123
[12] Ibid. Location 2529
[13] Olson, Mattis, and Mullen, *IRREGULAR WARFARE: COUNTERING IRREGULAR THREATS JOINT OPERATING CONCEPT*, 8 & 16.

Using the defined horizontal and vertical axes, non-state actors can now be notionally plotted based on where they fall on both continuums. Further segmentation can be arrived at by illustratively separating the graph into four quadrants representing the four natural distinctions of a two-axis arrangement as: high-challenge to the state with unconventional means, high challenge to the state with irregular warfare means, low challenge to the state with unconventional means, and so on. Three quadrants are easily defined with existing terms.

It's worth noting that "Guerrilla Insurgencies" are not at the top of the "challenge to state" axis. It follows logically that meeting the definition of a state-like actor would require a guerrilla insurgency to abandon clandestine or underground methods and begin operating in the open abandoning the clandestine nature characteristic of unconventional warfare. As a guerrilla insurgency gains territory and begins actually governing, it shifts to the right upper quadrant currently named 'Unknown Territory'. The actors who occupy this space are those who conduct irregular warfare and yet present a threat to the state of equal or higher magnitude than guerilla insurgencies. Defining the characteristics of this 'unknown territory' quadrant occurs later. But first we must locate where ISIS falls within the four quadrants.

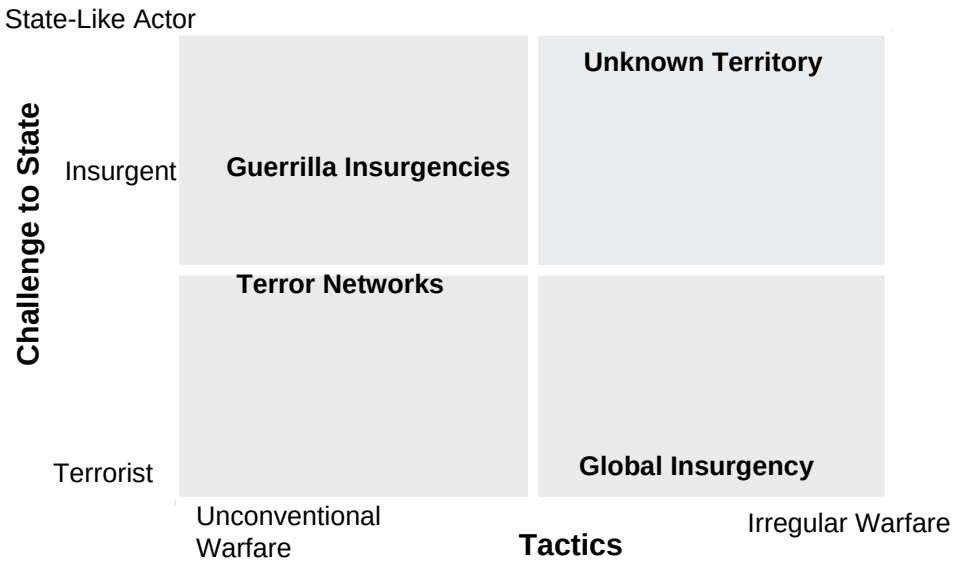

**Figure 4: Non-State Actor Segmentation**

Locating ISIS in this construct requires understanding its history and shifting mode of operation. From 2003–2013 ISIS, in its previous incarnations, operated an insurgency in an unconventional style, maintaining clandestine networks and conducting attacks in a fashion that allowed them to hide within the population. Their agenda, however, was a challenge to both the coalition authority and the U.S.-backed Iraqi government. Although they operated from within the local population and conducted criminal activities to gain revenue, they were never able to openly govern the population. With the capture of Ar-Rakkah in 2013 this mode shifted from clandestine to open insurgency. Because of this shift in approach and end goals, it is better to describe ISIS using a term inclusive of insurgencies but not limited to unconventional operations such as irregular warfare. ISIS no longer sought to just deny governmental functions to the states (Syria and Iraq), but through the seizure of territory and establishment of Shura Councils to create their own state.

As ISIS set up courts of law, collected taxes, established government services, and enforced social norms the group clearly began operating as a "state-like" actor, and given its rise might be better termed "emerging-state" or "proto-state" actor. Indeed the qualities of an "emerging-state" actor well qualify the upper right portion of the previously established quadrant. Locating ISIS in this space along with illustratively placing other non-state actor groups, the graph now appears as:

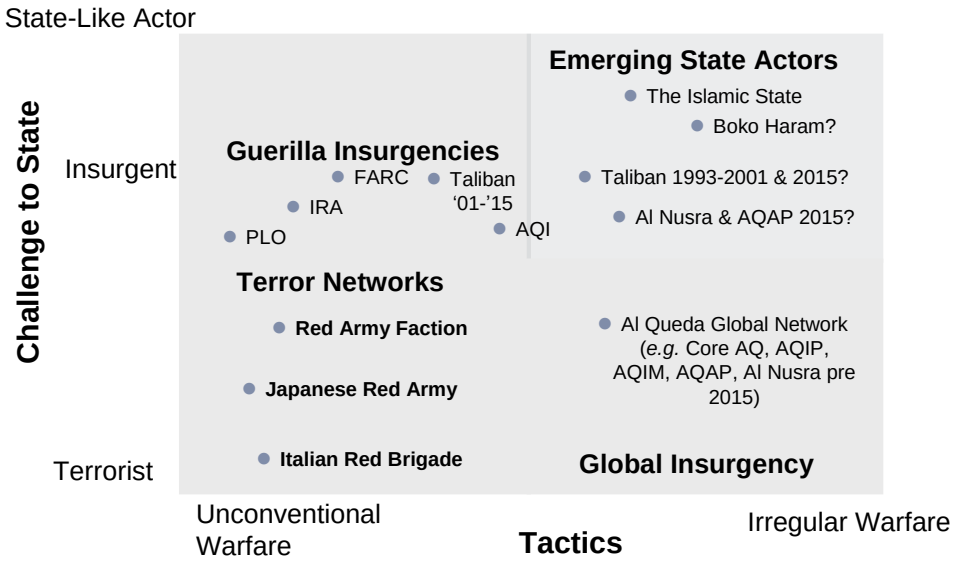


**Figure 5: Filled Non-State Actor Segmentation**

This structure now provides a shaping context for the discussion of "what is ISIS" and a point of alignment in the modeling effort: the amount of relevant population under some form of control by ISIS. From Turnley, two forms of control over a population are identified: population controlled by coercive power and population governed through legitimacy. Coercive power results from the exercise of "coercion and reward" and is "particularistic as it is support for a specific action or specific person, not for an institution or a system of government." Coercive power is more resource intensive as it "requires the investment in individuals who can continuously monitor behavior and apply either positive or negative pressure to induce compliance whenever necessary." [14] Legitimacy is a form of power that relies on the function of procedures that the governed population considers fair, and is established with credibility over time. Unlike coercive power used to ensure compliance, legitimacy "involves notions of obligation, i.e. the moral necessity to obey. Control by others is replaced by self-control, which socially is a much cheaper way to ensure social order."[15] Each institution created by the would-be governing

[14] Turnley et al., *COIN 2.0 Formulation*, 37-38.
[15] Ibid., 38–40.

power must itself create a variety of processes and procedures within which it exercises its duties. Legal courts hold trials and settle disputes, civic institutions provide public services, and law enforcement services react to crime. It is the perception of the target population over whether these procedures are "fair," relative to the norms of the target population that begin to establish credibility. Turnely emphasizes that credibility is "not event-based but process-based" and therefore legitimacy can only be gained through repetition of credible processes by considered "fair." [16] Once gained, legitimacy serves as a buffer against individual renegade officials or short periods of procedural injustice. This is because the population "believe[s] that, over time, the system will punish or otherwise deal with them."[17]

Turnley illustrates the transitioning distribution of a percentage of population controlled through coercive power and the percentage governed through legitimacy with a diagram presented as Figure 6. Institutions are created at times t1, t2 & t3, each deploying a series of procedures to execute their purpose. As each procedure by an institution is considered "fair," the amount of Power (coercive power) decreases as Legitimacy (governed through legitimacy) increases. Additionally, the succession of credible and fair institutions also decreases the amount of Power needed versus Legitimacy.

[16] Ibid., 38.
[17] Ibid., 39.

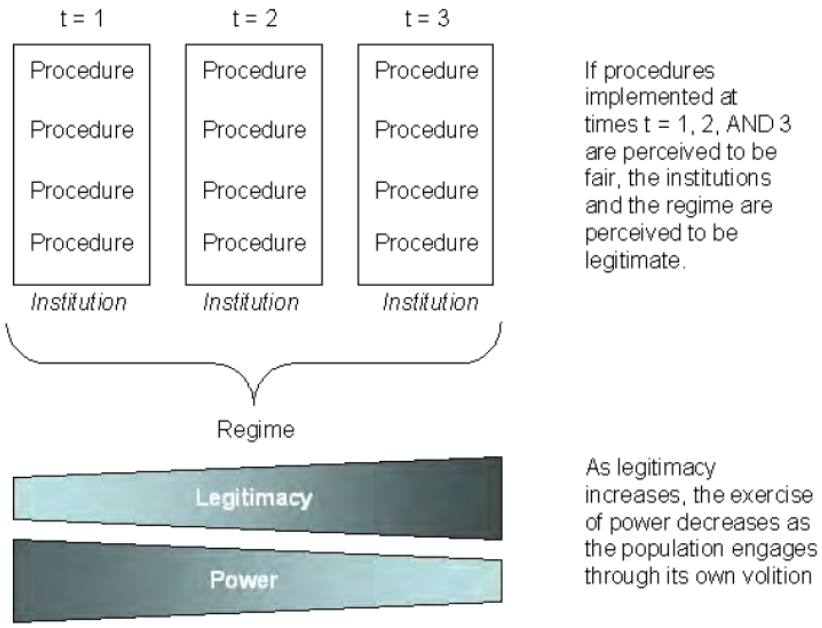


**Figure 6: Power & Legitimacy**

## Modeling Boundaries & Approach

Prior to creating a simulation model, the proposed theory to be tested must be developed into a strong logical argument. In system dynamics these logical structures are made visual and explicit with causal loop diagrams (CLD) that distill into to a few key feedback loops of the hypothesis of what is generating the proposed behavior. From this, the detailed CLD simulation models of hundreds of equations can be constructed. However, since models can never truly represent reality, boundary selection must be made explicitly clear. For the proposed hypothesis that ISIS as an emerging-state actor reasonable boundaries can be selected through a "slicing approach" to complex systems as advocated by Saeed in 1992.[18] In complex systems modes of behavior can be sliced across three axes as shown in

[18] Saeed, Khalid, "Slicing a Complex Problem for System Dynamics Modeling."

Figure 7: time, geography (both a geography of 'terrain' and a geography of 'things'), and simultaneous behavior modes that exist within a complex system.

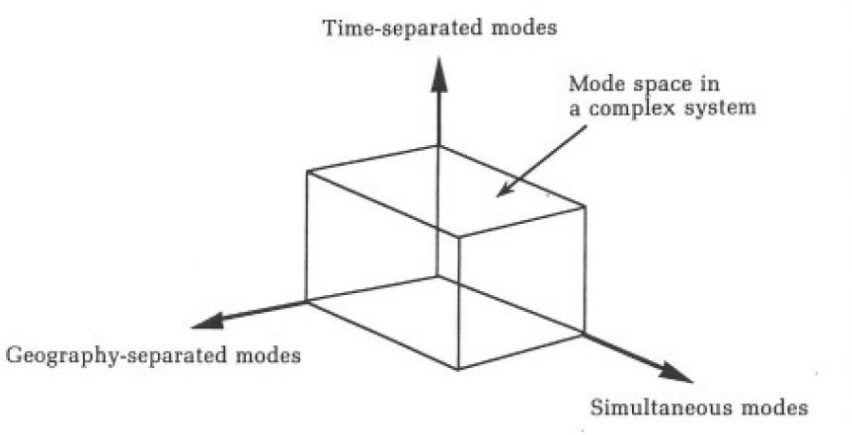


**Figure 7: Complex Problem Solving**

In this paper the complex system will be sliced as depicted in Table 1. Additional commentary on these selections is provided in the Appendix B.

**Table 1: Proposed Slicing of Simulation Model**

| Axis | Slice Modeled | Slice Not Modeled |
|---|---|---|
| Mode | Exponential growth of Governed Population | **Limits to Growth** |
| Time | Duration = 2013-2017<br>Unit = 6 months, dt = .0055 (or 1 day) | **Pre-2013 and greater than 5 year feedback loops** |
| Geography | Territory: Iraq & Syria Provinces & Cities<br>Ethno-Social Populations: Kurds, Shia & Suuni<br>Forces: ISIS vs. Everyone Else | **Cross Regional Flows**<br>**Tribal Structures**<br>**Towns & Villages** |
| **Policy Responses** | **Exogenous Policies** | **Latent Structure Policies** |

Two modeling methods are used in this paper: non-simulatable Causal Loop Diagrams to create a visual depiction of the emerging-state actor theory, and a simulation model developed to test the hypothesis that ISIS is an emerging-state actor.

## Hypothesis Design through Causal Loop Analysis

Existing causal loop structure for insurgencies in the literature is limited as discussed previously. Because the models used by Aamir were already extant, he did not provide an integrated causal loop

structure.[19] In their 'Farmers, Bandits, and Soldiers' model Saeed et. al. likewise did not depict a causal loop diagram.[20] Only in Anderson's paper was a causal loop diagram of his theoretical construct created, as depicted in Figure 8.[21]

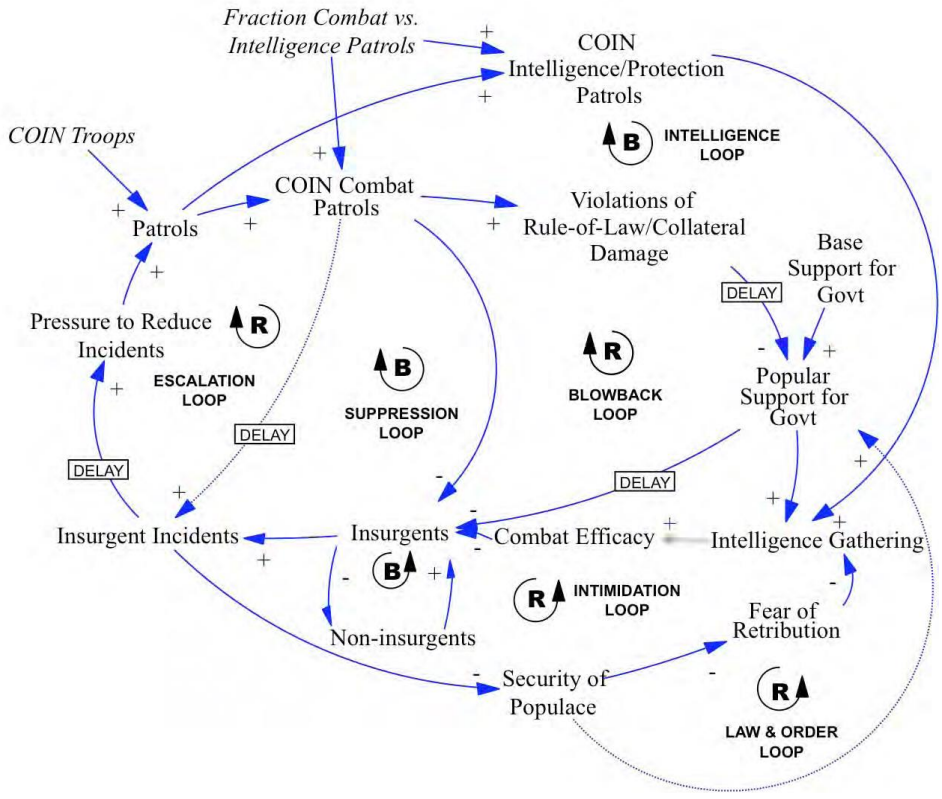


**Figure 8: Anderson COIN CLD**

Anderson's model is limited in its utility in examining ISIS and other emerging state actors using irregular warfare. This is because Anderson's model is built on the premise that insurgents are fighting a "classic" insurgency following O'Neill's definition that largely confines insurgents to operating in a guerrilla manner, e.g. "raids, ambushes, bombings, etc."[22] This is consistent with the Joint Forces definition of unconventional warfare of "operating through or with an underground, auxiliary, and

[19] Aamir, "Applying Existing System Dynamics Business Formulations to Model Terror Organizations," 8.
[20] Saeed, Pavlov, Oleg V., and Skorinko, Jeanine, "Farmers, Bandits and Soldiers: A Generic System for Addressing Peace Agendas."
[21] Anderson Jr., Edward J., "Modeling Insurgencies and Counterinsurgencies," 8.
[22] Ibid., 3.

guerrilla force in a denied area."[23] This does not comport with behavior that is state-like, or defined above as emerging-state behavior.

Causal loop diagrams can demonstrate the differences between a traditional insurgency and emerging-state actors. From these differences manifests the theory of emerging-state actor behavior and performance. These differences can then be tested in the simulation model for validation against the hypothesis that ISIS is an emerging state actor. A notional "classic" insurgency causal loop diagram is depicted in Figure 9.

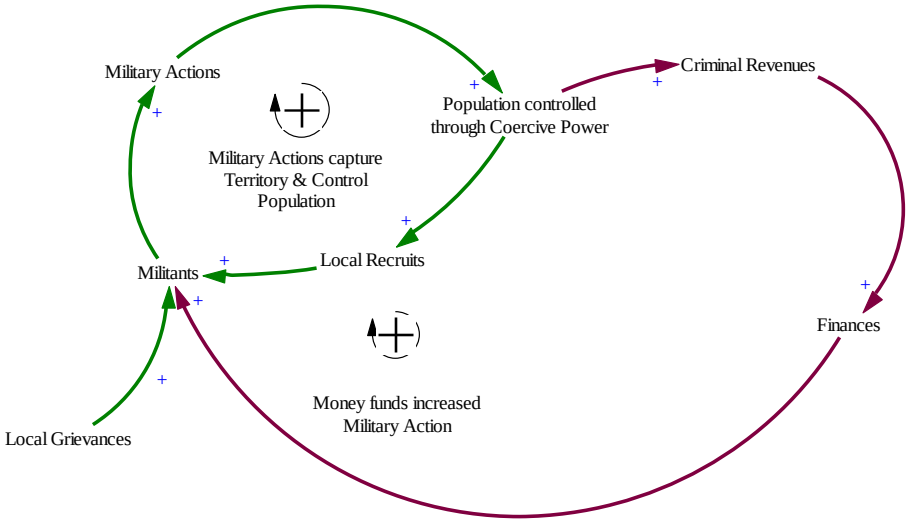


**Figure 9: Notional CLD of a Classical Insurgency**

The classical logic of an begins with local grievances leading to an increase in militants willing to conduct violence against the state. The causes of local grievances are irrelevant for purposes of this paper. What is key is that positive polarity indicates that as local grievances increase, so do militants, and if local grievances were to decrease, militants and their actions would also decrease. This is illustrative of the importance of resolving local grievances, often through political reform, as a sustained

[23] "Joint Publication 1-02: Dictionary of Military and Associated Terms," 261.

approach to ending an insurgency over time.[24] After that the non-state actor gains militants from local grievances, a feedback loop initiates, where they conduct military actions, which allow them to control a population through coercive power (intimidation). The insurgency then seeks to gain local recruits from the population by exploiting the local grievances, which increases the number of militants and allows them to conduct more military actions. The non-state insurgent actor funds its operations from criminal activities conducted within the territory they influence. These could be criminal activities targeting populations that are not aligned with the insurgents such as ransoms, extortion, reselling of stolen property, looting, and selling of blood-antiquities (stolen historical artifacts). Criminal activities also include activities which are illegal globally but may be tolerated locally such as the illegal drug trade. Finally, criminal revenues include informal taxation schemas that bear more resemblance to extortion than a formal state levied tax. These funds increase non-state insurgents finances, allowing them to support and pay more Militants. Both of these feedback loops increase the number of militants, which is how insurgencies gain their strength and staying power. Conversely, and logically, a sustained reduction in either local grievances through reconciliation, ability to gain finances, or reduction of militants through military action all hold the potential to reduce the feedback loop that powers the classic non-state actor insurgent, especially when applied in combination.

The difference between a non-state actor and emerging-state actor insurgencies lies almost wholly in the seizure of territory and its subsequent governing by the emerging-state actor as well as the exploitation of global grievances in addition to local. When we add this aspect to our existing CLD structure, three loops emerge: seizure of territory, control of population through legitimacy, and foreign recruiting by playing on global grievances. The larger CLD is depicted in Figure 10.

[24] Kilcullen, David, *Counterinsurgency*, 6–7 location 173–199.

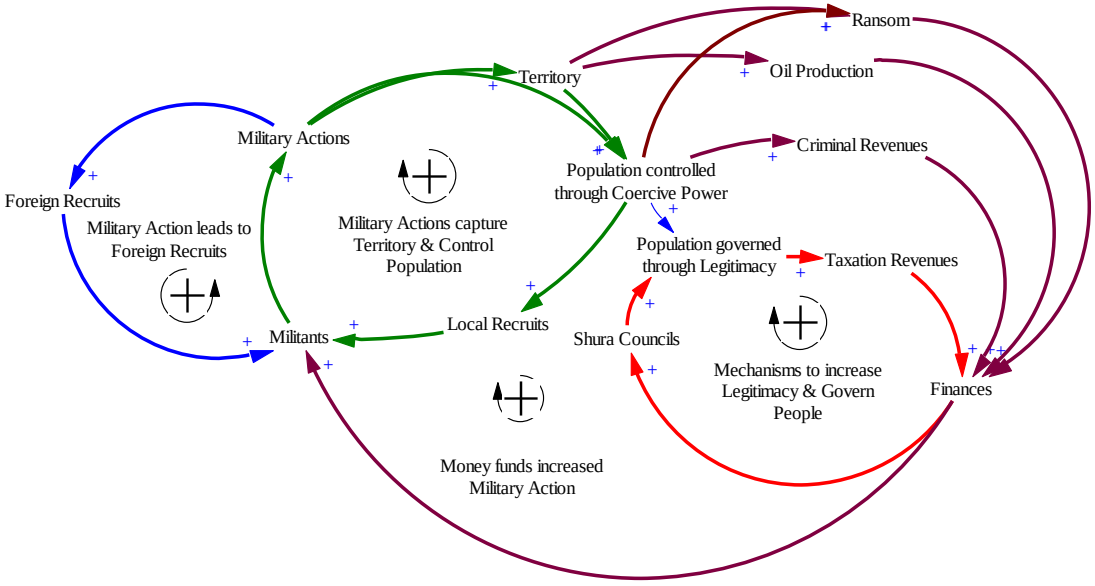


**Figure 10: CLD of an Emerging State Actor**

The first difference with the emerging state actor CLD is the input of non-local grievances that bring foreign recruits to an area. These militants may be aligned to the local grievances at first, but a reduction in local grievances will not result in a reduction of foreign intervention since those grievances are non-local. The second difference is that military actions in this model are designed not only to terrify or intimidate populations, but also to seize territory. This territory then enables an additional feedback loop of "territorial tevenues" to be activated. Control of territory allows a non-state actor to control the resource extractions that occur in that territory. These territorial revenues require coordination of workers and leveraging infrastructure, and they are difficult to secure when an insurgency operates in a classical clandestine manner. In Afghanistan the Taliban took advantage of opium farming, while in Nigeria Boko Haram helps fund itself through oil in Columbia the Revolutionary Armed Forces of Columbia (FARC) exploited the production of cocaine. For ISIS, the territorial revenue is oil and to a lesser extent blood antiquities. These additional financial inputs produced from lucrative trade charge

the feedback loop that runs through finances to obtain more militants, conduct more military actions and thus gain more territory.

Seizing territory opens another powerful feedback loop of enabling non-state actors to begin governing the population. This creates the processes by which coercive power shift to legitimate power. Populations controlled through legitimacy are less resource intensive to control, since the population "self-controls" and also allows taxation of normal commerce and individuals. The shift to Legitimacy also feeds back on itself. The more people governed through Legitimacy, the easier finances are collected through taxation, which fund local governance mechanisms. In ISIS's case, taxation funds their Shura Councils. These local governance mechanisms can provide the services that only a sovereign state actor can provide: law enforcement, judicial proceedings, building infrastructure, social services, and other government services that may have been lacking in the area.

Finally the entire system benefits from the non-local grievances that the emerging-state actor can leverage by drawing both recruits and individuals into its new government from abroad. The loss of local support is often a death-knell for classical insurgencies. But even if local support decreases, or shifts *against* the emerging-state actor the inflow of foreign militants and transplants mitigate the impact to the operations as will be shown in policy tests later in the paper.

The emerging state actor theory can be summarized as:

1. Local & non-local grievances bring militants and a non-state actor either emerges or is drawn into conflict.
2. The non-state actor uses militants and finances to conduct military actions.
3. As the non-state gains controlled population begins extracting coercive revenues through criminal activities and recruiting locally from within the controlled population.
4. Within its territory, the non-state actor attempts to monopolize the use of force, taxation, control of movement, and regulation of the economy. By operating in a sovereign manner, the non-state actor shifts to an emerging state actor.
5. Coercive revenues & territorial revenues are used to finance governing mechanisms which can begin building legitimacy to shift the controlled population into a governed population.

6. As the emerging-state actor gains a governed population, it also gains taxation revenue and increases its draw of non-local foreign recruits by propagandizing its non-local grievances, which may or may not align to local grievances.
7. The loops complete into a positive feedback loop of exponential growth. More militants mean more military actions, which means more territory and access to controlled populations, which can begin to be governed, fueling finances, which fund more militants and military actions.

The shift from a classic non-state actor insurgency to an emerging-state actor insurgency, in this hypothesis, occurs at step 4 and completes in step 5. This can be described in another way. For a non-state actor to become an emerging state actor it must:

1. Control territory to the exclusion of all other state actors.
2. Seek to govern that territory in an open manner to build legitimacy.

In the case of ISIS's predecessor AQI, the group was able to reach step 3 and partially step 4. Even though AQI certainly influenced a population and extracted criminal revenues from them, AQI was never able to meet the two criteria above to complete the transition from 4 to 5.

An astute reader might note that in this formulation, an emerging-state actor is self perpetuating, a foregone conclusion once militants enter the system. To complete the CLD in Figure 5, balancing loops are added representatives of various limits to growth. These are endogenous limits—externalities imposing limits on the emerging-state actor, but even with absent external pressure, some form of these limits can emerge over time.

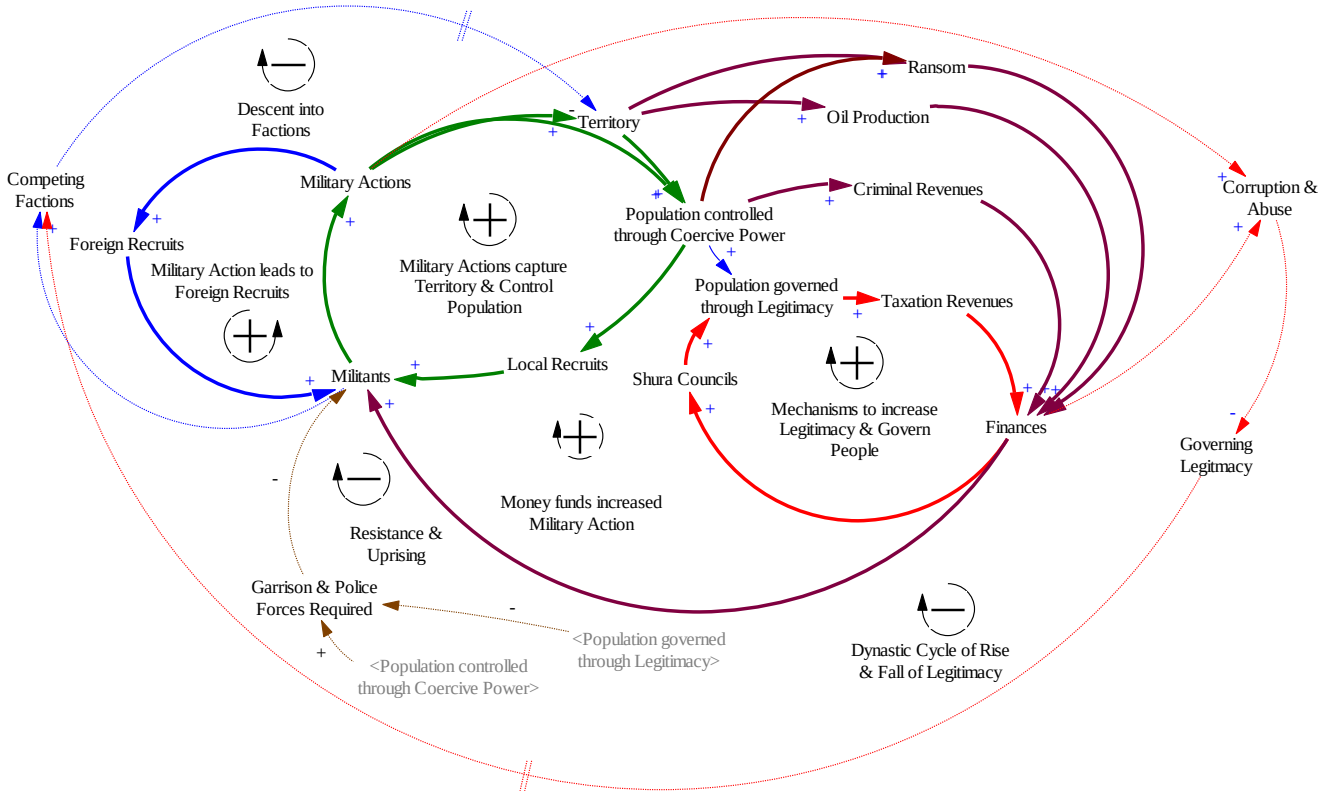


**Figure 11: Emerging State Actor with Balancing Loops**

The most immediate and pressing is the "Resistance & Uprising" loop. As ISIS controls more population, it requires more forces to garrison than population in order to prevent uprisings against their rule. This reduces the number of militants available to gain more territory. However, the force ratios (as discussed in the Appendix B) for garrisoning a population through coercive control are higher (ranging from 8:1 to as high as 55:1) than the ratios necessary to police a population (~2.8:1) governed through legitimacy. This speaks directly to a key benefit an emerging-state actor can gain over a non-state actor, as identified by Turnely et. al. Populations governed through legitimacy rather than coercive power are less resource intensive for the insurgency. Another negative feedback loop found in emerging-state actors is the "Descent into Factions." Because the emerging-state actor draws its support from both local and global grievances, and its forces are a mix of natives and foreigners from many countries; there is not the shared common background found in a locally arisen insurgency. This lack of common

background exacerbates factionalism and can lead to splits within the forces as the size of the emerging-state actor increases. This loop its precedence in ISIS's own emergence within the Al-Queda global franchisee network, splitting in 2013. Growth and size of any entity may lead to disagreements over both policy and personality, and if those factions are significant enough, they may break the emerging state actor apart. The Dynastic Cycle begins with the corruption and abuse of arbitrary power available to a state, similar to that described by Katouzian's theory of arbitrary state and society.[25] These abuses erode governing by legitimacy, feeding both the Uprising & Resistance loop and the Descent into Factions oop. Note however that with the CLD proposed above, the decrease of governing by legitimacy does not itself result in a loss of population governed through legitimacy. This indicates only if one of the competing factions itself begins as an insurgency, a non-state or emerging-state actor can pry significant portions of the population away from the first actor. Finally, the negative feedback loops of Descent into Factions and the Dynastic Cycle have a significant delay function and therefore may develop well after emerging-state actor has established itself. As modeled by Langarudi, the Katouzian dynastic cycle can take decades to manifest.[26] The Afghanistan Taliban, as an emerging-state actor for instance, maintained its governing legitimacy despite abuses until the post-9/11 U.S. invasion in 2001. For this reason in the attached simulation model, Dynastic Cycle and Descent into Faction feedback loops are not explicitly modeled as being outside the time horizon identified by the boundary assumptions. The impact of garrison forces however is modeled.

Returning to AQI and its failure to transition from step 4 to step 5, the inability to govern legitimately and relying only on coercive and often abusive power, exposed AQI to blowback from local fighters beginning in the Anbar Awakening of 2006, which is an example of the activation of the Uprising & Resistance negative feedback loop. Coinciding with this was an increase in U.S. forces due

[25] Langarudi and Radzicki, "A Simulation Model of Katouzian's Theory of Arbitrary State and Society," 7.
[26] Ibid., 10–16.

to the surge. These loops can therefore help explain not only the rise of ISIS in 2013, but the collapse of AQI forces in 2006–2007. A classical insurgent could not sustain itself in that environment.

## Hypothesis that ISIS is an Emerging State Actor

Based on the previous theoretical development, I propose the following hypothesis*:* the Islamic State (ISIS) is an emerging-state actor, which uses methods of irregular warfare to capture territory in order to influence populations ("coercive power"), which it then attempts to govern in furtherance of its objective to become a functioning state ("legitimate power"). I recognize that although the term for this category might be new in this application, the behavior and model is not, as other actors, such as the Taliban in Afghanistan and Hamas in Hezbollah, took this route as indicated by the segmentation.

We can now create a simulation model of sufficient detailing to test the hypothesis that ISIS is an emerging-state actor, and indeed the theory itself. The model is created in two sections: a strategic architecture of ISIS, and a world model within which ISIS operates. The strategic architecture identifies the resources and capabilities that determine performance at any point in time. This performance-based approach to modeling recognizes that these resources accumulate or deplete driven by flow-rates and the changes in the resource. Sub-systems representing the constants, parameters, information flow, and leadership decisions, as well as the influence of other resource levels, all combine to affect the rates of change. Reinforcing and balancing feedback interactions between these resources can be used to explain the dynamics of strategic performance. This aggregate strategic architecture is depicted in Figure 13.

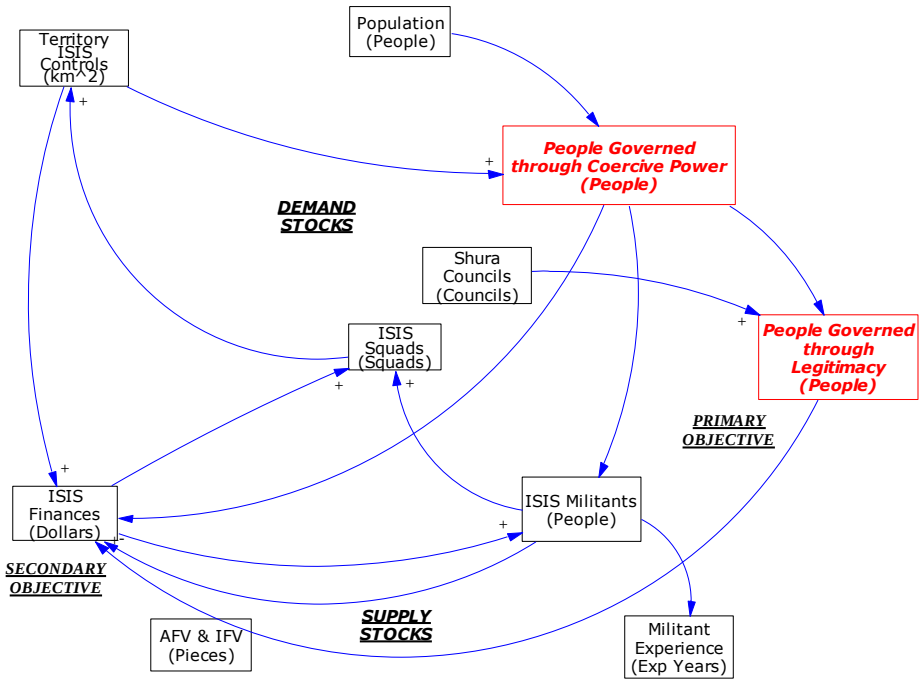


**Figure 12: ISIS Strategic Architecture**

The demand stocks in the strategic architecture represent first and foremost the "target population" that the state and emerging-state actor are competing over, and important attributes of said population. Likewise the mechanisms by which insurgents gain access to the "target population" which requires establishing some form of governance are the demands that ISIS is trying to meet. In order to achieve these demands, ISIS will use supply-stocks representing its capabilities and capacity.

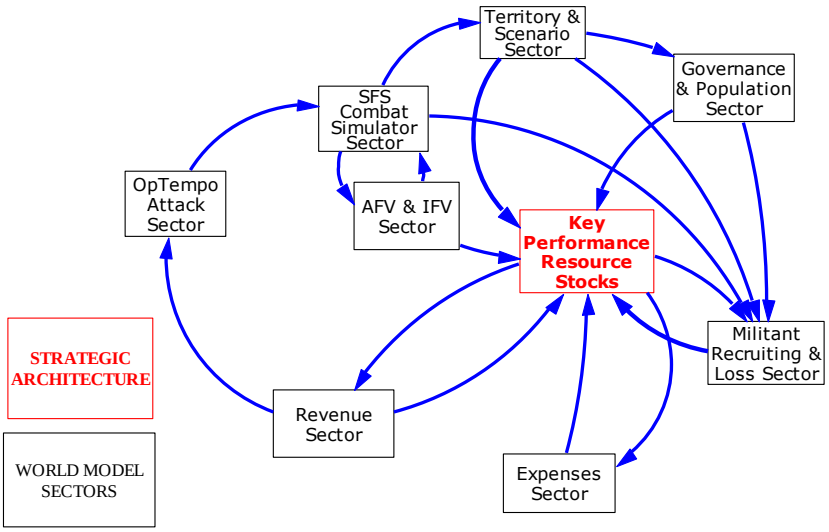


**Figure 13: World Model**

The ISIS strategic architecture is then located in a world model, as shown in Figure 14. The world model defines the "environment" within which subsystems interact with local conditions (where recruits and resources are located relative to what is controlled), competitors (who will resist expansion and what means are used), and even internal dynamics (how effectively revenue and expenses are managed) interact with the subsystems.

The baseline scenario seeks to replicate the conditions in Syria and Iraq beginning in 2013 and the expansion of ISIS as an emerging state-actor. Notably the baseline scenario is absent the significant intervention of third parties through 2020. When simulated at baseline parameters, the model replicates closely—but not exactly—the exponential growth of ISIS and seizure of large amounts of territory through 2015. Geographic boundaries at this point in the baseline simulation depict ISIS stalling and failing to take the city of Allepo, yet still having a western border in Aleppo, including in Kobani. The outskirts of Homs mark its southwest border in Syria. From this border back through eastern Syria, ISIS has complete control over Deir e Zor province, Ar Raqqah province, the Ayn al-Arab sub-district and Al Hasakah province. To the east in Iraq ISIS controls all of Anbar, Ninawa, and Salah ad-Din, including

the cities of Mosul, Ramadi, Fallujha, and Tikrit. To the north ISIS fails to take any of the Kirku province and is kept out of the major cities of Baghdad and Kirkuk. Clearly this does not reflect reality. ISIS never took and held Kobani, and with the intervention of numerous state-actors not modeled in the baseline, ISIS has already lost territory by mid-2016. The baseline simulation successfully replicates the behavior mode on which the dynamic hypothesis is based. Model simulations can be discussed quantitatively in a dashboard of key stocks in the model, as in Figure 15, in addition to a qualitative narrative that amplifies the understanding provided by the dashboard.

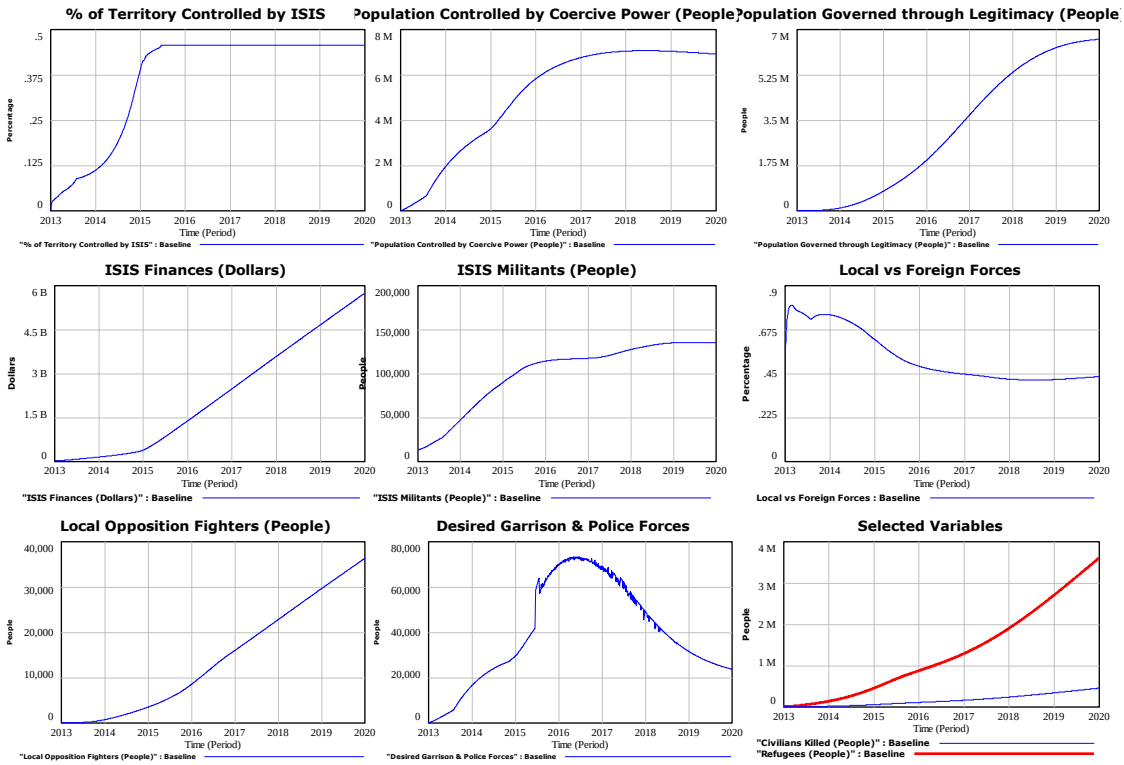


**Figure 14: Baseline Dashboard of Performance**

The narrative of this dashboard portrays what is described in the causal feedback loops earlier. ISIS is able to grow exponentially for a time by seizing territory, gaining a population that it first rules with coercive power and then shifts to legitimate government. The gains in both finances and militants aids ISIS in gaining more territory. However, as ISIS draws from global grievances, an increasing

percentage of these militants are foreigners, exacerbating the problem of local opposition fighters who , in addition to Iraqi & Syrian forces, begin resisting ISIS's rule. Over time this structure requires an increasing garrison and police force by ISIS to keep and maintain its holdings, which slows its ability to attack and gain new territory. This reaches an equilibrium point in the model at about 45% of all of Iraq and Syria (somewhere between Kobani and Aleppo in Syria and with most of Anbar in Iraq). There are nearly 8 million people underneath ISIS's rule from a conflict that has created nearly 500,000 casualties and close to 4 million refugees. Most worrisome, ISIS is creating a free cash flow measured in the billions of dollars through the black market sales of oil. Although the model does not account for where this surplus is used, it's clear that ISIS is using much of the extra cash to pursue a growth strategy through acquisition of a global network to both compete with Al-Queda and other state-actors worldwide.

## Experimentation to Test the Hypothesis

Having formed a logical construct of the hypothesis and its simulated baseline, it is worth returning to the proposed hypothesis: the Islamic State (ISIS) is an emerging-state actor which is using methods of irregular warfare to capture territory in order to influence populations ("coercive power") which it then attempts to govern in furtherance of its objective to become a functioning state ("legitimate power").

This hypothesis can be tested against the simulation model. Six propositions emerge from the hypothesis. Each can be tested quantitatively by making changes to the model as described in Table 2.

**Table 2: Proposition Tests**

| Proposition Tested | Change Summary | Subsystem & Formulation |
|---|---|---|
| Proposition 1: ISIS must take and control territory. | Remove ability to gain territory as a result of combat. | Combat Simulator Changes:<br>FLOT Movement Rate (FMR) = ((FMR Base1+FMR Base2)*"High Intensity FLOT Movement Rate (FMR) Multiplier")*Disable FLOT<br>Disable FLOT = 1 (normal) OR 0 (Proposition 1) |
| Proposition 2a: The territory must have valuable resources.<br>2b: Black market price of oil is $22/bbl | Sever link to oil production from captured territory or | Territory Subsystem Changes:<br>Available Oil Production = 5.013e+008*Disable Oil<br>Disable Oil = 1 (normal) OR 0 (Proposition 2) |

| | | |
|---|---|---|
| 2c: Black market price of oil drops to $11/bbl. | adjust price per bbl. | 2b: Price per Barrel of Oil is reduced from $45/bbl to $22/bbl & 2c: Price per Barrel of Oil is reduced from $45/bbl to $11/bbl |
| Proposition 3: The transition from coercively controlled to legitimately governed population cannot be too slow. | Increase Normal Time to Transition by 200%, 300% and 400%. | Governance & Population Subsystem Changes: Normal Time to Transition to Governance = 1 (6months) is changed to: 3a = 2 (12months), 3b = 3(18 months) 3c = 4 (24 months) and 3d= 100 (disabled) |
| Proposition 4: Local grievances are required for local recruiting. | Disable local recruiting only. | Militant Recruiting & Losses Subsystem Changes: (Recruit able Population of Controlled Population*Local Recruiting Rate*"Effect of Remaining Recruits on Local Recruiting (Opposition & Militant)")*Disable Local Recruiting<br>Disable Local Recruiting = 1 (Normal) or 0 (Proposition 4) |
| Proposition 5: Foreign recruits are required. | Disable foreign recruiting in the model. | (Actual Recruits per Suicide Attack*"Suicide Actions (Military Actions/Period)")*Foreign Recruiting Eliminated)*Bankruptcy Switch<br>Foreign Recruiting Eliminated = 1 (Normal) or 0 (Proposition 5) |
| Proposition 6: A "classical" insurgency is modeled with no transition to governance or significant foreign recruiting. | Combine Propositions 3d & 5. | See above. |

The subsequent simulation results of these experiments can be compared to the baseline performance. Significant change in the behavior mode (general shape and magnitude of behavior over time) are noteworthy, while minimal change is of little value. Initial testing identified a model boundary validation issue. The negative feedback loop characteristics of Resistance & Uprising did not seem to be creating any difference in scenarios 3a–3d, exactly where they would most logically occur. However when the model duration was extended from 2017 to 2020, these behaviors began emerging and played a significant limiting role in further growth of ISIS. Continuing boundary tests of duration out to 2050 identified additional behavior of interest emerged in 2030–2040 (ISIS was able to "regroup" and continue expanding). However, I considered this too far on the horizon to be of much practical use and instead re-ran all simulations with a new experimental duration boundary of 2020. The results of these tests are summarized in Table 3 and provide final values across four performance measures compared to the baseline.

**Table 3: Proposition Test Results**

| *Ending 2020 Values* | *Territory % Controlled* | *"Population Controlled by Coercive Power (People)"* | *"Population Governed through Legitimacy (People)"* | *"ISIS Finances (Dollars)"* | *"ISIS Militants (People)"* |
|---|---|---|---|---|---|
| ***Baseline*** | 46% | 6,916,093 | 6,623,453 | $ 5,738,208,768 | 135,069 |
| ***Proposition 1: No Territory*** | 0% | 239,010 | 235,555 | $ (42,046,628) | 5,056 |
| ***Proposition 2a: No Oil*** | 0% | 504,660 | 882,578 | $ (11,257,459) | 9,291 |
| ***Proposition 2b: Oil is $22/bbl*** | 46% | 6,922,469 | 6,641,158 | $ 2,745,061,888 | 133,984 |
| ***Proposition 2c: Oil is $10/bbl*** | 46% | 6,876,500 | 6,567,161 | $ 1,216,870,528 | 144,871 |
| ***Proposition 3a: Gain in Legitimacy 2x Slower*** | 46% | 6,912,644 | 5,533,945 | $ 5,557,155,328 | 140,954 |
| ***Proposition 3b: Gain in Legitimacy 3x Slower*** | 44% | 6,508,733 | 4,587,748 | $ 5,356,189,184 | 126,160 |
| ***Proposition 3c: Gain in Legitimacy x4 Slower*** | 28% | 5,943,307 | 3,915,551 | $ 5,164,296,704 | 54,517 |
| ***Proposition 3d: Gain in Legitimacy x100 Slower*** | 22% | 5,714,829 | 233,571 | $ 4,906,823,168 | 47,802 |
| ***Proposition 4: Disable Local Recruiting*** | 5% | 1,407,003 | 1,464,055 | $ 1,112,226,560 | 13,854 |
| ***Proposition 5: Disable Foreign Recruiting*** | 44% | 6,601,304 | 6,415,755 | $ 5,530,777,088 | 73,308 |
| ***Proposition 6: Combine Proposition #3 & #5*** | 23% | 5,767,964 | 226,966 | $ 4,890,185,216 | 33,360 |

The evidence for Propositions 1 & 2a indicates that an emerging-state actor must take territory upon which some valuable resource exists. However, the performance of 2b & 2c indicate that the resource need not be all that valuable relative to the expenses of maintaining the emerging-state actor. ISIS still performs just as well when black market oil sells for $22bbl and $11bbl respectively vs. $45bbl. The reasons are two fold. The cost of ISIS operations is very low relative to the incoming revenue. This should come as no surprise, as insurgencies have been funding themselves on shoestring

budgets for decades. However, the value of the resource relative to the expenses allows fast growth early on in the emerging-state actor life cycle. Once it has gained a sufficient Controlled Population and begun shifting it to Governed by Legitimacy, the resource revenues become less important to local operations. This allows the emerging-state actor to take the surplus funds provided by the valuable resource and begin expansion operations abroad. By 2020, even with lower oil revenues, ISIS still achieves significant performance according to the model. It holds only slightly less cash reserves, though still measured in billions. Though beyond the scope of this paper, the following questions arise: do emerging-state actors emerge in regions of low governance regions with valuable territorially controllable resources because the incentive is higher? Or do we only know of emerging-state actors in these areas because the lack of resources tends to cripple emerging-state actors from governing openly early on? Future research might consider whether classical insurgents desire to act more openly but adapt to clandestine activities out of necessity.

Propositions 3a–3d confirms that the time it takes to transition from coercive power to legitimate power is important, but there some range within 6 (baseline), 12 (3a) and 18 (3b) month transitions still allows ISIS to grow rapidly. However, periods of 24 months (3c) and higher (3d) sharply reduce performance. Propositions 4 & 5 confirm that both local recruiting and foreign recruiting are essential. Although it may not be surprising that local recruiting is essential, the significant difference foreign recruiting makes in comparing Proposition 5 performance to the Baseline is noteworthy. Finally, although the "classical insurgency" (6) generates a large area of coercive influence and significant cash––primarily because the territory ISIS controls produces oil—it only controls half of the territory of the emerging-state actor model, and less than a quarter of the militants under arms.

This performance of Proposition 6, depicting a classical insurgency, is worth comparing in greater detail to the hypothesis that ISIS is an emerging-state actor. We can explore this by replicating

the dashboard of charts previously used, but also plotting both the Baseline and Proposition 6 in the same dashboard format used in Figure 15. Both simulations are initialized with the same parameter values, matching actual starting conditions of 2013. Both simulations are run absent of significant third party intervention in Iraq or Syria through 2020.

In the Baseline and Proposition 6 simulations ISIS expands to roughly the same territorial extent, where both simulated ISIS entities stall, failing to advance further. Although in the Baseline simulation ISIS is able to maintain this territory and even grow its militant base, in the simulation of Proposition 6 ISIS begins declining from 2017 onward and then collapsing between 2019–2020. This collapse is caused by external pressure of Syrian and Iraqi forces, as well as internal uprisings of local opposition fighters who attack ISIS's existing holdings. The quantitative depiction of this stall and collapse is depicted in Figure 16, with a narrative provided afterwards.

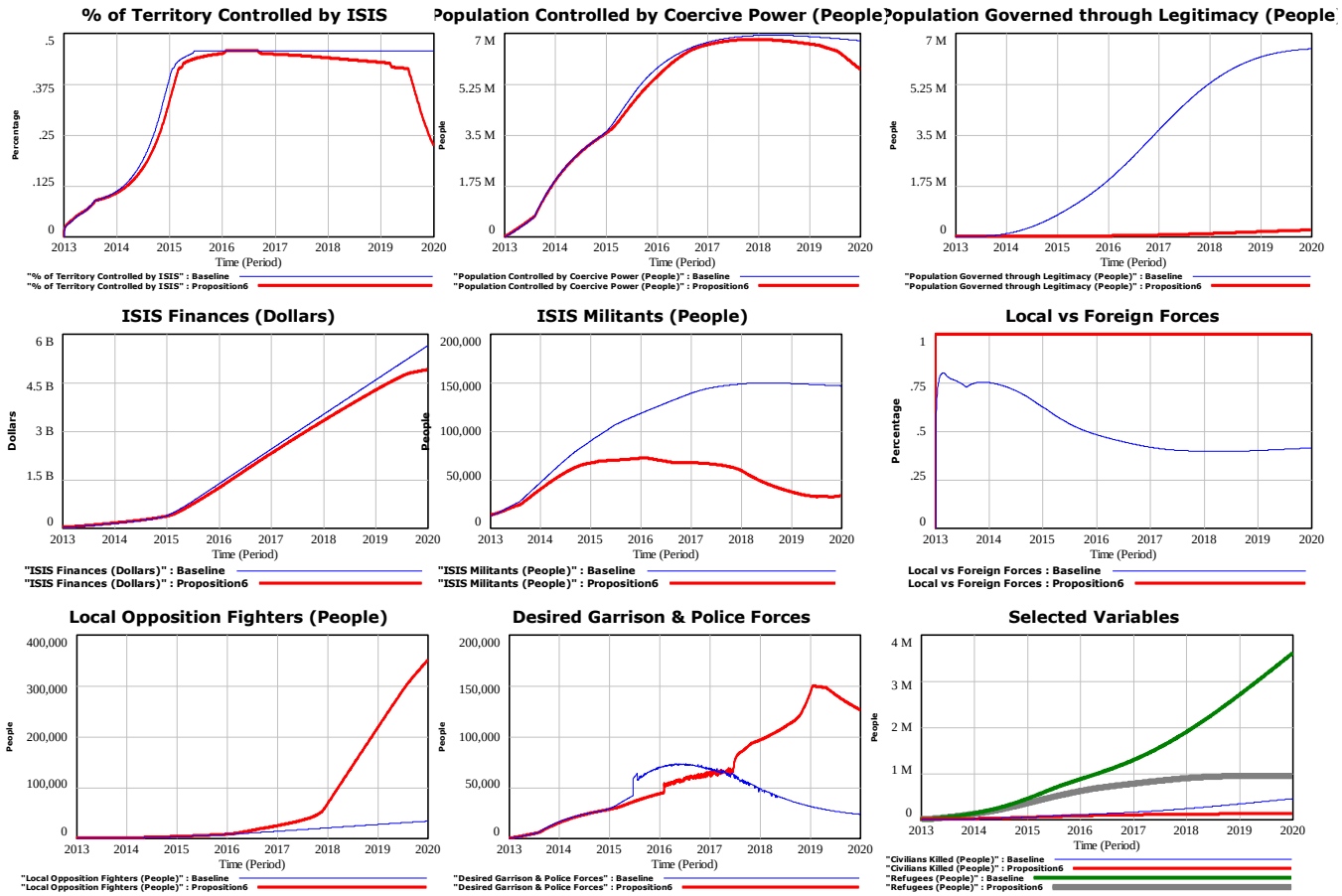


**Figure 15: Dashboard Performance Baseline (Emerging-State Actor) vs. Proposition 6 (Classical Insurgency)**

The graph narratives are of emerging-state actor ISIS holding onto its gained territory, as well as its controlled population, primarily because its militant base is higher than in the classical insurgency of Proposition 6, which loses nearly half of the gained territory. The Baseline behavior occurs because the emerging-state actor ISIS is attracting foreign fighters. Even though these foreign fighters cause friction, which results in a higher need for garrison troops in occupied territories, the steady flow of fighters ultimately provides enough troops to supply those garrison requirements. This reduces local opposition. The resistance peaks early and begins declining due to the shift from coercive to legitimate governmental power. The classical insurgency test of Proposition 6 shows that ISIS would gain territory and population quickly as a local-only force. However, without being able to draw in foreign recruits or

transition to a governing system, ISIS would struggle to garrison an ever-increasing restive population. Eventually, the insurgency cannot garrison sufficiently and a mass uprising breaks out in late 2017, resulting in the loss of the territory. It is possible that AQI suffered a scenario such as this in 2006, rapidly gaining control of nearly one million civilians, but unable to garrison sufficiently or transition to a governing system because they remained clandestine. The rapid decline of ISIS in the Proposition 6 model bears similarities to the AQI collapse in 2006, as the Anbar Awakening provided just the kind of massive backlash indicated by this model. However, it should be clear, this model does not simulate AQI or the conditions in 2006, and there were many other conditions which occurred simultaneously with the Anbar Awakening.

# Policy Tests to Contain ISIS

## Best Case Tests

With some understanding of the theory of emerging-state actors, we can shift to policy analysis. What available and politically plausible policies will contain or defeat an emerging-state actor like ISIS?

The model is set to enable policy testing against the Strategic Architecture. Currently debated policies on how to confront ISIS are stated below in the form of how they might affect resource dynamic flows into the key resource stocks. These only include politically viable policies, so a full-scale ground invasion by US forces is ruled out:

1. Do nothing.
2. Attack ISIS's oil production (BPD) and work to reduce the effectiveness of oil smuggling ($ per BPD) in order to decrease the inflow of revenue to ISIS Finances.
3. Convince allies not to pay ransoms for ISIS hostages to decrease the inflow of revenue to ISIS Finances.
4. Embed military advisers and personnel to improve the fighting quality via a boost to morale and experience of forces opposing ISIS, and to increase the outflow of ISIS Militants (killed or capture), and decrease the rate at which Territory is Controlled by ISIS.
5. Work to reduce the effectiveness of foreign recruiting to reduce the inflow to ISIS Militants.

6. Supply opposing forces with advanced military equipment improving their capabilities (Weapon Values) in order to increase the outflow of ISIS Militants (killed or capture) and decrease the rate at which Territory is Controlled by ISIS.
7. Leverage close air support missions to aid opposing forces engaged in combat with ISIS, in order to increase the outflow of ISIS Militants (killed or capture) and decrease the rate at which Territory is Controlled by ISIS.

One type of policy analysis available is a "hypothetical best case" scenario. These policies are tested without realistic operational constraints and begin at 2013. These best case results can then be compared to the baseline, which is the policy of "do nothing." If even the "'best case" scenario does not perform better than the baseline, it is unlikely to do so when realistic operational constraints and an implementation timetable is placed upon it. The hypothetical tests involve arbitrarily setting parameters in the model to the values indicated in Table 1.

**Table 4: Hypothetical Best Case Policy Tests Summary**

| Proposition Tested | Hypothetical Best Case | Subsystem & Formulation |
|---|---|---|
| Policy 1: Do nothing. (Baseline) | No Changes | No Changes |
| Policy 2: Attack ISIS's oil production (BPD) and work to reduce the effectiveness of oil smuggling ($ per BPD) in order to decrease the inflow of revenue to ISIS Finances. | Sever link to oil production from captured territory. | Territory Subsystem Changes:<br>Available Oil Production = 5.013e+008*Disable Oil<br>Disable Oil = 1 (normal) OR 0 (Proposition 2) |
| Policy 3: Convince allies not to pay ransoms for ISIS hostages to decrease the inflow of revenue to ISIS Finances. | Sever link to ransom revenue creation. | Revenue Subsystem Changes:<br>IF THEN ELSE (Time>Policy Intervention Time, Ransom Elimination,1)<br>Ransom Elimination = 1 (normal) OR 0 (Policy3) |
| Policy 4: Embed military advisers and personnel to improve the fighting quality via a boost to morale and experience of forces opposing ISIS, in order to increase the outflow of ISIS militants (killed or capture) and decrease the rate at which territory is controlled by ISIS. | Increase Blue Force Morale by 25% and Blue Force Average Experience by 1 Year. | Territory Subsystem Changes:<br>Moral Effect = IF THEN ELSE(Time>Policy Intervention Time,"Embed US Advisers (Morale)",0)<br>Embed Us Advisors (Morale) = 0 (Normal) OR .25 (Policy4)<br>Experience Effect = IF THEN ELSE(Time>Policy Intervention Time,"Embed US Adivsers (Experience)",0)<br>Embed US Advisors (Experience) = 0 (Normal) or 1 (Policy4) |
| Policy 5: Work to reduce the effectiveness of foreign recruiting to reduce the inflow to ISIS Militants. | Disable foreign recruiting in the model. | (Actual Recruits per Suicide Attack*"Suicide Actions (Military Actions/Period)")*Foreign Recruiting Eliminated)*Bankruptcy Switch<br>Foreign Recruiting Eliminated = 1 (Normal) or 0 (Proposition 5) |
| Policy 6: Supply opposing forces with advanced military equipment, improving their capabilities (Weapon Values) in order to increase the outflow | Increase Weapons Value for Blue Forces by 25%. | Situational Force Scoring Subsystem:<br>SFS Avg Blue Inf WEI/WUV = 1+Supply Better US Equipment<br>Supply Better US Equipment = 0 (Normal) .25 (Policy |

| | | |
|---|---|---|
| of ISIS Militants (killed or capture) and decrease the rate at which territory is controlled by ISIS. | | 6)<br>The same change is applied to Avg Blue Heavy Weapons & Artillery. |
| Policy 7a & 7b: Leverage close air support missions to aid opposing forces engaged in combat with ISIS, in order to increase the outflow of ISIS militants (killed or capture) and decrease the rate at which territory is controlled by ISIS. | Increase overall Blue Force Combat Strength by 10% for 7a and 50% for 7b representing minimal and intensive support. | Blue Force Strength = (SFS Blue Heavy Weapons Situational Strength+SFS Blue Indirect Attack Situational Strength+SFS Blue Infantry Situational Strength<br>)+((SFS Blue Heavy Weapons Situational Strength+SFS Blue Indirect Attack Situational Strength+SFS Blue Infantry Situational Strength<br>)*Ground Support Campaign Start)<br>Ground Support Campaign Start = IF THEN ELSE(Targeting Switch=0,US Airpower Support Step Height,0)<br>Airpower Support Step = 0 (normal) 1.1 (7a minimal campaign) and 1.5 (7b intensive campaign) |

These tests are also implemented with zero ramp up time and beginning at the start of the simulation in 2103, unrealistic in the real world but simplified for purposes of evaluating if these polices could ever be successful.

The results of these tests are summarized in Table 1 that provides final values across four performance measures compared to the baseline.

**Table 5: Hypothetical Best Case Results**

| *Ending 2020 Values* | *Territory % Controlled* | *"Population Controlled by Coercive Power (People)"* | *"Population Governed through Legitimacy (People)"* | *"ISIS Finances (Dollars)"* | *"ISIS Militants (People)"* |
|---|---|---|---|---|---|
| ***Baseline*** | 46% | 6,916,093 | 6,623,453 | $ 5,738,208,768 | 135,069 |
| ***Policy 2*** | 0% | 720,020 | 1,141,213 | $ (11,855,729) | 11,206 |
| ***Policy 3*** | 46% | 6,747,141 | 6,473,906 | $ 5,710,391,296 | 146,514 |
| ***Policy 4*** | 46% | 6,636,047 | 6,243,996 | $ 5,045,048,320 | 153,598 |
| ***Policy 5*** | 46% | 7,072,286 | 6,731,906 | $ 5,821,407,744 | 80,085 |
| ***Policy 6*** | 46% | 6,695,826 | 6,384,421 | $ 5,446,244,864 | 149,387 |
| ***Policy 7a*** | 46% | 6,748,507 | 6,475,611 | $ 5,676,901,888 | 146,468 |
| ***Policy 7b*** | 46% | 6,748,507 | 6,475,611 | $ 5,676,901,888 | 146,468 |

Only two policies in the best case scenario create meaningful change. The first is Policy 2, the complete reduction of oil revenue from the beginning hamstrings ISIS's performance. The second, Policy 5, eliminates foreign recruits, leaving ISIS with just over half the militants as in the baseline, but at one of the largest controlled populations. This seemingly paradoxical result is explained in more detail below. Even though the remaining policies all seem to end at about the same place, the behavior patterns over time show that some of these policies have delayed the pace at which ISIS expanded as shown below in Figure 6 comparing policies 3 and 4 and 6 and 7b with the baseline in terms of % of territory controlled by 2020. However this is simply delaying the inevitable, as in all scenarios ISIS has reached its natural limit of territorial gain at about 47% of Syria and Iraq by 2016.

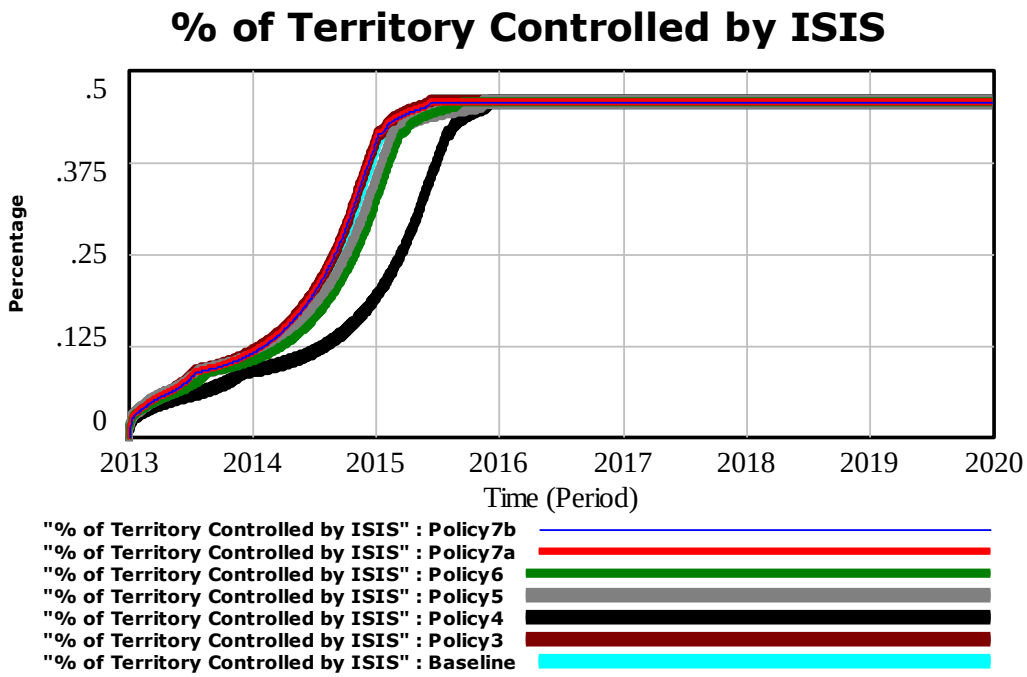


**Figure 16: Pct of Territory Controlled in Select Policy Scenarios**

A few insights are gained even from this unrealistic best case scenario tests. Some policies actually improve ISIS's position while others only delay the inevitable, and only one policy significantly changes the outcome (Policy 2). Insights from these results are discussed below as a Foreign Recruiting Dilemma and Partial Measures Paradox.

## The Foreign Recruiting Dilemma

The results for Foreign Recruiting (Policy 5) are surprising, as it leaves ISIS in a stronger position, even with fewer militants. This can be explained by looking at Average Militant Experience, which is a tracking co-flow of ISIS militants and places it next to percent of Local vs. Foreign Troops that tracks the mix of locally recruited ISIS fighters versus Foreign Recruits from abroad.

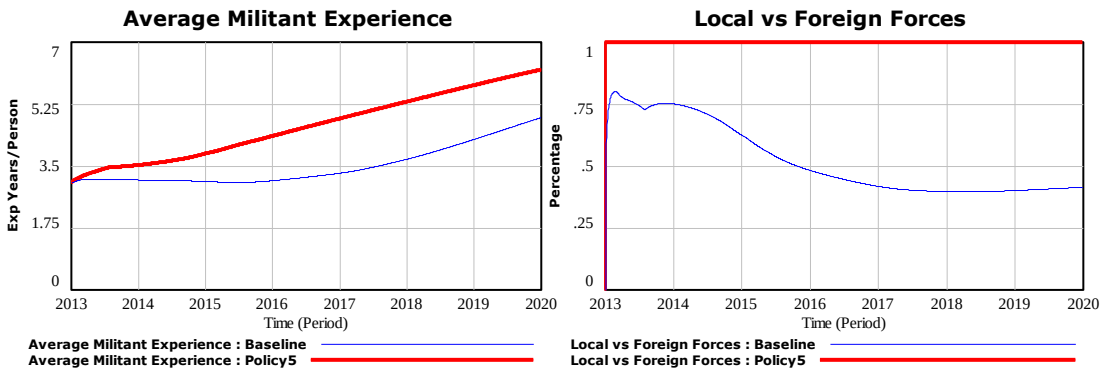


**Figure 17: Foreign Recruiting Dilemma**

The more foreign recruits ISIS has, the lower its Average Militant Experience will be as the foreign recruits arrive. Since the Average Militant Experience drives combat performance, recruiting performance, resource exploitation, transition to governance, and more, the more skilled ISIS is in terms of the Average Militant Experience, the better it performs. When Policy 5 eliminates foreign recruits by 100% the loss in manpower is more than made up for by the improvement in other factors that drive ISIS's performance. This is not to say there are not very valid reasons for seeking to stem the flow of foreign recruits, such as they may return from whence they came, now militarized. Such factors and considerations are beyond the scope of this model.

## The Partial Measures Paradox

Policy 4 (embed advisors) and Policy 6 (supply weaponry) result in ISIS controlling less population, but having more militants by the end of the scenario. This is explainable by the Partial Measures Paradox, an important dynamic that can emerge in many policy tests. In essence, the Partial Measures Paradox shows that by slowing ISIS down early, it keeps them from growing too fast and contains them to territory that is more favorable to their causes both in terms of socio-ethnic demographics and resource extraction. This actually allows them to gain more recruits and resources

earlier than they would have by growing rapidly and overextending themselves into less favorable areas, which require more garrisons and provides less recruits. The temporary setback to territory gain is reversed when ISIS has increased its manpower and finances, and now stronger than it would've been originally, it performs better over time in the ensuing territories. This can be demonstrated in a few charts narrowed in on a timeline 2014–2016, the key period where this paradox emerges.

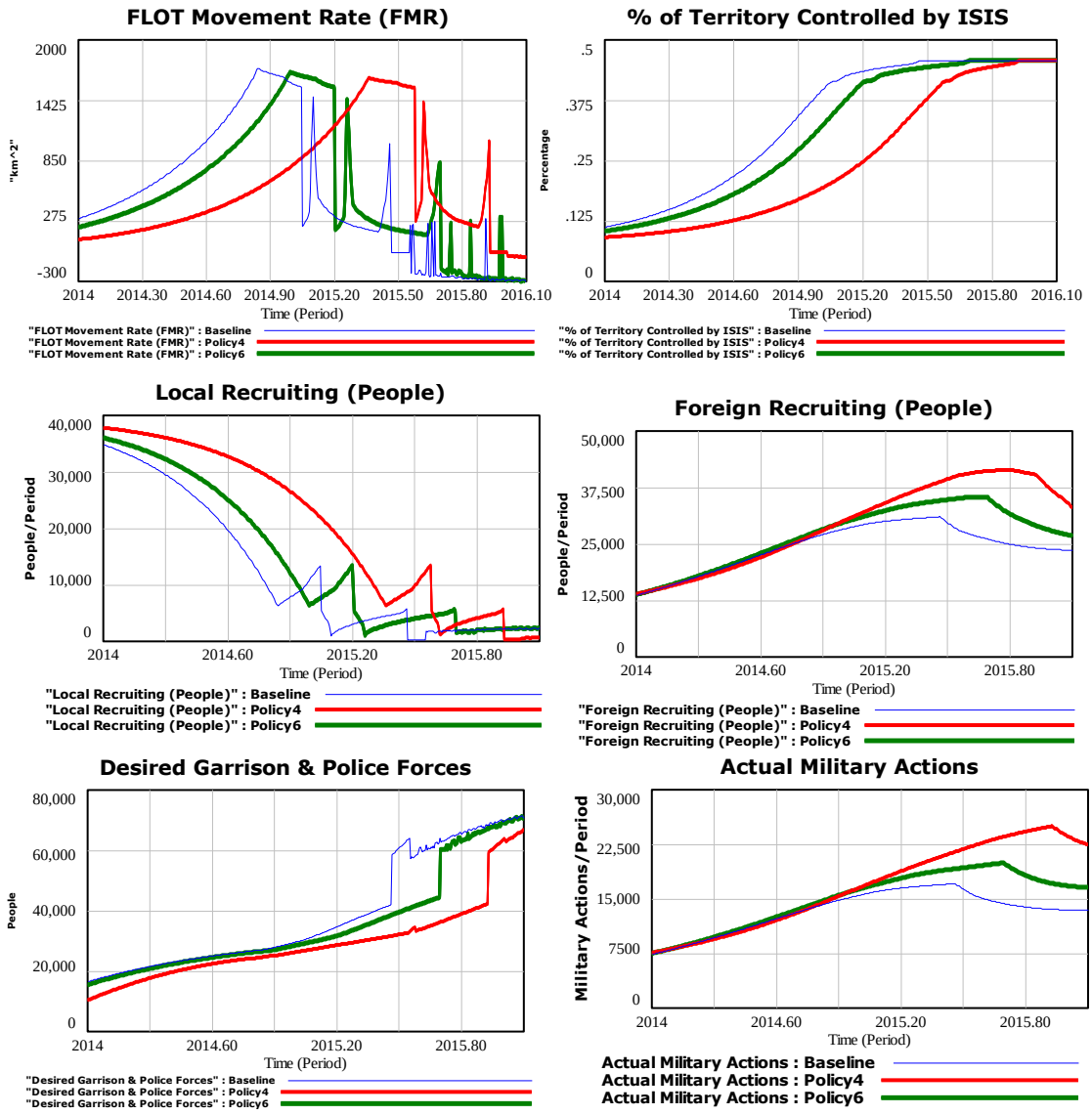


**Figure 18: Partial Measures Paradox 2014-2016**

First, as expected we see that Policy 4 and Policy 6 both limited ISIS's Forward Movement Rate due to the marginally increased combat effectiveness provided by U.S. support via embedded advisors and advanced weaponry. This is reflected in the decreased amount of territory controlled by ISIS. However, the local recruiting and foreign recruiting are both higher, as the areas ISIS controls are more favorable. Likewise the desired garrison and police forces are lower, which in turn allows for more military actions. In the long run, the larger militant force will gain experience earlier than would have occurred in the baseline scenario, allowing ISIS to outperform what would have occurred had they been allowed to expand beyond their favorable areas early on. Finally, when the U.S. supplies the Blue Force (the opponents of ISIS) with more powerful weapons, as ISIS gains a portion of that equipment through scavenging on the battlefield, they gain that improved combat effectiveness.

## Portfolio Analysis with Operational Constraints

Another form of policy test that can be conducted on the model is to simulate a basket of policy options, selecting a timing window and with operational constraints that are realistic. We know that Policy 2, attacking the ISIS oil infrastructure stopped ISIS's growth in its track in the hypothetical best case scenario, but this policy assumed a one hundred percent successful destruction of ISIS's nascent oil infrastructure in 2013, well before ISIS was considered a serious national security threat. However, at the point the U.S. began its air campaign against ISIS during the Anbar offensive of 2014, would combining additional policies with targeting oil production via an air campaign have resulted in reversing or containing ISIS's growth? Or will it result in a version of the partial measures paradox?

In this portfolio analysis, Policies 2, 4, 6, and 7 are combined. This scenario is equivalent to a U.S. and Coalition air campaign that targets both ISIS oil infrastructures as well as provides close-air support to Blue Forces. In addition, U.S. advisors are embedded with Blue Forces and advanced U.S.

weaponry is supplied to Blue Forces. This is not an implausible scenario to simulate, as it accounts for a significant intervention, but well short of a full-scale invasion that would be politically untenable. The intervention date is set at June of 2014, the actual point in which U.S. military intervention began with an air campaign against ISIS. Since Policies 4 and 6 are not in conflict, they can be tested as they were individually above. However, policies 2 and 7 both rely on air assets to conduct different missions, where one is the targeting of ISIS oil infrastructure, and the other a close-combat support of Blue Forces. These options are further constrained by significant U.S. airpower can be projected into the region. The current rate of air strikes is roughly 10 per day roughly split between Iraq and Syria (see Appendix B on Airpower). Furthermore, an air strike targeting a modular oil refinery takes about between 300–500 BPD of production. How many air strikes are needed to significantly impact ISIS's oil production? And would that level of airpower detract from the ability to provide close ground support?

To test these parameters three activity levels will be set for airpower: 10 per day to indicate today's policy, 100 per day to indicate a ten-fold increase in operational tempo, and 500 per day to indicate a theoretical maximum sustained operational tempo for a significant period of time. [27] Furthermore the air strikes will target ISIS oil production 100% until it is destroyed, and then shift into a ground support role. This is based off the knowledge that eliminating ISIS's oil revenue was a key factor in reducing its growth under the hypothetical best case scenario. Parameters are indicated in Table 3. All policies include embedding U.S. troops as advisors and supplying weaponry as per Policies 4 and 6 previously, and all policies begin with an intervention date in the model of June 2014 (2014.5).

**Table 5: Portfolio Policy Analysis Air Campaign Parameters**

| Scenario | Strikes/Day | Strikes vs. Oil Production until Destroyed | Combat Effectiveness increase from Ground Support Airpower after Oil |
|---|---|---|---|

[27] This tempo was established and maintained for 10 weeks in the late 1990's Kosovo Air Campaign. The largest single-day airpower attack in modern history was the first day of the invasion of Iraq where 1200 strikes were carried out in a single day. This is not considered sustainable long term.

| | | | Destroyed |
|---|---|---|---|
| Policy 8 Minimal Air Campaign | 10/day | 10/day | 1% |
| Policy 9 Significant Air Campaign | 100/day | 100/day | 10% |
| Policy 10 Intensive Air Campaign | 500/day | 500/day | 50% |

We can now compare these portfolio policies against the baseline performance against the original dashboard used above.

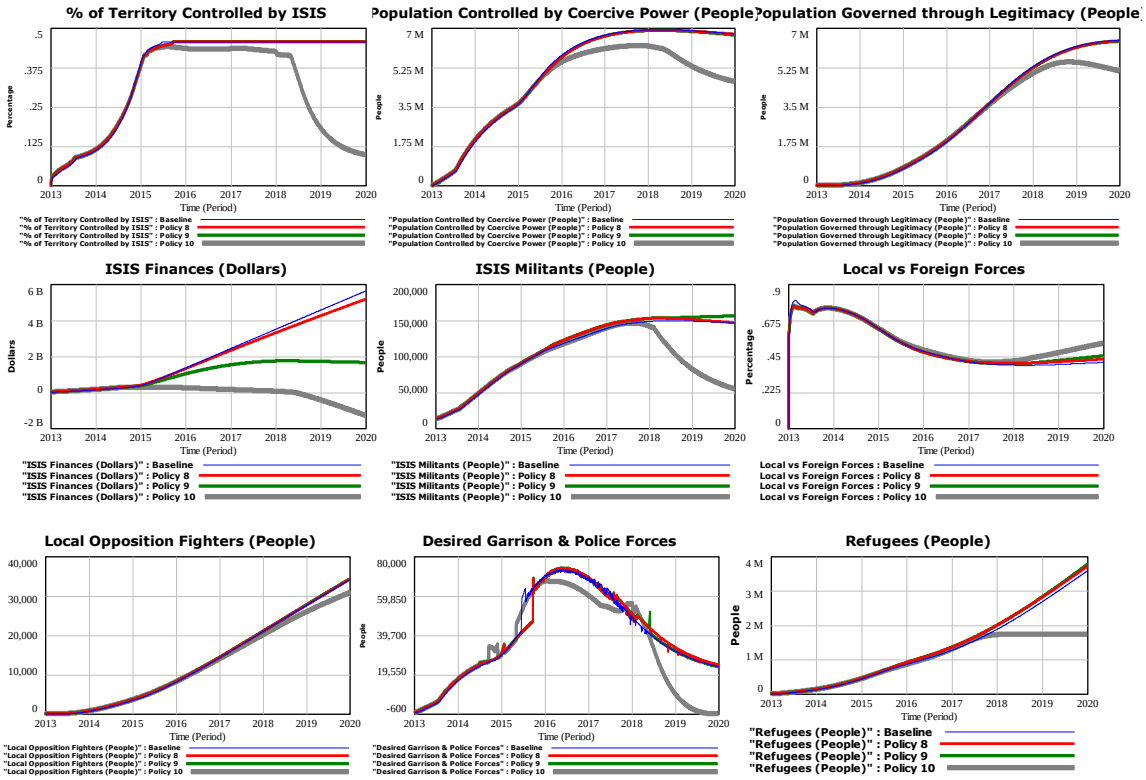


**Figure 19: Portfolio Analysis with Operational Constraints Implemented at 2014.5**

In narrative, both Policies 8 and 9 struggle to materially impact the conflict. This is because the rates of strikes per day against the oil production are insufficient to destroy it completely over the length of the simulation. Only Policy 10, at a 500 strikes per day tempo can both destroy the oil production and then subsequently shift to support the ground war with air strikes. As a result, only Policy 10 shows ISIS being pushed back, its population under control reduced, number of militants depleted. Even with a

smaller population to control, Policy 10 still shows a significant amount of local opposition fighters that ISIS must now combat. In summary, the results are better, but not ideal. How is it that a combination of effective policies performed little better than any one single policy? The reason is threefold: the partial measures paradox, timing, and overlapping targets. As the partial measures paradox has been discussed above, focus now turns to matters of timing and overlap of targets.

## Policy Timing

With an emerging-state actor like ISIS there are windows of opportunity that have the maximum effect. These windows exist prior to the significant acquisition of territory that grants them access to exploitable resources and population to control and then seek to govern. To illustrate the importance of timing, the set of same policy interventions as Policy 8 can be moved back to 2013.5, relabeled "Policy 8 Early" and compared against Policy 10 begun in 2014.5. Policy 9 Early, Policy 10, and the baseline are now compared in the dashboard set of graphs.

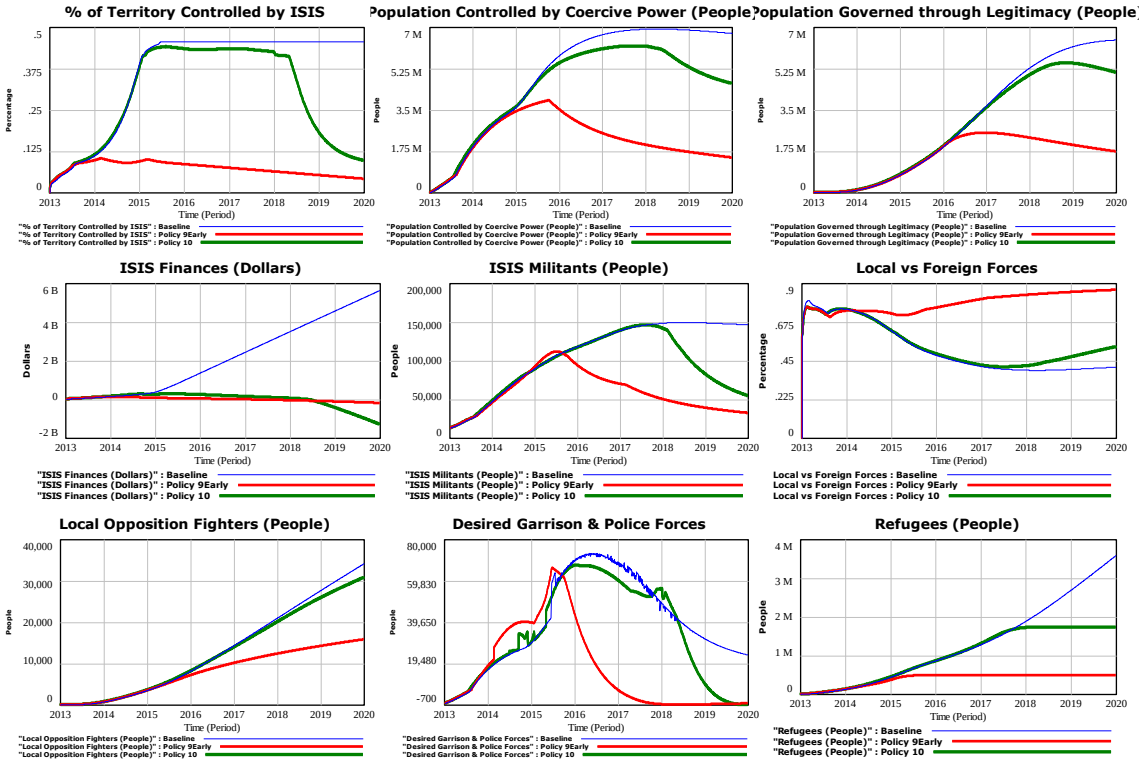


**Figure 20: Comparison of Significant Air Campaign at 2013.5 vs. Intensive Air Campaign at 2014.5**

As can be seen in Figure 10, even though the Significant Air Campaign of Policy 9 conducts only a fifth of the sorties as the Intensive Campaign, because it begins earlier in 2013.5 vs. 2014.5; Policy 9 has a greater impact on the dynamics of the overall conflict. ISIS's oil production, which is smaller, is destroyed more quickly, allowing air assets to switch to ground combat support. Even though these are only one-fifth of the strikes of the more detailed policy, because they are occurring earlier this ground combat support is preventing ISIS from gaining more territory. As ISIS cannot gain territory, it cannot gain more oil resources, populations to recruit from, militants, or other benefits. This is reflected in the sharply weaker performance of ISIS in Policy 9 across many of the charts. However, the analysis would also reflect that because ISIS was never able to conduct a foreign recruiting campaign by launching suicide bombing and IED attacks, the number of foreign recruits remains low relative to the population. This means that what populations ISIS does control are easier to garrison and police than in other scenarios where more of their force is composed of foreign fighters. Timing therefore is crucial for

policy consideration, and the earlier the better with an opponent who seeks to gain power through territorial conquest as an emerging-state actor like ISIS would.

### POLICY OVERLAP

A second challenge to the set of policies is overlap of targeting factors. All three policies aim at combating the power of the opposition: embedding U.S. troops to bolster experience and morale, equipping opposition forces with modern U.S. weaponry, and providing close combat support. In combat, more ISIS forces are destroyed relative to how many would have been, and this reduces ISIS militants through the outflow of losses. Unfortunately unless the support is sufficient to actually enable the opposing forces to prevail over ISIS, the effect is not enough. The same ISIS militant can only be killed or detained once, whether by a more experienced and higher morale soldier, through better equipment, or U.S. combat airpower.

## Incremental Knowledge Gain

Conducting a limited suite of policy intervention evaluations does reveal key insights into conducting interventions against emerging-state actors. Exogenous factors can provide only an incremental setback for the emerging-state actor until territory is taken away from them, and they are challenged to overcome the reinforcing feedback loops from which an emerging-state actor benefits. Because an emerging state actor relies on few exogenous factors for its success, there are only limited avenues to "harm" an actor like ISIS from outside its operative territory. Except for a minimal amount of foreign donations and the flow of foreign recruits, all other key resources ISIS relies upon to be successful can be found within the territory they control. It follows that only the retaking of this territory, in some manner that disrupts the ability of an emerging state actor to govern, will lead to conditions that may enable changing the dynamic of behavior. But taking territory severs the key feedback loops that make emerging state actors different—and more dangerous—than a classic insurgent non-state actor. This is a

key difference to understand from a policy standpoint between classic non-state actor insurgents and emerging state actors such as ISIS.

## Conclusion

The hypothesis that the Islamic State is an emerging-state actor using the means of irregular warfare to usurp existing state-actors to gain control of target populations is considered plausible, though not proven, by the limited initial simulation tests conducted in this paper. The policy analysis shows the differences in performance of an emerging-state model and a classical insurgency model. Calling upon global rather than local grievances the emerging-state actor draws foreign fighters and seizes territory upon which it exercises sovereign control and begins openly governing. The use of governing mechanisms shifts the population from being controlled by coercive power to being governed by legitimacy, freeing up garrison troops to continue expansion and territorial gain. The dynamic hypothesis of an emerging-state actor is better able to explain ISIS's behavior pattern than traditional insurgency models. These propositions not only define the Islamic State but also form the basis of a theory of emerging-state actor conflicts.

Intervention policies against emerging-state actors can be simulated in isolation, in combination, and at different timing windows. Evaluation of these policies yields key insights into the dynamics of intervention against these actors and the dilemmas policy planners face and militaries may encounter when executing interventions. Reducing or degrading ISIS's capabilities from abroad is made exceedingly difficult because the majority of their resources are generated from within the territory they control. There are few levers to pull from outside this territory, as any efforts that end up being diluted into partial measures risk leaving ISIS in a better position than when it started. Additionally, how interventions are timed is critical in that those timed after the acquisition of territory have significantly less effect than prior to territorial gain. Finally, that many policies overlap over the same form of target.

Attempting to kill an ISIS militant means that even a portfolio of policies may not have an aggregate effect equal to the sum of its parts.

This paper creates a detailed scenario-based simulation model allowing for future policy testing of what interventions might help contain or mitigate the growth of ISIS and other emerging-state actors. It can also provides a basis for more experiments and examination of behavior of emerging-state actors as well as insurgency non-state actors over time.

Limitations related to modeling choices are covered at the conclusion of the Appendix B. Theoretical limitations exist in that there may be other equally plausible explanations for ISIS's performance that are localized to Syria and Iraq, such as the existing sectarian and ethno-social tensions ISIS is able to capitalize upon. If these conditions are enabling ISIS's growth, the theory presented here may not be transferable to other regions that do not reflect such a fractured environment. Additional limitations lie in the model boundaries selected as discussed in the slicing section of the paper. As indicated, even in the initial tests, adjusting the duration boundary from 2017 to 2020 revealed interesting behavior. Since all models are reflective of these modeling choices, simulations made outside the boundaries may point to different causes. Finally, there is no mental model of the behavior or ideation of the participants, be they ISIS militants, foreign recruits, Blue Force conscripts, or opposition local fighters, and this may overlook significant factors of agent motivation.

For policy analysis, limitations include that the policies selected for analysis were not comprehensive of all possible policies and combinations, but instead selected to illustrate key dynamics and insight. In some cases, parameter values were arbitrarily chosen to represent the policies. Combinations of different policies, or tested with different parameters, could yield contrary results. Finally, there is no mental model of the behavior or ideation of the participants in the simulation model.

Introduction of foreign-national troops, even as advisors, could engender significant local distrust and may result in a dramatic change from the performance of a policy discussed above.

Future work with this theory could involve resolving the above weaknesses and improving policy analysis fidelity by including more accurate parameterization, like a “flight simulator” user controller to enable construction of different policy options as well as optimization testing to cover a broader policy space with thousands of permutations rather than a handful. The SFS Combat Simulator sector and Territory sector represent a novel approach to resolving both high fidelity combat simulation and geospatial detail in system dynamics model. This is worth additional exploration and explanation as noteworthy contribution to simulation modeling methodology for conflict models.

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# Appendix A – Model Structure Overview & Equations

Each model sector is represented first via a visual overview of the structure followed by the complete list of equations. Overall simulation control parameters are:

(001) FINAL TIME = 2020
Units: Period
The final time for the simulation.

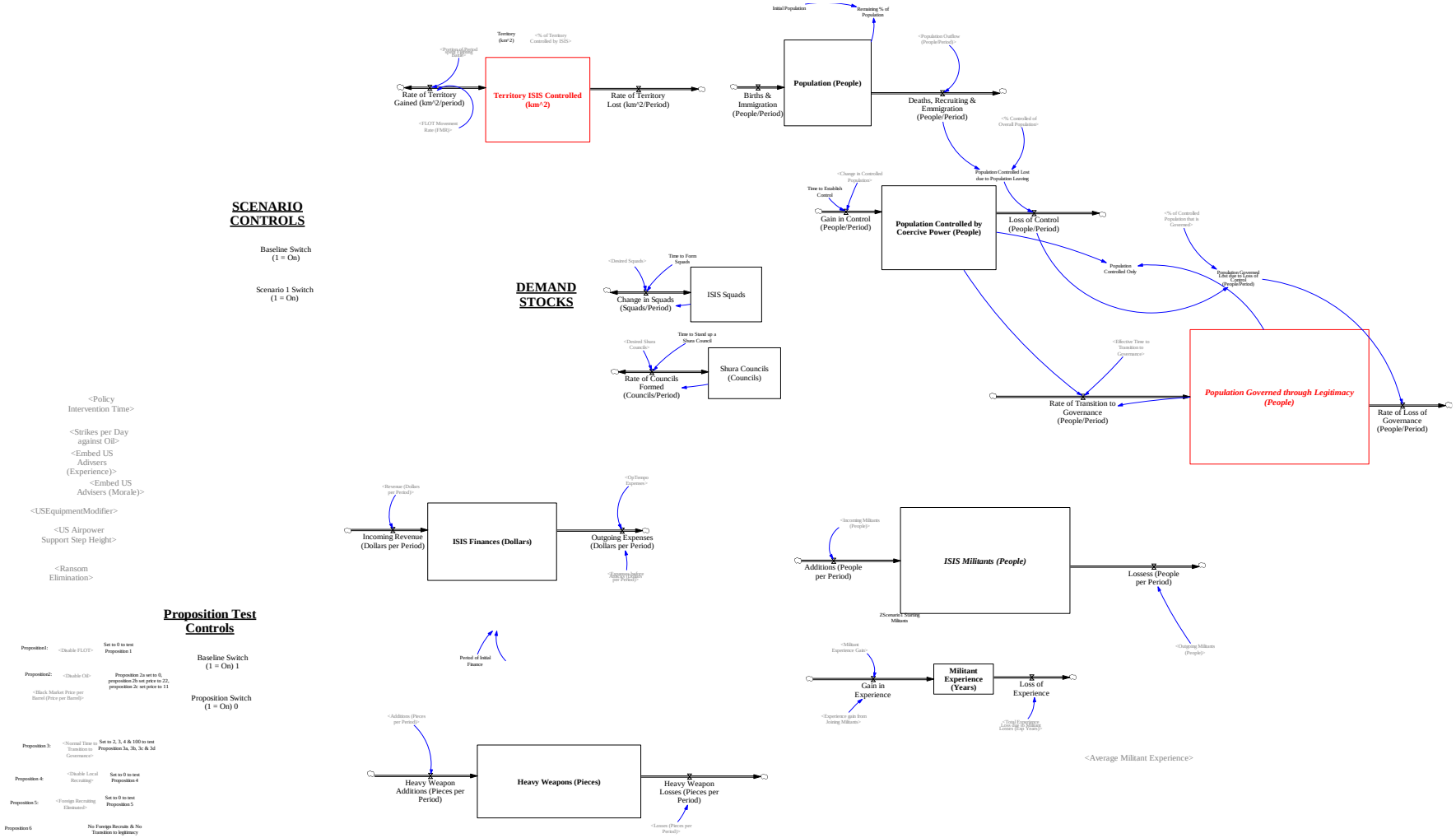
(002) INITIAL TIME = 2013
Units: Period
The initial time for the simulation.

(003) SAVEPER =
TIME STEP
Units: Period [0,?]
The frequency with which output is stored.

(004) TIME STEP = 0.0055
Units: Period [0,?]
The time step for the simulation.

**********

# *Resource Strategy Map Sector Structure*

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## *Resource Strategy Map Sector Equations*

(005) "% Controlled of Overall Population"=
ZIDZ("Population Controlled by Coercive Power (People)", "Population (People)")
Units: Fraction

(012) "% of Controlled Population that is Governed"=
ZIDZ("Population Governed through Legitimacy (People)","Population Controlled by Coercive Power (People)")
Units: Fraction

(017) "% of Territory Controlled by ISIS"=
"Territory ISIS Controlled (km^2)"/"Territory (km^2)"
Units: Percentage

(024) "Additions (People per Period)"=
"Incoming Militants (People)"
Units: People/Period

(025) "Additions (Pieces per Period)"=
Heavy Weapons Looted
Units: Pieces/Period

(037) Average Militant Experience=
ZIDZ("Militant Experience (Years)","ISIS Militants (People)")
Units: Exp Years/Person

(039) "Baseline Switch (1 = On) 1"=
1
Units: Dmnl

(040) "Baseline Switch (1 = On)"=
0
Units: Dmnl

(044) "Births & Immigration (People/Period)"=
0
Units: People/Period

(068) Capability of Military Actions based on Squads=
ISIS Squads*Normal Military Capability of Squads
Units: Military Actions/Period

(070) Change in Controlled Population=
ISIS Controlled Population-"Population Controlled by Coercive Power (People)"
Units: People

(071) "Change in Squads (Squads/Period)"=
(Desired Squads-ISIS Squads)/Time to Form Squads
Units: Squads/Period

(094) "Deaths, Recruiting & Emmigration (People/Period)"=
"Population Outflow (People/Period)"
Units: People/Period

(103) Desired Shura Councils=
("Population Governed through Legitimacy (People)"+Ungoverned Population)/Normal Ratio of Shura Councils to Population
Units: Councils

(104) Desired Squads=
("ISIS Militants (People)"-Actual Garrison)/Normal Size of Squad
Units: Squads

(108) Disable FLOT=
1
Units: Dmnl
Used to test Proposition 1. Normal value =1 , disabled value = 0.

(110) Disable Local Recruiting=
1
Units: Dmnl
Normal value is 1, set to 0 to test Proposition 4.

(111) Disable Oil=
1
Units: Barrels/Period
Used for Proposition 2 - normal value =1, disabled value = 0

(124) Effective Time to Transition to Governance=
Normal Time to Transition to Governance*Effect of Shura Council Sufficiency on Transition to Governance
Units: Period

(125) "Embed US Adivsers (Experience)"=
1
Units: Exp Years
0 is normal. 1 is the increase in average Exp Years due to having US troops embedded.

(126) "Embed US Advisers (Morale)"=
0.25
Units: Dmnl

0 is normal. .25 is nominal additional morale factor for US troops being embedded.

(132) "Expenses before Attacks (Dollars per Period)"=
"Administration & Governance Expense (Dollars per Period)"+"Death Benefits (Dollars per Period)"+"Detention Benefits (Dollars per Period)"
+"Media Border Security & Other Expenses (Dollars per Period)"+"Military Procurement (Dollars per Period)"
+"Payroll (Dollars per Period)"
Units: Dollars/Period

(137) Experience gain from Joining Militants=
(Average Experience of Escaped Detainee*"Escaped Detainees Joining ISIS (People)")+("Foreign Recruiting (People)"*Average Experience of Foreign Recruit
)+("Local Recruiting (People)"*Average Experience of Local Recruit)
Units: Exp Years/Period

(139) "FLOT Movement Rate (FMR)"=
(((FMR Base1+FMR Base2)*"High Intensity FLOT Movement Rate (FMR) Multiplier")*Disable FLOT)*Movement Direction
Units: "km^2"

(143) Foreign Recruiting Eliminated=
1
Units: Dmnl
Normal is 1. 0 means foreign recruiting is completely eliminated.

(144) "Gain in Control (People/Period)"=
Change in Controlled Population/Time to Establish Control
Units: People/Period

(145) Gain in Experience=
Experience gain from Joining Militants+Militant Experience Gain
Units: Exp Years/Period

(149) "Heavy Weapon Losses (Pieces per Period)"=
MAX(0,"Losses (Pieces per Period)")
Units: Pieces/Period

(150) "Heavy Weapons (Pieces)"= INTEG (
"Heavy Weapon Additions (Pieces per Period)"-"Heavy Weapon Losses (Pieces per Period)",
0)
Units: Pieces

(156) "Incoming Militants (People)"=

"Local Recruiting (People)"+"Foreign Recruiting (People)"+"Escaped Detainees Joining ISIS (People)"
Units: People/Period

(157) "Incoming Revenue (Dollars per Period)"=
"Revenue (Dollars per Period)"
Units: Dollars/Period

(170) Initial Population=
3.99671e+007
Units: People

(176) "ISIS Finances (Dollars)"= INTEG (
"Incoming Revenue (Dollars per Period)"-"Outgoing Expenses (Dollars per Period)",
"ZScenario1: Starting Cash")
Units: Dollars
("Baseline Switch (1 = On)"*(Capability of Military Actions based on Squads*Cost per Attack))+("Scenario 1 Switch (1 = On)"*"ZScenario1:
Starting Cash")

(178) "ISIS Militants (People)"= INTEG (
"Additions (People per Period)"-"Lossess (People per Period)",
("Scenario 1 Switch (1 = On)"*ZScenario1 Starting Militants))
Units: People
Scenario Determines starting value.

(182) ISIS Squads= INTEG (
"Change in Squads (Squads/Period)",
"ISIS Militants (People)"/Normal Size of Squad)
Units: Squads
Initialized at the starting Initial Number of Militants divided by the Normal Size of Squads

(192) "Black Market Price per Barrel (Price per Barrel)"=
45
Units: Dollars/Barrels

(196) "Heavy Weapon Additions (Pieces per Period)"=
"Additions (Pieces per Period)"
Units: Pieces/Period

(200) "Loss of Control (People/Period)"=
Population Controlled Lost due to Population Leaving
Units: People/Period

(201) Loss of Experience=
"Total Experience Loss due to Militant Losses (Exp Years)"

Units: Exp Years/Period

(202) "Losses (Pieces per Period)"=
"Lost in Battle (Pieces per Period)"+"Lost to Maintenance (Pieces per Period)"
Units: Pieces/Period

(203) "Lossess (People per Period)"=
MAX(0,"Outgoing Militants (People)")
Units: People/Period
Fix max function with different first order control. MAX(0,("ISIS Militants (People)"-"Outgoing Militants (People)")/Time to Lose Militants)

(209) "Militant Experience (Years)"= INTEG (
Gain in Experience-Loss of Experience,
("Scenario 1 Switch (1 = On)"*"ZScenario1: Starting Experience"))
Units: Exp Years

(215) Militant Experience Gain=
"ISIS Militants (People)"*Experience gained per Period
Units: Exp Years/Period

(227) Normal Ratio of Shura Councils to Population=
100000
Units: People/Council

(229) Normal Size of Squad=
11
Units: People/Squad

(230) Normal Time to Transition to Governance=
1
Units: Period
The Normal Time to transition from Controlled to Governance is 1 period, or 6 months. This is estimated based on the time it took ISIS to
establish governance in Ar Raqqah city from March 2013 to June 2013. The Normal time to Transition to Governance is modified by other
factors to determine the Effective time to Transition.

(235) OpTempo Expenses=
Actual Military Actions*Cost per Military Action
Units: Dollars/Period

(237) "Outgoing Expenses (Dollars per Period)"=
MAX(0,("Expenses before Attacks (Dollars per Period)"+OpTempo Expenses))
Units: Dollars/Period

MAX(0,"ISIS Finances (Dollars)"-("Expenses before Attacks (Dollars per Period)"+OpTempo Expenses))

(238) "Outgoing Militants (People)"=
"Deaths (People/Period)"+"Defections (People)"+"Detentions (People)"
Units: People/Period

(242) Period of Initial Finance=
1
Units: Period

(244) Policy Intervention Time=
2013.5
Units: Period

(245) "Population (People)"= INTEG (
"Births & Immigration (People/Period)"-"Deaths, Recruiting & Emmigration (People/Period)",
Initial Population)
Units: People
Combined population of all Syrian and Iraqi Provinces. “Provinces of Syria”, Administrative Divisions of Countries, Statoids, last
modified September 22, 2004, accessed September 19th, 2014, http://www.statoids.com/usy.html. “Provinces of Iraq”, Administrative
Divisions of Countries, Statoids, last modified March 16, 2014, accessed September 19th, 2014, http://www.statoids.com/uiq.html.

(246) "Population Controlled by Coercive Power (People)"= INTEG (
"Gain in Control (People/Period)"-"Loss of Control (People/Period)",
("Scenario 1 Switch (1 = On)"*"ZScenario1: Starting Population Controlled"))
Units: People

(247) Population Controlled Lost due to Population Leaving=
"Deaths, Recruiting & Emmigration (People/Period)"*"% Controlled of Overall Population"
Units: People/Period

(248) Population Controlled Only=
"Population Controlled by Coercive Power (People)"-"Population Governed through Legitimacy (People)"
Units: People

(249) "Population Governed Lost due to Loss of Control (People/Period)"=
"Loss of Control (People/Period)"*"% of Controlled Population that is Governed"
Units: People/Period

(250) "Population Governed through Legitimacy (People)"= INTEG (
"Rate of Transition to Governance (People/Period)"-"Rate of Loss of Governance (People/Period)",
0)
Units: People

(251) "Population Outflow (People/Period)"=
"Civilian Deaths (People/Period)"+"Local Recruiting (People)"+"Refugees Leaving (People/Period)"
Units: People/Period

(252) Portion of Period spent Fighting Battle=
0.0055
Units: Period

(254) "Proposition Switch (1 = On) 0"=
1
Units: Dmnl

(256) Ransom Elimination=
0
Units: Dmnl
Normal value is 1. 0 means all ransom is eliminated.

(261) "Rate of Councils Formed (Councils/Period)"=
(Desired Shura Councils-"Shura Councils (Councils)")/Time to Stand up a Shura Council
Units: Councils/Period

(268) "Rate of Loss of Governance (People/Period)"=
"Population Governed Lost due to Loss of Control (People/Period)"
Units: People/Period

(270) "Rate of Territory Gained (km^2/period)"=
"FLOT Movement Rate (FMR)"/Portion of Period spent Fighting Battle
Units: "km^2"/Period

(271) "Rate of Territory Lost (km^2/Period)"=
0
Units: "km^2"/Period

(272) "Rate of Transition to Governance (People/Period)"=
("Population Controlled by Coercive Power (People)"-"Population Governed through Legitimacy (People)")/Effective Time to Transition to Governance
Units: People/Period

(292) "Remaining % of Population"=

"Population (People)"/Initial Population
Units: Percentage

(294) "Revenue (Dollars per Period)"=
"Donations (Dollars per Period)"+"Pre Donations Revenue (Dollars per Period)"
Units: Dollars/Period

(296) "Scenario 1 Switch (1 = On)"=
1
Units: Dmnl

(329) "Shura Councils (Councils)"= INTEG (
"Rate of Councils Formed (Councils/Period)",
"Population Governed through Legitimacy (People)"/Normal Ratio of Shura Councils to Population)
Units: Councils
Initialized at the Starting Governed Population / Normal ratio of Shura Councils

(336) Strikes per Day against Oil=
0
Units: Strikes/Period
Normal value is 0. Minimal is 5, Significant is 50, intensive is 250.

(371) "Territory (km^2)"=
619308
Units: "km^2"
Includes all Provinces and Governates of Iraq and Syria. “Provinces of Syria”, Administrative Divisions of Countries, Statoids, last
modified September 22, 2004, accessed September 19th, 2014, http://www.statoids.com/usy.html. “Provinces of Iraq”, Administrative
Divisions of Countries, Statoids, last modified March 16, 2014, accessed September 19th, 2014, http://www.statoids.com/uiq.html.

(372) "Territory ISIS Controlled (km^2)"= INTEG (
"Rate of Territory Gained (km^2/period)"-"Rate of Territory Lost (km^2/Period)",
("Scenario 1 Switch (1 = On)"*"ZScenario1: Starting Territory"))
Units: "km^2"

(378) Time to Establish Control=
1
Units: Period

(379) Time to Form Squads=
0.16
Units: Period
Ceylan Yeginsu, “ISIS Draws a Steady Stream of Recruits from Turkey,” nytimes.com,

http://www.nytimes.com/2014/09/16/world/europe/turkey-is-a-steady-source-of-isis-recruits.html, accessed October 25, 2014. (CHECK LONGER TRAINING PERIOD)

(380) Time to Lose Militants=
1
Units: Period

(384) Time to Stand up a Shura Council=
0.5
Units: Period
Estimated need source.

(387) "Total Experience Loss due to Militant Losses (Exp Years)"=
(Average Militant Experience*"Outgoing Militants (People)")
Units: Exp Years/Period

(394) US Airpower Support Step Height=
0
Units: Dmnl
1 is normal. 1.01 is minimal, 1.10 is significant and 1.5 is intensive.

(395) USEquipmentModifier=
0.25
Units: Dmnl/Assets

(399) ZScenario1 Starting Militants=
13200
Units: People

(400) "ZScenario1: Starting Cash"=
Period of Initial Finance*(5e+006+("Expenses before Attacks (Dollars per Period)"*4))
Units: Dollars

(401) "ZScenario1: Starting Experience"=
39928
Units: Exp Years
2824 Escaped Detainees @ 10 years experience (28,240), 2600 Local Fighters @ 3 Years Epxerience (7800), 7776 Foreign Fighters at .5 Experience (3888) = 39928

(402) "ZScenario1: Starting Population Controlled"=
0
Units: People

(403) "ZScenario1: Starting Territory"=

0
Units: "km^2"

(005) "% Controlled of Overall Population"=
ZIDZ("Population Controlled by Coercive Power (People)", "Population (People)")
Units: Fraction

(012) "% of Controlled Population that is Governed"=
ZIDZ("Population Governed through Legitimacy (People)","Population Controlled by Coercive Power (People)")
Units: Fraction

(017) "% of Territory Controlled by ISIS"=
"Territory ISIS Controlled (km^2)"/"Territory (km^2)"
Units: Percentage

(024) "Additions (People per Period)"=
"Incoming Militants (People)"
Units: People/Period

(025) "Additions (Pieces per Period)"=
Heavy Weapons Looted
Units: Pieces/Period

(037) Average Militant Experience=
ZIDZ("Militant Experience (Years)","ISIS Militants (People)")
Units: Exp Years/Person

(039) "Baseline Switch (1 = On) 1"=
1
Units: Dmnl

(040) "Baseline Switch (1 = On)"=
0
Units: Dmnl

(044) "Births & Immigration (People/Period)"=
0
Units: People/Period

(068) Capability of Military Actions based on Squads=
ISIS Squads*Normal Military Capability of Squads
Units: Military Actions/Period

(070) Change in Controlled Population=
ISIS Controlled Population-"Population Controlled by Coercive Power (People)"
Units: People

(071) "Change in Squads (Squads/Period)"=

(Desired Squads-ISIS Squads)/Time to Form Squads
Units: Squads/Period

(094) "Deaths, Recruiting & Emmigration (People/Period)"=
"Population Outflow (People/Period)"
Units: People/Period

(103) Desired Shura Councils=
("Population Governed through Legitimacy (People)"+Ungoverned Population)/Normal Ratio of Shura Councils to Population
Units: Councils

(104) Desired Squads=
("ISIS Militants (People)"-Actual Garrison)/Normal Size of Squad
Units: Squads

(108) Disable FLOT=
1
Units: Dmnl
Used to test Proposition 1. Normal value =1 , disabled value = 0.

(110) Disable Local Recruiting=
1
Units: Dmnl
Normal value is 1, set to 0 to test Proposition 4.

(111) Disable Oil=
1
Units: Barrels/Period
Used for Proposition 2 - normal value =1, disabled value = 0

(124) Effective Time to Transition to Governance=
Normal Time to Transition to Governance*Effect of Shura Council Sufficiency on Transition to Governance
Units: Period

(125) "Embed US Adivsers (Experience)"=
1
Units: Exp Years
0 is normal. 1 is the increase in average Exp Years due to having US troops embedded.

(126) "Embed US Advisers (Morale)"=
0.25
Units: Dmnl
0 is normal. .25 is nominal additional morale factor for US troops being embedded.

(132) "Expenses before Attacks (Dollars per Period)"=
"Administration & Governance Expense (Dollars per Period)"+"Death Benefits (Dollars per Period)"+"Detention Benefits (Dollars per Period)"
+"Media Border Security & Other Expenses (Dollars per Period)"+"Military Procurement (Dollars per Period)"
+"Payroll (Dollars per Period)"
Units: Dollars/Period

(137) Experience gain from Joining Militants=
(Average Experience of Escaped Detainee*"Escaped Detainees Joining ISIS (People)")+("Foreign Recruiting (People)"*Average Experience of Foreign Recruit
)+("Local Recruiting (People)"*Average Experience of Local Recruit)
Units: Exp Years/Period

(139) "FLOT Movement Rate (FMR)"=
(((FMR Base1+FMR Base2)*"High Intensity FLOT Movement Rate (FMR) Multiplier")*Disable FLOT)*Movement Direction
Units: "km^2"

(143) Foreign Recruiting Eliminated=
1
Units: Dmnl
Normal is 1. 0 means foreign recruiting is completely eliminated.

(144) "Gain in Control (People/Period)"=
Change in Controlled Population/Time to Establish Control
Units: People/Period

(145) Gain in Experience=
Experience gain from Joining Militants+Militant Experience Gain
Units: Exp Years/Period

(149) "Heavy Weapon Losses (Pieces per Period)"=
MAX(0,"Losses (Pieces per Period)")
Units: Pieces/Period

(150) "Heavy Weapons (Pieces)"= INTEG (
"Heavy Weapon Additions (Pieces per Period)"-"Heavy Weapon Losses (Pieces per Period)",
0)
Units: Pieces

(156) "Incoming Militants (People)"=
"Local Recruiting (People)"+"Foreign Recruiting (People)"+"Escaped Detainees Joining ISIS (People)"
Units: People/Period

(157) "Incoming Revenue (Dollars per Period)"=
"Revenue (Dollars per Period)"
Units: Dollars/Period

(170) Initial Population=
3.99671e+007
Units: People

(176) "ISIS Finances (Dollars)"= INTEG (
"Incoming Revenue (Dollars per Period)"-"Outgoing Expenses (Dollars per Period)",
"ZScenario1: Starting Cash")
Units: Dollars
("Baseline Switch (1 = On)"*(Capability of Military Actions based on Squads*Cost per Attack))+("Scenario 1 Switch (1 = On)"*"ZScenario1:
Starting Cash")

(178) "ISIS Militants (People)"= INTEG (
"Additions (People per Period)"-"Lossess (People per Period)",
("Scenario 1 Switch (1 = On)"*ZScenario1 Starting Militants))
Units: People
Scenario Determines starting value.

(182) ISIS Squads= INTEG (
"Change in Squads (Squads/Period)",
"ISIS Militants (People)"/Normal Size of Squad)
Units: Squads
Initialized at the starting Initial Number of Militants divided by the Normal Size of Squads

(192) "Black Market Price per Barrel (Price per Barrel)"=
45
Units: Dollars/Barrels

(196) "Heavy Weapon Additions (Pieces per Period)"=
"Additions (Pieces per Period)"
Units: Pieces/Period

(200) "Loss of Control (People/Period)"=
Population Controlled Lost due to Population Leaving
Units: People/Period

(201) Loss of Experience=
"Total Experience Loss due to Militant Losses (Exp Years)"
Units: Exp Years/Period

(202) "Losses (Pieces per Period)"=

"Lost in Battle (Pieces per Period)"+"Lost to Maintenance (Pieces per Period)"
Units: Pieces/Period

(203) "Lossess (People per Period)"=
MAX(0,"Outgoing Militants (People)")
Units: People/Period
Fix max function with different first order control. MAX(0,("ISIS Militants (People)"-"Outgoing Militants (People)")/Time to Lose Militants)

(209) "Militant Experience (Years)"= INTEG (
Gain in Experience-Loss of Experience,
("Scenario 1 Switch (1 = On)"*"ZScenario1: Starting Experience"))
Units: Exp Years

(215) Militant Experience Gain=
"ISIS Militants (People)"*Experience gained per Period
Units: Exp Years/Period

(227) Normal Ratio of Shura Councils to Population=
100000
Units: People/Council

(229) Normal Size of Squad=
11
Units: People/Squad

(230) Normal Time to Transition to Governance=
1
Units: Period
The Normal Time to transition from Controlled to Governance is 1 period, or 6 months. This is estimated based on the time it took ISIS to
establish governance in Ar Raqqah city from March 2013 to June 2013. The Normal time to Transition to Governance is modified by other
factors to determine the Effective time to Transition.

(235) OpTempo Expenses=
Actual Military Actions*Cost per Military Action
Units: Dollars/Period

(237) "Outgoing Expenses (Dollars per Period)"=
MAX(0,("Expenses before Attacks (Dollars per Period)"+OpTempo Expenses))
Units: Dollars/Period
MAX(0,"ISIS Finances (Dollars)"-("Expenses before Attacks (Dollars per Period)"+OpTempo Expenses))

(238) "Outgoing Militants (People)"=
"Deaths (People/Period)"+"Defections (People)"+"Detentions (People)"
Units: People/Period

(242) Period of Initial Finance=
1
Units: Period

(244) Policy Intervention Time=
2013.5
Units: Period

(245) "Population (People)"= INTEG (
"Births & Immigration (People/Period)"-"Deaths, Recruiting & Emmigration (People/Period)",
Initial Population)
Units: People
Combined population of all Syrian and Iraqi Provinces. “Provinces of Syria”, Administrative Divisions of Countries, Statoids, last
modified September 22, 2004, accessed September 19th, 2014, http://www.statoids.com/usy.html. “Provinces of Iraq”, Administrative
Divisions of Countries, Statoids, last modified March 16, 2014, accessed September 19th, 2014, http://www.statoids.com/uiq.html.

(246) "Population Controlled by Coercive Power (People)"= INTEG (
"Gain in Control (People/Period)"-"Loss of Control (People/Period)",
("Scenario 1 Switch (1 = On)"*"ZScenario1: Starting Population Controlled"))
Units: People

(247) Population Controlled Lost due to Population Leaving=
"Deaths, Recruiting & Emmigration (People/Period)"*"% Controlled of Overall Population"
Units: People/Period

(248) Population Controlled Only=
"Population Controlled by Coercive Power (People)"-"Population Governed through Legitimacy (People)"
Units: People

(249) "Population Governed Lost due to Loss of Control (People/Period)"=
"Loss of Control (People/Period)"*"% of Controlled Population that is Governed"
Units: People/Period

(250) "Population Governed through Legitimacy (People)"= INTEG (
"Rate of Transition to Governance (People/Period)"-"Rate of Loss of Governance (People/Period)",

0)
Units: People

(251) "Population Outflow (People/Period)"=
"Civilian Deaths (People/Period)"+"Local Recruiting (People)"+"Refugees Leaving (People/Period)"
Units: People/Period

(252) Portion of Period spent Fighting Battle=
0.0055
Units: Period

(254) "Proposition Switch (1 = On) 0"=
1
Units: Dmnl

(256) Ransom Elimination=
0
Units: Dmnl
Normal value is 1. 0 means all ransom is eliminated.

(261) "Rate of Councils Formed (Councils/Period)"=
(Desired Shura Councils-"Shura Councils (Councils)")/Time to Stand up a Shura Council
Units: Councils/Period

(268) "Rate of Loss of Governance (People/Period)"=
"Population Governed Lost due to Loss of Control (People/Period)"
Units: People/Period

(270) "Rate of Territory Gained (km^2/period)"=
"FLOT Movement Rate (FMR)"/Portion of Period spent Fighting Battle
Units: "km^2"/Period

(271) "Rate of Territory Lost (km^2/Period)"=
0
Units: "km^2"/Period

(272) "Rate of Transition to Governance (People/Period)"=
("Population Controlled by Coercive Power (People)"-"Population Governed through Legitimacy (People)")/Effective Time to Transition to Governance
Units: People/Period

(292) "Remaining % of Population"=
"Population (People)"/Initial Population
Units: Percentage

(294) "Revenue (Dollars per Period)"=
"Donations (Dollars per Period)"+"Pre Donations Revenue (Dollars per Period)"
Units: Dollars/Period

(296) "Scenario 1 Switch (1 = On)"=
1
Units: Dmnl

(329) "Shura Councils (Councils)"= INTEG (
"Rate of Councils Formed (Councils/Period)",
"Population Governed through Legitimacy (People)"/Normal Ratio of Shura Councils to Population)
Units: Councils
Initialized at the Starting Governed Population / Normal ratio of Shura Councils

(336) Strikes per Day against Oil=
0
Units: Strikes/Period
Normal value is 0. Minimal is 5, Significant is 50, intensive is 250.

(371) "Territory (km^2)"=
619308
Units: "km^2"
Includes all Provinces and Governates of Iraq and Syria. “Provinces of Syria”, Administrative Divisions of Countries, Statoids, last
modified September 22, 2004, accessed September 19th, 2014, http://www.statoids.com/usy.html. “Provinces of Iraq”, Administrative
Divisions of Countries, Statoids, last modified March 16, 2014, accessed September 19th, 2014, http://www.statoids.com/uiq.html.

(372) "Territory ISIS Controlled (km^2)"= INTEG (
"Rate of Territory Gained (km^2/period)"-"Rate of Territory Lost (km^2/Period)",
("Scenario 1 Switch (1 = On)"*"ZScenario1: Starting Territory"))
Units: "km^2"

(378) Time to Establish Control=
1
Units: Period

(379) Time to Form Squads=
0.16
Units: Period
Ceylan Yeginsu, “ISIS Draws a Steady Stream of Recruits from Turkey,” nytimes.com,
http://www.nytimes.com/2014/09/16/world/europe/turkey-is-a-steady-source-of-isis-recruits.html, accessed October 25, 2014. (CHECK LONGER
TRAINING PERIOD)

(380) Time to Lose Militants=
1
Units: Period

(384) Time to Stand up a Shura Council=
0.5
Units: Period
Estimated need source.

(387) "Total Experience Loss due to Militant Losses (Exp Years)"=
(Average Militant Experience*"Outgoing Militants (People)")
Units: Exp Years/Period

(394) US Airpower Support Step Height=
0
Units: Dmnl
1 is normal. 1.01 is minimal, 1.10 is significant and 1.5 is intensive.

(395) USEquipmentModifier=
0.25
Units: Dmnl/Assets

(399) ZScenario1 Starting Militants=
13200
Units: People

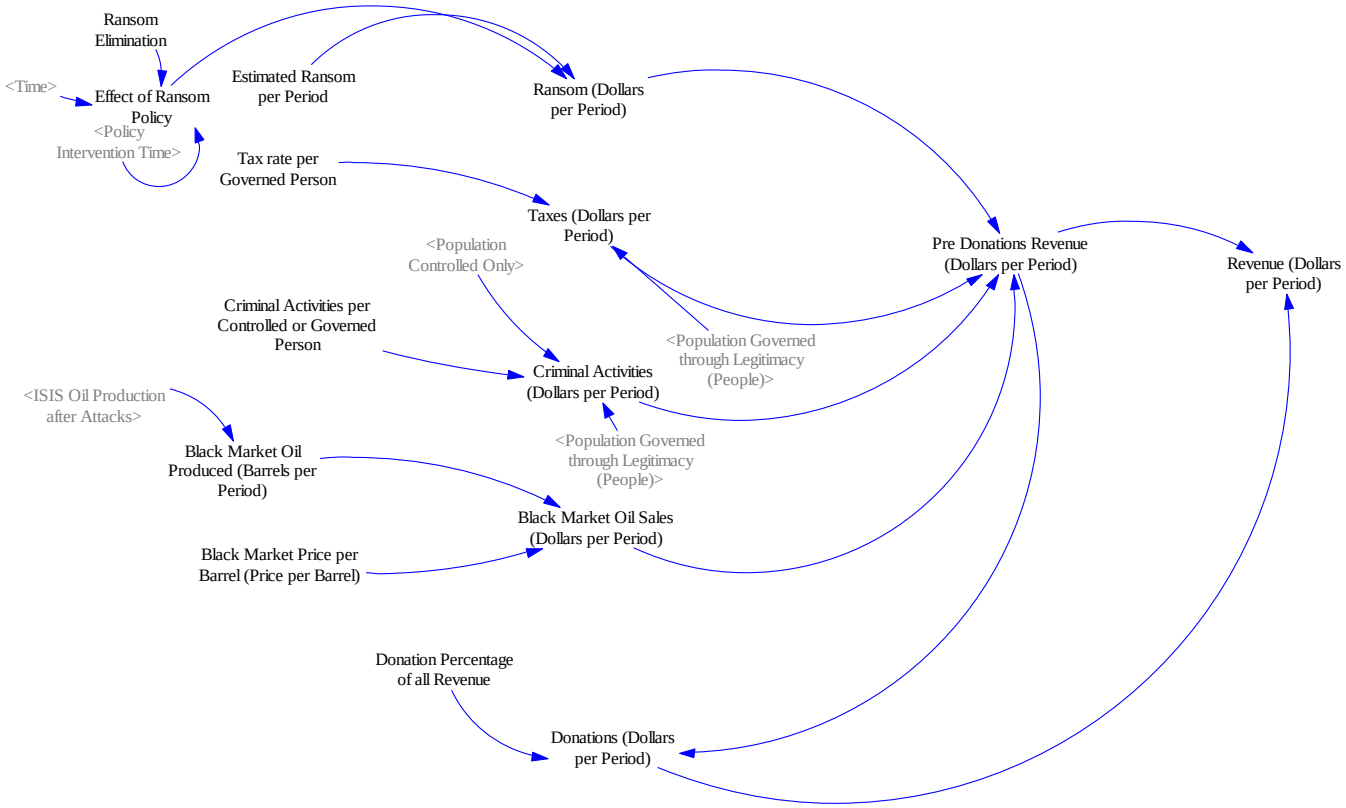
(400) "ZScenario1: Starting Cash"=
Period of Initial Finance*(5e+006+("Expenses before Attacks (Dollars per Period)"*4))
Units: Dollars

(401) "ZScenario1: Starting Experience"=
39928
Units: Exp Years
2824 Escaped Detainees @ 10 years experience (28,240), 2600 Local Fighters @ 3 Years Epxerience (7800), 7776 Foreign Fighters at .5
Experience (3888) = 39928

(402) "ZScenario1: Starting Population Controlled"=
0
Units: People

(403) "ZScenario1: Starting Territory"=
0
Units: "km^2"

## *Revenue Sector Structure*

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## *Revenue Sector Equations*

(045) "Black Market Oil Produced (Barrels per Period)" = ISIS Oil Production after Attacks
Units: Barrels/Period
Prior to US airstrikes ISIS was producing between 25,000-40,000 barrels of oil a day (BPD) across a dozen oil wells.

(077) "Criminal Activities (Dollars per Period)" = Criminal Activities per Controlled or Governed Person * ( Population Controlled Only + "Population Governed through Legitimacy (People)" )
Units: Dollars/Period

(078) Criminal Activities per Controlled or Governed Person = 2.76
Units: Dollars/(Period*Person)
Converting these to $/Person/Period works out from a range of $1.62 to $3.90/Person/Period for Population Controlled. Taken at midpoint.

(118) Effect of Ransom Policy = IF THEN ELSE ( Time > Policy Intervention Time , Ransom Elimination , 1)
Units: Dmnl

(129) Estimated Ransom per Period = 6e+006
Units: Dollars/Period
Assuming a simple $2M/Month for ransoms results in $6M/Period.

(180) ISIS Oil Production after Attacks = ISIS Oil Production before Attacks - Effect of Attacks on Oil Production
Units: Barrels/Period

(191) "Black Market Oil Sales (Dollars per Period)" = "Black Market Price per Barrel (Price per Barrel)" * "Black Market Oil Produced (Barrels per Period)"

Units: Dollars/Period

(192) "Black Market Price per Barrel (Price per Barrel)" = 45
Units: Dollars/Barrels

(193) Donation Percentage of all Revenue = 0.04
Units: Dmnl

(194) "Donations (Dollars per Period)" = "Pre Donations Revenue (Dollars per Period)" * Donation Percentage of all Revenue
Units: Dollars/Period

(244) Policy Intervention Time = 2013.5
Units: Period

(248) Population Controlled Only = "Population Controlled by Coercive Power (People)" - "Population Governed through Legitimacy (People)"
Units: People

(250) "Population Governed through Legitimacy (People)" = INTEG( "Rate of Transition to Governance (People/Period)" - "Rate of Loss of Governance (People/Period)"
, 0)
Units: People

(253) "Pre Donations Revenue (Dollars per Period)" = "Taxes (Dollars per Period)" + "Ransom (Dollars per Period)" + "Criminal Activities (Dollars per Period)"
+ "Black Market Oil Sales (Dollars per Period)"
Units: Dollars/Period

(255) "Ransom (Dollars per Period)" = Estimated Ransom per Period * Effect of Ransom Policy
Units: Dollars/Period

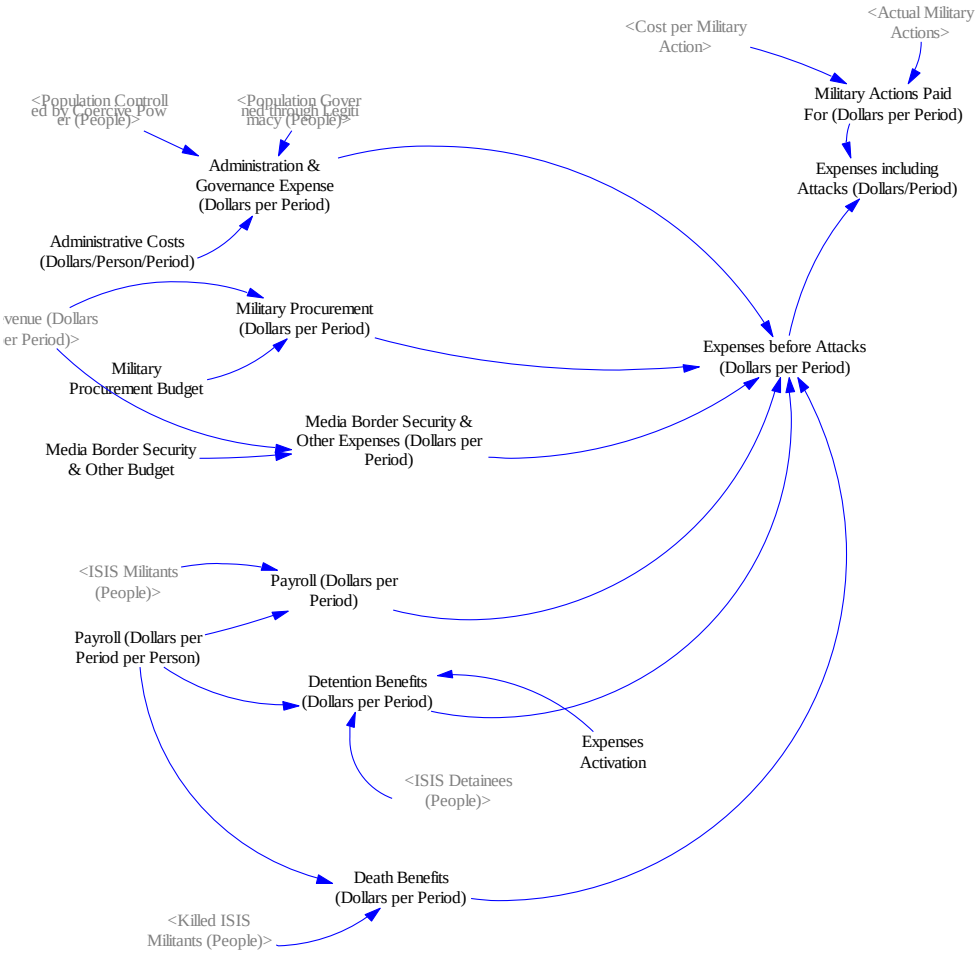
(256) Ransom Elimination = 0
Units: Dmnl
Normal value is 1. 0 means all ransom is eliminated.

(294) "Revenue (Dollars per Period)" = "Donations (Dollars per Period)" + "Pre Donations Revenue (Dollars per Period)"
Units: Dollars/Period

(369) Tax rate per Governed Person = 15.995
Units: Dollars/(Period*Person)
Dividing this amount into the estimated Population governed for the 2014 Period results in a range from $11.99-$20 Person/Period for
Population Governed.

(370) "Taxes (Dollars per Period)" = Tax rate per Governed Person * "Population Governed through Legitimacy (People)"
Units: Dollars/Period

## *Expense Sector Structure*



## *Expense Sector Equations*

(022) Actual Military Actions = IF THEN ELSE ( Capacity for Military Actions based on Budget > Capability of Military Actions based on Squads , Capability of Military Actions based on Squads
, Capacity for Military Actions based on Budget )
Units: Military Actions/Period

(026) "Administration & Governance Expense (Dollars per Period)" = ( "Population Governed through Legitimacy (People)" + "Population Controlled by Coercive Power (People)"
) * "Administrative Costs (Dollars/Person/Period)"
Units: Dollars/Period

(076) Cost per Military Action = 2700
Units: Dollars/Military Action
Analysis showed that for each $2700 transferred to a sector command, an AQI attack was launched. This cost includes not only direct costs
of the attack, but indirect costs of all the other factors necessary for AQI to peform in that sector outside Media, Courts,
Administration. Furthermore, there was a strong correlation (.66) between the rate of fund flows increasing or decreasing and corresponding
changes in the pace of attacks. RAND 57-69.

(090) "Death Benefits (Dollars per Period)" = "Killed ISIS Militants (People)" * "Payroll (Dollars per Period per Person)"
Units: Dollars/Period
Still needs to have the organizational reset barriers put in 2007 & 2013.

(105) "Detention Benefits (Dollars per Period)" = ( "ISIS Detainees (People)" * "Payroll (Dollars per Period per Person)" ) * ( 0 + Expenses Activation
)
Units: Dollars/Period
Still needs to have the organizational reset barriers put in 2007 & 2013.

(131) Expenses Activation = STEP ( 1, 2014)
Units: Dmnl

(132) "Expenses before Attacks (Dollars per Period)" = "Administration & Governance Expense (Dollars per Period)" + "Death Benefits (Dollars per Period)"
+ "Detention Benefits (Dollars per Period)" + "Media Border Security & Other Expenses (Dollars per Period)" + "Military Procurement (Dollars per Period)"
+ "Payroll (Dollars per Period)"
Units: Dollars/Period

(135) "Expenses including Attacks (Dollars/Period)" = "Expenses before Attacks (Dollars per Period)" + "Military Actions Paid For (Dollars per Period)"

Units: Dollars/Period

(175) "ISIS Detainees (People)" = INTEG( "Rate of Detentions (People/Period)" - "Rate of Escape or Release (People/Period)" , 2890)
Units: People
Set as 0 update to final number at start

(178) "ISIS Militants (People)" = INTEG( "Additions (People per Period)" - "Lossess (People per Period)" , ( "Scenario 1 Switch (1 = On)" * ZScenario1 Starting Militants
) )
Units: People
Scenario Determines starting value.

(185) "Killed ISIS Militants (People)" = INTEG( "Rate of Deaths (People/Period)" , 0)
Units: People
Adjust initial level based on starting time of model.

(190) "Administrative Costs (Dollars/Person/Period)" = 0.185
Units: Dollars/(Period*Person)
This implies a cost per ControlledPerson for overhead administration of $.185 per ControlledPerson/Period. RAND,40.

(208) "Media Border Security & Other Budget" = 0.06
Units: Dmnl
All other expenses were combined into a single bucket that amounts to 6% of all revenue. RAND

(211) "Military Actions Paid For (Dollars per Period)" = Cost per Military Action * Actual Military Actions
Units: Dollars/Period

(214) "Media Border Security & Other Expenses (Dollars per Period)" = "Revenue (Dollars per Period)" * "Media Border Security & Other Budget"
Units: Dollars/Period

(218) "Military Procurement (Dollars per Period)" = "Revenue (Dollars per Period)" * Military Procurement Budget
Units: Dollars/Period

(219) Military Procurement Budget = 0.1
Units: Dmnl
According to the RAND analysis purchases related to military procurement – heavy weapons, ammunition, logistics and maintenance ran about
10% of all revenues. RAND

(239) "Payroll (Dollars per Period per Person)" = 366

Units: Dollars/(Period*Person)
RAND 45-48. Includes direct pay to militant of $41/month and dependent (on averaqge one) pay of $20/month for $61/month or $366/period.

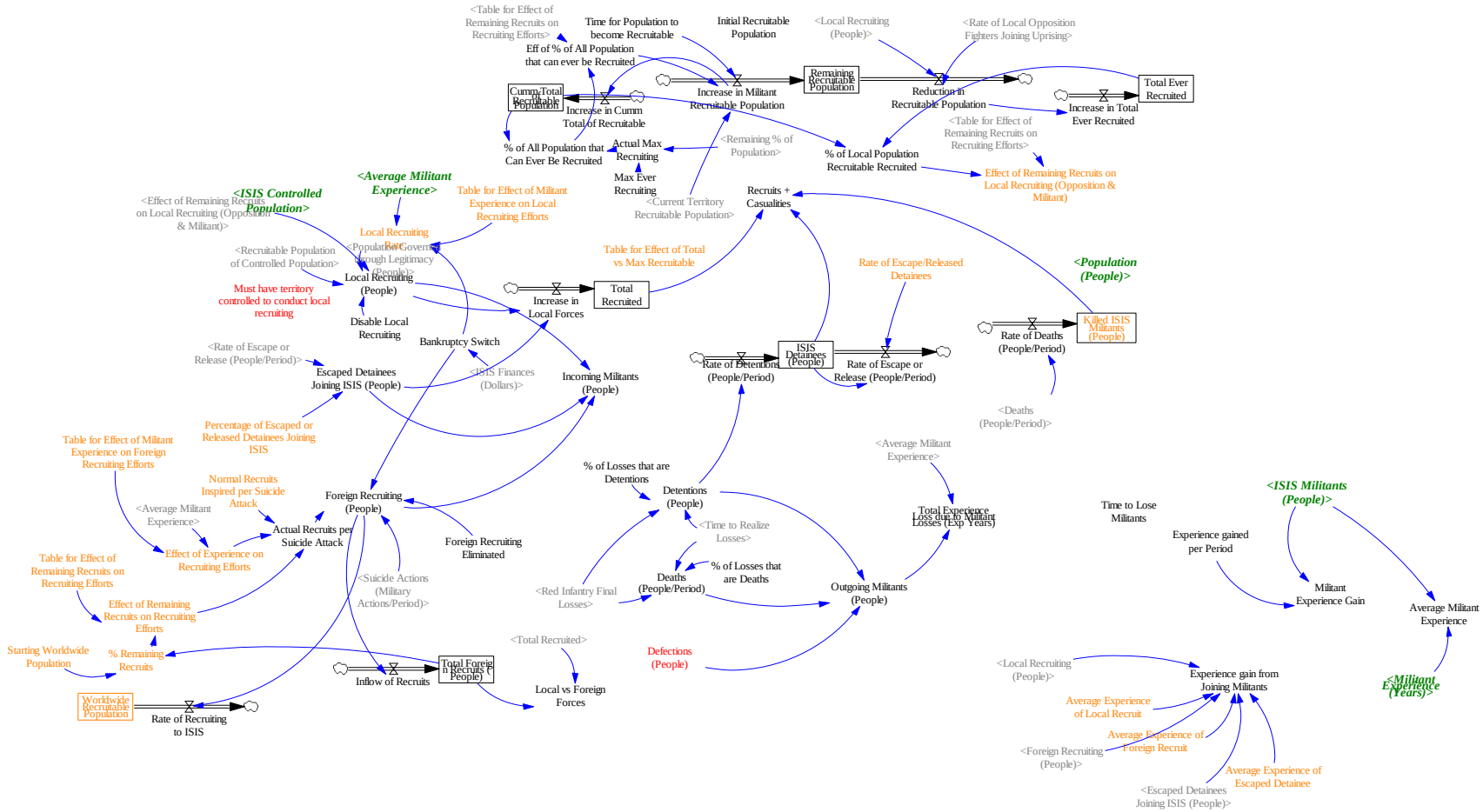
(240) "Payroll (Dollars per Period)" = "ISIS Militants (People)" * "Payroll (Dollars per Period per Person)"
Units: Dollars/Period

(246) "Population Controlled by Coercive Power (People)" = INTEG( "Gain in Control (People/Period)" - "Loss of Control (People/Period)" , ( "Scenario 1 Switch (1 = On)"
* "ZScenario1: Starting Population Controlled" ) )
Units: People

(250) "Population Governed through Legitimacy (People)" = INTEG( "Rate of Transition to Governance (People/Period)" - "Rate of Loss of Governance (People/Period)"
, 0)
Units: People

(294) "Revenue (Dollars per Period)" = "Donations (Dollars per Period)" + "Pre Donations Revenue (Dollars per Period)"
Units: Dollars/Period

# *Militant Recruiting & Loss Sector Structure*

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## *Militant Recruiting & Loss Sector Equations*

(010) "% of All Population that Can Ever Be Recruited" = Cumm Total of Recruitable Population / Actual Max Recruiting
Units: Percentage

(014) "% of Local Population Recruitable Recruited" = ZIDZ ( Total Ever Recruited , Cumm Total of Recruitable Population )
Units: Percentage

(015) "% of Losses that are Deaths" = 0.43
Units: Fraction
Derived from research need to finalize.

(016) "% of Losses that are Detentions" = 0.57
Units: Fraction
Derived from research. Need to confirm with causal factors.

(018) "% Remaining Recruits" = "Total Foreign Recruits (People)" / Starting Worldwide Population
Units: Percentage

(021) Actual Max Recruiting = Max Ever Recruiting * "Remaining % of Population"
Units: People

(023) Actual Recruits per Suicide Attack = Normal Recruits Inspired per Suicide Attack * Effect of Experience on Recruiting Efforts * Effect of Remaining Recruits on Recruiting Efforts

Units: People/Military Action

(034) Average Experience of Escaped Detainee = 10
Units: Exp Years/Person
Set at 10 need actual vaule to finish.

(035) Average Experience of Foreign Recruit = 1
Units: Exp Years/Person
Set at 1 update for final.

(036) Average Experience of Local Recruit = 3
Units: Exp Years/Person
Set at 3 update for final.

(037) Average Militant Experience = ZIDZ ( "Militant Experience (Years)" , "ISIS Militants (People)" )
Units: Exp Years/Person

(038) Bankruptcy Switch = IF THEN ELSE ( "ISIS Finances (Dollars)" < -100000, 0, 1)

Units: Dmnl

(082) Cumm Total of Recruitable Population = INTEG( Increase in Cumm Total of Recruitable , 0)
Units: People

(085) Current Territory Recruitable Population = "ZScenario1: Table for Cumm Total Recruitable Population based on Location of ISIS on Map" ( Current Location of ISIS on Territorial Map
)
Units: People

(091) "Deaths (People/Period)" = ( Red Infantry Final Losses * "% of Losses that are Deaths" ) / Time to Realize Losses
Units: People/Period

(096) "Defections (People)" = 0
Units: People/Period

(106) "Detentions (People)" = ( Red Infantry Final Losses * "% of Losses that are Detentions" ) / Time to Realize Losses
Units: People/Period

(110) Disable Local Recruiting = 1
Units: Dmnl
Normal value is 1, set to 0 to test Proposition 4.

(113) "Eff of % of All Population that can ever be Recruited" = Table for Effect of Remaining Recruits on Recruiting Efforts ( "% of All Population that Can Ever Be Recruited"
)
Units: Percentage

(115) Effect of Experience on Recruiting Efforts = Table for Effect of Militant Experience on Foreign Recruiting Efforts ( Average Militant Experience
)
Units: Dmnl

(119) "Effect of Remaining Recruits on Local Recruiting (Opposition & Militant)" = Table for Effect of Remaining Recruits on Recruiting Efforts ( "% of Local Population Recruitable Recruited"
)
Units: Dmnl

(120) Effect of Remaining Recruits on Recruiting Efforts = Table for Effect of Remaining Recruits on Recruiting Efforts ( "% Remaining Recruits" )
Units: Dmnl

(128) "Escaped Detainees Joining ISIS (People)" = "Rate of Escape or Release (People/Period)" * Percentage of Escaped or Released Detainees Joining ISIS

Units: People/Period

(137) Experience gain from Joining Militants = ( Average Experience of Escaped Detainee * "Escaped Detainees Joining ISIS (People)" ) + ( "Foreign Recruiting (People)"
* Average Experience of Foreign Recruit ) + ( "Local Recruiting (People)" * Average Experience of Local Recruit )
Units: Exp Years/Period

(138) Experience gained per Period = 0.5
Units: Exp Years/(Period*Person)

(142) "Foreign Recruiting (People)" = ( ( Actual Recruits per Suicide Attack * "Suicide Actions (Military Actions/Period)" ) * Foreign Recruiting Eliminated
) * Bankruptcy Switch
Units: People/Period

(143) Foreign Recruiting Eliminated = 1
Units: Dmnl
Normal is 1. 0 means foreign recruiting is completely eliminated.

(156) "Incoming Militants (People)" = "Local Recruiting (People)" + "Foreign Recruiting (People)" + "Escaped Detainees Joining ISIS (People)"
Units: People/Period

(162) Increase in Cumm Total of Recruitable = Increase in Militant Recruitable Population
Units: People/Period

(164) Increase in Local Forces = ( "Local Recruiting (People)" + "Escaped Detainees Joining ISIS (People)" )
Units: People/Period

(165) Increase in Militant Recruitable Population = ( Current Territory Recruitable Population * "Eff of % of All Population that can ever be Recruited"
) / Time for Population to become Recruitable
Units: People/Period

(166) Increase in Total Ever Recruited = Reduction in Recruitable Population
Units: People/Period

(169) Inflow of Recruits = "Foreign Recruiting (People)"
Units: People/Period

(171) Initial Recruitable Population = 50662
Units: People
Pull from the Scenario Builder Cumm Total of Recruitable Population.

(174) ISIS Controlled Population = ( "Baseline Switch (1 = On)" * "ZBaseline: Table for Percentage of Population Controlled based on Location of ISIS on Territorial Map"
( Current Location of ISIS on Territorial Map ) * Total Population ) + ( "Scenario 1 Switch (1 = On)" * "ZScenario1: Table for Percentage of Population Controlled Based on Location of ISIS on Territorial Map"
( Current Location of ISIS on Territorial Map ) * Total Population )
Units: People

(175) "ISIS Detainees (People)" = INTEG( "Rate of Detentions (People/Period)" - "Rate of Escape or Release (People/Period)" , 2890)
Units: People
Set as 0 update to final number at start

(176) "ISIS Finances (Dollars)" = INTEG( "Incoming Revenue (Dollars per Period)" - "Outgoing Expenses (Dollars per Period)" , "ZScenario1: Starting Cash"
)
Units: Dollars
("Baseline Switch (1 = On)"*(Capability of Military Actions based on Squads*Cost per Attack))+("Scenario 1 Switch (1 = On)"*"ZScenario1:
Starting Cash")

(178) "ISIS Militants (People)" = INTEG( "Additions (People per Period)" - "Lossess (People per Period)" , ( "Scenario 1 Switch (1 = On)" * ZScenario1 Starting Militants
) )
Units: People
Scenario Determines starting value.

(185) "Killed ISIS Militants (People)" = INTEG( "Rate of Deaths (People/Period)" , 0)
Units: People
Adjust initial level based on starting time of model.

(189) "Local Recruiting (People)" = ( Recruitable Population of Controlled Population * Local Recruiting Rate * "Effect of Remaining Recruits on Local Recruiting (Opposition & Militant)"
) * Disable Local Recruiting
Units: People/Period
Must have territorial control to begin local recruiting.

(198) Local Recruiting Rate = Table for Effect of Militant Experience on Local Recruiting Efforts ( Average Militant Experience ) * Bankruptcy Switch
Units: Fraction
Derived from AQI implied local recruiting patterns. Actual source (perhaps Accidental Guerilla effect) would be better.

(199) Local vs Foreign Forces = ZIDZ ( Total Recruited , ( Total Recruited + "Total Foreign Recruits (People)" ) )

Units: Percentage

(206) Max Ever Recruiting = 3.39502e+006
Units: People

(209) "Militant Experience (Years)" = INTEG( Gain in Experience - Loss of Experience , ( "Scenario 1 Switch (1 = On)" * "ZScenario1: Starting Experience"
) )
Units: Exp Years

(215) Militant Experience Gain = "ISIS Militants (People)" * Experience gained per Period
Units: Exp Years/Period

(228) Normal Recruits Inspired per Suicide Attack = 18
Units: People/Military Action
Need source for final. Read 26 recruits per suicide attack, this should be a higher end.

(238) "Outgoing Militants (People)" = "Deaths (People/Period)" + "Defections (People)" + "Detentions (People)"
Units: People/Period

(241) Percentage of Escaped or Released Detainees Joining ISIS = 1
Units: Fraction
Set at 1 check estiamte for final.

(245) "Population (People)" = INTEG( "Births & Immigration (People/Period)" - "Deaths, Recruiting & Emmigration (People/Period)" , Initial Population
)
Units: People
Combined population of all Syrian and Iraqi Provinces. “Provinces of Syria”, Administrative Divisions of Countries, Statoids, last
modified September 22, 2004, accessed September 19th, 2014, http://www.statoids.com/usy.html. “Provinces of Iraq”, Administrative
Divisions of Countries, Statoids, last modified March 16, 2014, accessed September 19th, 2014, http://www.statoids.com/uiq.html.

(250) "Population Governed through Legitimacy (People)" = INTEG( "Rate of Transition to Governance (People/Period)" - "Rate of Loss of Governance (People/Period)"
, 0)
Units: People

(262) "Rate of Deaths (People/Period)" = "Deaths (People/Period)"
Units: People/Period

(263) "Rate of Detentions (People/Period)" = "Detentions (People)"
Units: People/Period

(264) "Rate of Escape or Release (People/Period)" = "ISIS Detainees (People)" * "Rate of Escape/Released Detainees"
Units: People/Period

(265) "Rate of Escape/Released Detainees" = 0.5
Units: 1/Period

(267) Rate of Local Opposition Fighters Joining Uprising = Diehards joining Uprising + ( Effect of Ungarrision Ratio on Recruiting Rate * Current Territory Recruitable Population
) / Time for Uprising to Form
Units: People/Period

(269) Rate of Recruiting to ISIS = "Foreign Recruiting (People)"
Units: People/Period

(274) Recruitable Population of Controlled Population = "ZScenario1: Table for Recruitable Population based on Location of ISIS on Territorial Map" (
Current Location of ISIS on Territorial Map )
Units: People/Period

(275) "Recruits + Casualities" = "ISIS Detainees (People)" + "Killed ISIS Militants (People)" + Total Recruited
Units: People

(283) Red Infantry Final Losses = ( Red Infantry Initial Losses - ( Red Infantry Initial Losses * "Infantry Recovery (People/Period)" ) )
Units: People

(287) Reduction in Recruitable Population = "Local Recruiting (People)" + Rate of Local Opposition Fighters Joining Uprising
Units: People/Period

(292) "Remaining % of Population" = "Population (People)" / Initial Population
Units: Percentage

(293) Remaining Recruitable Population = INTEG( Increase in Militant Recruitable Population - Reduction in Recruitable Population , Initial Recruitable Population
)
Units: People

(334) Starting Worldwide Population = 100000
Units: People

(340) "Suicide Actions (Military Actions/Period)" = Actual Military Actions * "% of Actions that are Suicide Attacks"
Units: Military Actions/Period

(348) Table for Effect of Militant Experience on Foreign Recruiting Efforts ( [(0,0)-(5,2)],(0,0.5),(1,0.75),(2,0.9),(3,1),(4,1.25),(5,1.5) )
Units: Dmnl

(349) Table for Effect of Militant Experience on Local Recruiting Efforts ( [(0,0)-(5,0.3)],(0,0.01),(1,0.03),(2,0.06),(3,0.09),(4,0.11),(5,0.12) )
Units: Fraction

(353) Table for Effect of Remaining Recruits on Recruiting Efforts ( [(0,0)-(1,1)],(0,1),(0.1,1),(0.2,1),(0.3,1),(0.4,1),(0.5,1),(0.6,0.95),(0.7,0.85)
,(0.8,0.65),(0.9,0.25),(0.95,0.15),(0.97,0.07),(0.99,0.01),(1,0),(1,0) )
Units: Dmnl
This is a modeler created variable.

(358) Table for Effect of Total vs Max Recruitable ( [(0,0)-(1,1)],(0,1),(0.1,1),(0.2,1),(0.3,1),(0.4,1),(0.5,1),(0.6,0.95),(0.7,0.85),(0.8,0.65),(0.9,0.25)
,(0.95,0.15),(0.97,0.07),(0.99,0.01),(1,0),(1,0) )
Units: Dmnl

(375) Time for Population to become Recruitable = 1
Units: Period

(380) Time to Lose Militants = 1
Units: Period

(381) Time to Realize Losses = 1
Units: Period

(386) Total Ever Recruited = INTEG( Increase in Total Ever Recruited , 0)
Units: People

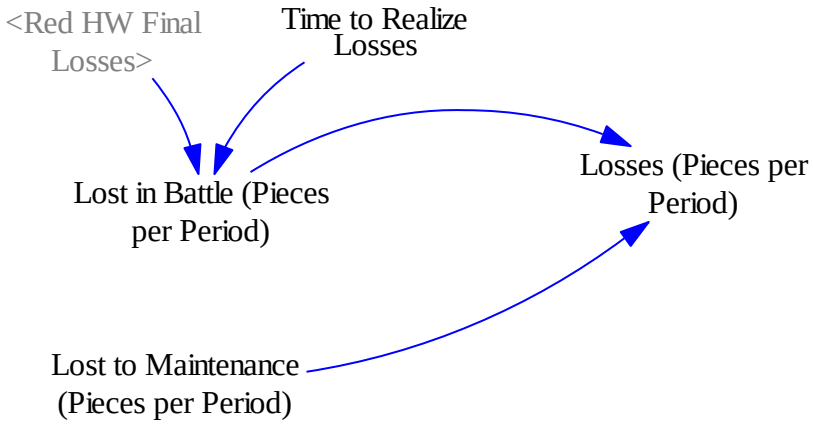
(387) "Total Experience Loss due to Militant Losses (Exp Years)" = ( Average Militant Experience * "Outgoing Militants (People)" )
Units: Exp Years/Period

(388) "Total Foreign Recruits (People)" = INTEG( Inflow of Recruits , 0)
Units: People

(390) Total Recruited = INTEG( Increase in Local Forces , 0)
Units: People

(396) Worldwide Recruitable Population = INTEG( - Rate of Recruiting to ISIS , Starting Worldwide Population )
Units: People

## *Heavy Weapon (AFV & IFV) Sector Structure*


## *Heavy Weapon (AFV & IFV) Sector Equations*

(025) "Additions (Pieces per Period)" = Heavy Weapons Looted
Units: Pieces/Period

(151) Heavy Weapons Looted = ( ( Blue HW Initial Losses * Scavenging Rate of Heavy Weapons ) + ( Blue Artillery Initial Losses * Scavenging Rate of Heavy Weapons ) ) / "Time to Repair & Operate"
Units: Pieces/Period

(197) "Heavy Weapons Purchased (Pieces per Period)" = 0
Units: Pieces/Period

(202) "Losses (Pieces per Period)" = "Lost in Battle (Pieces per Period)" + "Lost to Maintenance (Pieces per Period)"
Units: Pieces/Period

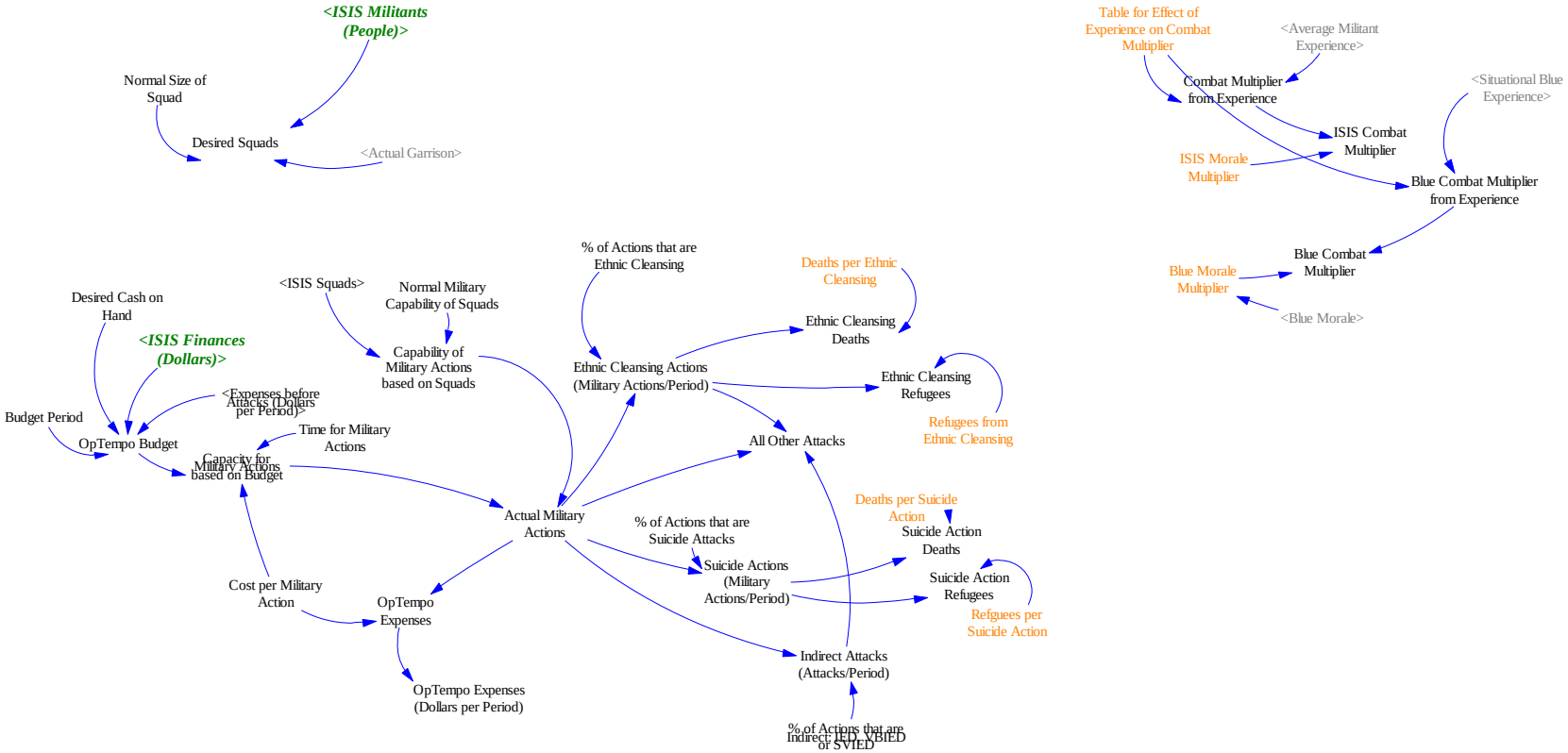
(204) "Lost in Battle (Pieces per Period)" = Red HW Final Losses / Time to Realize Losses
Units: Pieces/Period

(205) "Lost to Maintenance (Pieces per Period)" = 0
Units: Pieces/Period

(278) Red HW Final Losses = ( Red HW Initial Losses - ( Red HW Initial Losses * HW Recovery ) )
Units: Pieces

(381) Time to Realize Losses = 1
Units: Period

# *OpTempo Attacks Sector Structure*



## *OpTempo Attacks Sector Equations*

(007) "% of Actions that are Ethnic Cleansing" = 0.1
Units: Percentage

(008) "% of Actions that are Indirect: IED, VBIED or SVIED" = 0.1
Units: Percentage

(009) "% of Actions that are Suicide Attacks" = 0.1
Units: Percentage

(019) Actual Garrison = MIN ( "Desired Garrison & Police Forces" , Max Garrison Allocation )
Units: People

(022) Actual Military Actions = IF THEN ELSE ( Capacity for Military Actions based on Budget > Capability of Military Actions based on Squads , Capability of Military Actions based on Squads , Capacity for Military Actions based on Budget )
Units: Military Actions/Period

(027) All Other Attacks = Actual Military Actions - "Ethnic Cleansing Actions (Military Actions/Period)" - "Indirect Attacks (Attacks/Period)"
Units: Military Actions/Period

(037) Average Militant Experience = ZIDZ ( "Militant Experience (Years)" , "ISIS Militants (People)" )
Units: Exp Years/Person

(050) Blue Combat Multiplier = 1 + ( Blue Morale Multiplier + Blue Combat Multiplier from Experience )
Units: Dmnl

(051) Blue Combat Multiplier from Experience = Table for Effect of Experience on Combat Multiplier ( Situational Blue Experience )
Units: Dmnl
Table for Effect of Experience on Combat Multiplier(Average Blue Experience)

(065) Blue Morale = "ZScenario1: Table of Blue Morale Based on ISIS Location on Territorial Map" ( Current Location of ISIS on Territorial Map ) + Morale Effect

Units: Dmnl

(066) Blue Morale Multiplier = Blue Morale
Units: Dmnl

(067) Budget Period = 1

Units: Period

(068) Capability of Military Actions based on Squads = ISIS Squads * Normal Military Capability of Squads
Units: Military Actions/Period

(069) Capacity for Military Actions based on Budget = ( OpTempo Budget / Cost per Military Action ) / Time for Military Actions
Units: Military Actions/Period

(074) Combat Multiplier from Experience = Table for Effect of Experience on Combat Multiplier ( Average Militant Experience )
Units: Dmnl

(076) Cost per Military Action = 2700
Units: Dollars/Military Action
Analysis showed that for each $2700 transferred to a sector command, an AQI attack was launched. This cost includes not only direct costs
of the attack, but indirect costs of all the other factors necessary for AQI to peform in that sector outside Media, Courts,
Administration. Furthermore, there was a strong correlation (.66) between the rate of fund flows increasing or decreasing and corresponding
changes in the pace of attacks. RAND 57-69.

(092) Deaths per Ethnic Cleansing = 25
Units: People/Military Action
Check source.

(093) Deaths per Suicide Action = 10
Units: People/Military Action

(101) Desired Cash on Hand = 250000
Units: Dollars

(104) Desired Squads = ( "ISIS Militants (People)" - Actual Garrison ) / Normal Size of Squad
Units: Squads

(130) "Ethnic Cleansing Actions (Military Actions/Period)" = Actual Military Actions * "% of Actions that are Ethnic Cleansing"
Units: Military Actions/Period

(132) "Expenses before Attacks (Dollars per Period)" = "Administration & Governance Expense (Dollars per Period)" + "Death Benefits (Dollars per Period)"
+ "Detention Benefits (Dollars per Period)" + "Media Border Security & Other Expenses (Dollars per Period)" + "Military Procurement (Dollars per Period)"
+ "Payroll (Dollars per Period)"

Units: Dollars/Period

(133) Ethnic Cleansing Deaths = "Ethnic Cleansing Actions (Military Actions/Period)" * Deaths per Ethnic Cleansing
Units: People/Period

(134) Ethnic Cleansing Refugees = "Ethnic Cleansing Actions (Military Actions/Period)" * Refugees from Ethnic Cleansing
Units: People/Period

(167) "Indirect Attacks (Attacks/Period)" = Actual Military Actions * "% of Actions that are Indirect: IED, VBIED or SVIED"
Units: Military Actions/Period

(173) ISIS Combat Multiplier = 1 + ( Combat Multiplier from Experience + ISIS Morale Multiplier )
Units: Dmnl

(176) "ISIS Finances (Dollars)" = INTEG( "Incoming Revenue (Dollars per Period)" - "Outgoing Expenses (Dollars per Period)" , "ZScenario1: Starting Cash"
)
Units: Dollars
("Baseline Switch (1 = On)"*(Capability of Military Actions based on Squads*Cost per Attack))+("Scenario 1 Switch (1 = On)"*"ZScenario1:
Starting Cash")

(178) "ISIS Militants (People)" = INTEG( "Additions (People per Period)" - "Lossess (People per Period)" , ( "Scenario 1 Switch (1 = On)" * ZScenario1 Starting Militants
) )
Units: People
Scenario Determines starting value.

(179) ISIS Morale Multiplier = 0.125
Units: Dmnl
Need data

(182) ISIS Squads = INTEG( "Change in Squads (Squads/Period)" , "ISIS Militants (People)" / Normal Size of Squad )
Units: Squads
Initialized at the starting Initial Number of Militants divided by the Normal Size of Squads

(226) Normal Military Capability of Squads = 3
Units: Military Actions/(Period*Squad)
1 every 2 months is normal

(229) Normal Size of Squad = 11
Units: People/Squad

(234) OpTempo Budget = MAX ( 0, ( "ISIS Finances (Dollars)" - Desired Cash on Hand ) - "Expenses before Attacks (Dollars per Period)" * Budget Period
)
Units: Dollars

(235) OpTempo Expenses = Actual Military Actions * Cost per Military Action
Units: Dollars/Period

(236) "OpTempo Expenses (Dollars per Period)" = OpTempo Expenses
Units: Dollars/Period

(288) Refguees per Suicide Action = 25
Units: People/Military Action

(290) Refugees from Ethnic Cleansing = 250
Units: People/Military Action

(330) Situational Blue Experience = "ZScenario1: Table of Blue Experienced based on ISIS Location on Territorial Map" ( Current Location of ISIS on Territorial Map
) + Experience Effect
Units: Exp Years

(338) Suicide Action Deaths = "Suicide Actions (Military Actions/Period)" * Deaths per Suicide Action
Units: People/Period

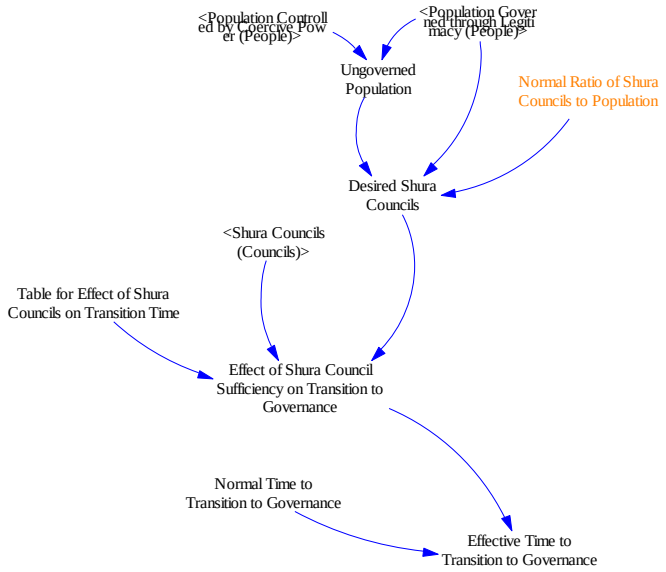
(339) Suicide Action Refugees = "Suicide Actions (Military Actions/Period)" * Refguees per Suicide Action
Units: People/Period

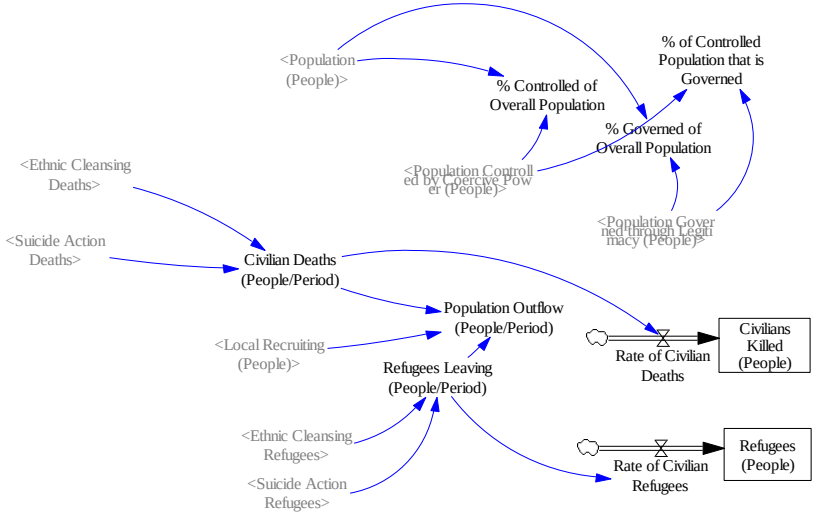
(340) "Suicide Actions (Military Actions/Period)" = Actual Military Actions * "% of Actions that are Suicide Attacks"
Units: Military Actions/Period

(347) Table for Effect of Experience on Combat Multiplier ( [(0,-0.3)-(4,1)],(0,-0.25),(0.5,-0.125),(1,0),(1.5,0.125),(2,0.25),(2.5,0.5),(3,0.75) )
Units: Dmnl

(374) Time for Military Actions = 1
Units: Periods

## *Governance & Population Sector Structure*



## *Governance & Population Sector Equations*

(005) "% Controlled of Overall Population" = ZIDZ ( "Population Controlled by Coercive Power (People)" , "Population (People)" )
Units: Fraction

(006) "% Governed of Overall Population" = ZIDZ ( "Population Governed through Legitimacy (People)" , "Population (People)" )
Units: Fraction

(012) "% of Controlled Population that is Governed" = ZIDZ ( "Population Governed through Legitimacy (People)" , "Population Controlled by Coercive Power (People)"
)
Units: Fraction

(072) "Civilian Deaths (People/Period)" = Ethnic Cleansing Deaths + Suicide Action Deaths
Units: People/Period

(073) "Civilians Killed (People)" = INTEG( Rate of Civilian Deaths , 0)
Units: People

(103) Desired Shura Councils = ( "Population Governed through Legitimacy (People)" + Ungoverned Population ) / Normal Ratio of Shura Councils to Population

Units: Councils

(124) Effective Time to Transition to Governance = Normal Time to Transition to Governance * Effect of Shura Council Sufficiency on Transition to Governance

Units: Period

(133) Ethnic Cleansing Deaths = "Ethnic Cleansing Actions (Military Actions/Period)" * Deaths per Ethnic Cleansing
Units: People/Period

(134) Ethnic Cleansing Refugees = "Ethnic Cleansing Actions (Military Actions/Period)" * Refugees from Ethnic Cleansing
Units: People/Period

(189) "Local Recruiting (People)" = ( Recruitable Population of Controlled Population * Local Recruiting Rate * "Effect of Remaining Recruits on Local Recruiting (Opposition & Militant)"
) * Disable Local Recruiting
Units: People/Period
Must have territorial control to begin local recruiting.

(195) Effect of Shura Council Sufficiency on Transition to Governance = Table for Effect of Shura Councils on Transition Time ( ZIDZ ( "Shura Councils (Councils)"
, Desired Shura Councils ) )
Units: Dmnl

(227) Normal Ratio of Shura Councils to Population = 100000
Units: People/Council

(230) Normal Time to Transition to Governance = 1
Units: Period
The Normal Time to transition from Controlled to Governance is 1 period, or 6 months. This is estimated based on the time it took ISIS to
establish governance in Ar Raqqah city from March 2013 to June 2013. The Normal time to Transition to Governance is modified by other
factors to determine the Effective time to Transition.

(245) "Population (People)" = INTEG( "Births & Immigration (People/Period)" - "Deaths, Recruiting & Emmigration (People/Period)" , Initial Population
)
Units: People
Combined population of all Syrian and Iraqi Provinces. “Provinces of Syria”, Administrative Divisions of Countries, Statoids, last
modified September 22, 2004, accessed September 19th, 2014, http://www.statoids.com/usy.html. “Provinces of Iraq”, Administrative
Divisions of Countries, Statoids, last modified March 16, 2014, accessed September 19th, 2014, http://www.statoids.com/uiq.html.

(246) "Population Controlled by Coercive Power (People)" = INTEG( "Gain in Control (People/Period)" - "Loss of Control (People/Period)" , ( "Scenario 1 Switch (1 = On)"
* "ZScenario1: Starting Population Controlled" ) )
Units: People

(250) "Population Governed through Legitimacy (People)" = INTEG( "Rate of Transition to Governance (People/Period)" - "Rate of Loss of Governance (People/Period)"
, 0)
Units: People

(251) "Population Outflow (People/Period)" = "Civilian Deaths (People/Period)" + "Local Recruiting (People)" + "Refugees Leaving (People/Period)"
Units: People/Period

(259) Rate of Civilian Deaths = "Civilian Deaths (People/Period)"
Units: People/Period

(260) Rate of Civilian Refugees = "Refugees Leaving (People/Period)"

Units: People/Period

(289) "Refugees (People)" = INTEG( Rate of Civilian Refugees , 0)
Units: People

(291) "Refugees Leaving (People/Period)" = Ethnic Cleansing Refugees + Suicide Action Refugees
Units: People/Period

(329) "Shura Councils (Councils)" = INTEG( "Rate of Councils Formed (Councils/Period)" , "Population Governed through Legitimacy (People)" / Normal Ratio of Shura Councils to Population )
Units: Councils
Initialized at the Starting Governed Population / Normal ratio of Shura Councils

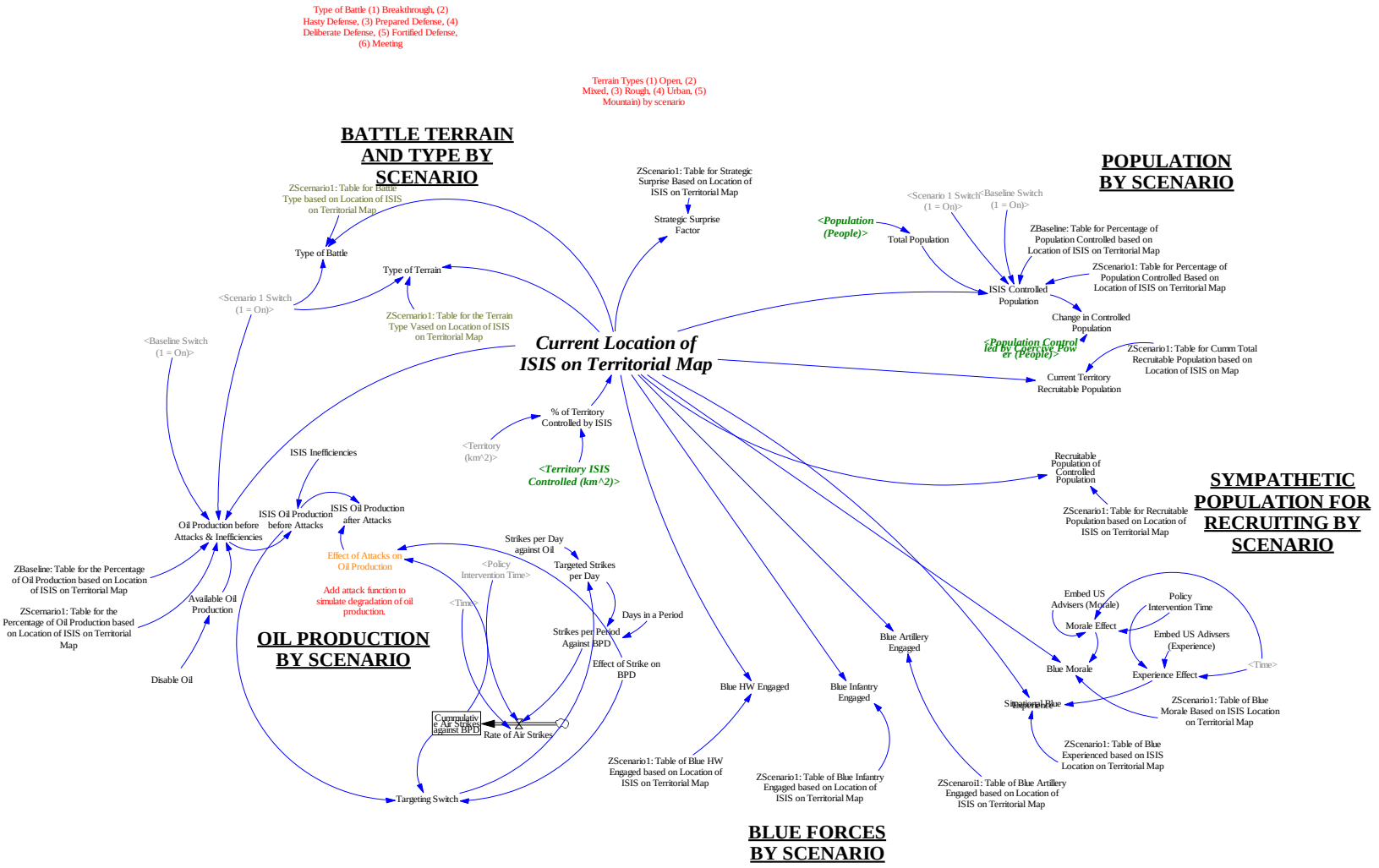
(338) Suicide Action Deaths = "Suicide Actions (Military Actions/Period)" * Deaths per Suicide Action
Units: People/Period

(339) Suicide Action Refugees = "Suicide Actions (Military Actions/Period)" * Refguees per Suicide Action
Units: People/Period

(354) Table for Effect of Shura Councils on Transition Time ( [(0,0)-(1,10)],(0,10),(1,1) )
Units: Dmnl

(393) Ungoverned Population = "Population Controlled by Coercive Power (People)" - "Population Governed through Legitimacy (People)"
Units: People

# *Territory & Scenario Sector Structure*



## *Territory & Scenario Sector Equations*

(017) "% of Territory Controlled by ISIS" = "Territory ISIS Controlled (km^2)" / "Territory (km^2)"
Units: Percentage

(033) Available Oil Production = 5.013e+008 * Disable Oil
Units: Barrels/Period
Total Syria & Iraq production pre-war and prior to ISIS inefficiences or attacks.

(040) "Baseline Switch (1 = On)" = 0
Units: Dmnl

(047) Blue Artillery Engaged = "ZScenaroi1: Table of Blue Artillery Engaged based on Location of ISIS on Territorial Map" ( Current Location of ISIS on Territorial Map
)
Units: Pieces

(055) Blue HW Engaged = "ZScenario1: Table of Blue HW Engaged based on Location of ISIS on Territorial Map" ( Current Location of ISIS on Territorial Map
)
Units: Pieces

(061) Blue Infantry Engaged = "ZScenario1: Table of Blue Infantry Engaged based on Location of ISIS on Territorial Map" ( Current Location of ISIS on Territorial Map
)
Units: People

(065) Blue Morale = "ZScenario1: Table of Blue Morale Based on ISIS Location on Territorial Map" ( Current Location of ISIS on Territorial Map ) + Morale Effect

Units: Dmnl

(070) Change in Controlled Population = ISIS Controlled Population - "Population Controlled by Coercive Power (People)"
Units: People

(083) Cummulative Air Strikes against BPD = INTEG( Rate of Air Strikes , 0)
Units: Strikes

(084) Current Location of ISIS on Territorial Map = "% of Territory Controlled by ISIS"
Units: Percentage

(085) Current Territory Recruitable Population = "ZScenario1: Table for Cumm Total Recruitable Population based on Location of ISIS on Map" ( Current Location of ISIS on Territorial Map
)
Units: People

(087) Days in a Period = 180
Units: Dmnl

(111) Disable Oil = 1
Units: Barrels/Period
Used for Proposition 2 - normal value =1, disabled value = 0

(114) Effect of Attacks on Oil Production = Cummulative Air Strikes against BPD * Effect of Strike on BPD
Units: Barrels/Period

(121) Effect of Strike on BPD = 400
Units: Barrels/(Period*Strike)

(125) "Embed US Adivsers (Experience)" = 1
Units: Exp Years
0 is normal. 1 is the increase in average Exp Years due to having US troops embedded.

(126) "Embed US Advisers (Morale)" = 0.25
Units: Dmnl
0 is normal. .25 is nominal additional morale factor for US troops being embedded.

(136) Experience Effect = IF THEN ELSE ( Time > Policy Intervention Time , "Embed US Adivsers (Experience)" , 0)
Units: Exp Years

(174) ISIS Controlled Population = ( "Baseline Switch (1 = On)" * "ZBaseline: Table for Percentage of Population Controlled based on Location of ISIS on Territorial Map"
( Current Location of ISIS on Territorial Map ) * Total Population ) + ( "Scenario 1 Switch (1 = On)" * "ZScenario1: Table for Percentage of Population Controlled Based on Location of ISIS on Territorial Map"
( Current Location of ISIS on Territorial Map ) * Total Population )
Units: People

(177) ISIS Inefficiencies = 0.5
Units: Fraction

(180) ISIS Oil Production after Attacks = ISIS Oil Production before Attacks - Effect of Attacks on Oil Production
Units: Barrels/Period

(181) ISIS Oil Production before Attacks = "Oil Production before Attacks & Inefficiencies" * ISIS Inefficiencies
Units: Barrels/Period

(222) Morale Effect = IF THEN ELSE ( Time > Policy Intervention Time , "Embed US Advisers (Morale)" , 0)
Units: Dmnl

(232) "Oil Production before Attacks & Inefficiencies" = ( "Baseline Switch (1 = On)" * "ZBaseline: Table for the Percentage of Oil Production based on Location of ISIS on Territorial Map"
( Current Location of ISIS on Territorial Map ) * Available Oil Production ) + ( "Scenario 1 Switch (1 = On)" * "ZScernario1: Table for the Percentage of Oil Production based on Location of ISIS on Territorial Map"
( Current Location of ISIS on Territorial Map ) * Available Oil Production )
Units: Barrels/Period
At least one switch must be activated on main page.

(244) Policy Intervention Time = 2013.5
Units: Period

(245) "Population (People)" = INTEG( "Births & Immigration (People/Period)" - "Deaths, Recruiting & Emmigration (People/Period)" , Initial Population
)
Units: People
Combined population of all Syrian and Iraqi Provinces. “Provinces of Syria”, Administrative Divisions of Countries, Statoids, last
modified September 22, 2004, accessed September 19th, 2014, http://www.statoids.com/usy.html. “Provinces of Iraq”, Administrative
Divisions of Countries, Statoids, last modified March 16, 2014, accessed September 19th, 2014, http://www.statoids.com/uiq.html.

(246) "Population Controlled by Coercive Power (People)" = INTEG( "Gain in Control (People/Period)" - "Loss of Control (People/Period)" , ( "Scenario 1 Switch (1 = On)"
* "ZScenario1: Starting Population Controlled" ) )
Units: People

(257) Rate of Air Strikes = IF THEN ELSE ( Time > Policy Intervention Time , Strikes per Period Against BPD , 0)
Units: Strikes/Period

(274) Recruitable Population of Controlled Population = "ZScenario1: Table for Recruitable Population based on Location of ISIS on Territorial Map" (
Current Location of ISIS on Territorial Map )
Units: People/Period

(296) "Scenario 1 Switch (1 = On)" = 1
Units: Dmnl

(330) Situational Blue Experience = "ZScenario1: Table of Blue Experienced based on ISIS Location on Territorial Map" ( Current Location of ISIS on Territorial Map

) + Experience Effect
Units: Exp Years

(335) Strategic Surprise Factor = "ZScenario1: Table for Strategic Surprise Based on Location of ISIS on Territorial Map" ( Current Location of ISIS on Territorial Map
)
Units: Dmnl

(336) Strikes per Day against Oil = 0
Units: Strikes/Period
Normal value is 0. Minimal is 5, Significant is 50, intensive is 250.

(337) Strikes per Period Against BPD = Targeted Strikes per Day * Days in a Period
Units: Strikes/Period

(367) Targeted Strikes per Day = Strikes per Day against Oil * Targeting Switch
Units: Strikes/Period

(368) Targeting Switch = IF THEN ELSE ( Cummulative Air Strikes against BPD > ( ISIS Oil Production before Attacks / Effect of Strike on BPD ) , 0, 1)
Units: Dmnl

(371) "Territory (km^2)" = 619308
Units: "km^2"
Includes all Provinces and Governates of Iraq and Syria. “Provinces of Syria”, Administrative Divisions of Countries, Statoids, last
modified September 22, 2004, accessed September 19th, 2014, http://www.statoids.com/usy.html. “Provinces of Iraq”, Administrative
Divisions of Countries, Statoids, last modified March 16, 2014, accessed September 19th, 2014, http://www.statoids.com/uiq.html.

(372) "Territory ISIS Controlled (km^2)" = INTEG( "Rate of Territory Gained (km^2/period)" - "Rate of Territory Lost (km^2/Period)" , ( "Scenario 1 Switch (1 = On)"
* "ZScenario1: Starting Territory" ) )
Units: "km^2"

(389) Total Population = "Population (People)"
Units: People

(391) Type of Battle = ( "Scenario 1 Switch (1 = On)" * "ZScernario1: Table for Battle Type based on Location of ISIS on Territorial Map" ( Current Location of ISIS on Territorial Map
) )
Units: Dmnl

(392) Type of Terrain = ( "Scenario 1 Switch (1 = On)" * "ZScernario1: Table for the Terrain Type Vased on Location of ISIS on Territorial Map" ( Current Location of ISIS on Territorial Map

) )
Units: Dmnl

(397) "ZBaseline: Table for Percentage of Population Controlled based on Location of ISIS on Territorial Map" ( [(0,0)-(1,1)],(0,0),(1,1) )
Units: Percentage

(398) "ZBaseline: Table for the Percentage of Oil Production based on Location of ISIS on Territorial Map" ( [(0,0)-(1,1)],(0,0),(1,1) )
Units: Percentage
Need Values for Total BPD Potential Production

(404) "ZScenario1: Table for Cumm Total Recruitable Population based on Location of ISIS on Map" ( [(0,0)-(1,400000)],(0.00317,50662),(0.00322,125750)
,(0.0566,356842),(0.08828,487942),(0.08844,599080),(0.08866,1.01308e+006),(0.31224,1.08208e+006),(0.3725,1.18374e+006),(0.41247,1.33232e+006)
,(0.41263,1.39212e+006),(0.41885,1.40175e+006),(0.45652,1.4655e+006),(0.45657,1.468e+006),(0.48642,1.858e+006),(0.48672,2.17782e+006),(0.50235,2.23182e+006)
,(0.50251,2.3169e+006),(0.51686,2.5611e+006),(0.51702,2.67367e+006),(0.5852,2.83867e+006),(0.61432,2.94867e+006),(0.61465,3.30947e+006),(0.61482,3.39502e+006)
)
Units: People

(405) "ZScenario1: Table for Percentage of Population Controlled Based on Location of ISIS on Territorial Map" ( [(0,0)-(1,1)],(0.00317,0.006),(0.00322,0.014)
,(0.0566,0.039),(0.08828,0.053),(0.08844,0.065),(0.08866,0.11),(0.31224,0.118),(0.3725,0.129),(0.41247,0.145),(0.41263,0.151),(0.41885,0.156)
,(0.45652,0.188),(0.45657,0.189),(0.48642,0.254),(0.48672,0.308),(0.50235,0.321),(0.50251,0.343),(0.51686,0.383),(0.51702,0.402),(0.5852,0.43)
,(0.61432,0.457),(0.61465,0.638),(0.61482,0.681) )
Units: Percentage

(406) "ZScenario1: Table for Recruitable Population based on Location of ISIS on Territorial Map" ( [(0,0)-(1,400000)],(0.00317,50662),(0.00322,75088)
,(0.0566,231092),(0.08828,131100),(0.08844,111138),(0.08866,414000),(0.31224,69000),(0.3725,101660),(0.41247,148580),(0.41263,59800),(0.41885,9626)
,(0.45652,63756),(0.45657,2500),(0.48642,390000),(0.48672,319815),(0.50235,54000),(0.50251,85079),(0.51686,244200),(0.51702,112575),(0.5852,165000)
,(0.61432,110000),(0.61465,360800),(0.61482,85550) )
Units: People/(Period*Percentage)

(407) "ZScenario1: Table for Strategic Surprise Based on Location of ISIS on Territorial Map" ( [(0,0)-(1,1)],(0.00317,0.05),(0.00322,0.05),(0.0566,0.25)
,(0.08828,0.25),(0.08844,0.5),(0.08866,0.5),(0.31224,1),(0.41247,1),(0.41263,1),(0.41885,1),(0.45652,1),(0.45657,1),(0.48642,1),(0.48672,1)

,(0.50235,1),(0.50251,1),(0.51686,1),(0.51702,1),(0.5852,1),(0.61432,1),(0.61465,1),(0.61482,1)
,(1,1) )
Units: Dmnl

(408) "ZScenario1: Table of Blue Experienced based on ISIS Location on Territorial Map" ( [(0,0)-
(1,5)],(0.00317,0.25),(0.00322,0.25),(0.0566,0.25),(0.08828,0.25)
,(0.08844,0.25),(0.08866,0.25),(0.31224,0.25),(0.3725,0.25),(0.41247,0.25),(0.41263,5),(0.4188
5,5),(0.45652,5),(0.45657,3),(0.48642,3),(0.48672,3)
,(0.50235,5),(0.50251,5),(0.51686,3),(0.51702,3),(0.5852,3),(0.61432,3),(0.61465,3),(0.61482,3)
)
Units: Exp Years

(409) "ZScenario1: Table of Blue HW Engaged based on Location of ISIS on Territorial Map" ( [(0,0)-
(1,5000)],(0.00317,80),(0.00322,119),(0.0566,365),(0.08828,207)
,(0.08844,176),(0.08866,654),(0.31224,109),(0.3725,161),(0.41247,235),(0.41263,95),(0.41885,
70),(0.45652,28),(0.45657,454),(0.48642,436),(0.48672,1218)
,(0.50235,51),(0.50251,455),(0.51686,301),(0.51702,126),(0.5852,799),(0.61432,400),(0.61465,
4796),(0.61482,3197) )
Units: Pieces/Percentage

(410) "ZScenario1: Table of Blue Infantry Engaged based on Location of ISIS on Territorial Map"
( [(0,0)-(1,600000)],(0.00317,8531),(0.00322,12645),(0.0566,38916)
,(0.08828,22077),(0.08844,18716),(0.08866,69717),(0.31224,11620),(0.3725,17120),(0.41247,2
5021),(0.41263,10070),(0.41885,7456),(0.45652,2941)
,(0.45657,48375),(0.48642,46440),(0.48672,129753),(0.50235,5433),(0.50251,48437),(0.51686,
32090),(0.51702,13468),(0.5852,85140),(0.61432,42605)
,(0.61465,510840),(0.61482,340560) )
Units: People/Percentage

(411) "ZScenario1: Table of Blue Morale Based on ISIS Location on Territorial Map" ( [(0,-0.3)-
(1,0.15)],(0.00317,-0.25),(0.00322,-0.25),(0.0566,-0.25)
,(0.08828,-0.25),(0.08844,-0.25),(0.08866,-0.25),(0.31224,-0.25),(0.3725,-
0.25),(0.41247,0),(0.41263,0),(0.41885,0),(0.45652,0.125),(0.45657,0.125)
,(0.48642,0.125),(0.48672,0.05),(0.50235,0.05),(0.50251,0.05),(0.51686,0),(0.51702,0),(0.5852,
0),(0.61432,0),(0.61465,0.125),(0.61482,0.125)
)
Units: Dmnl

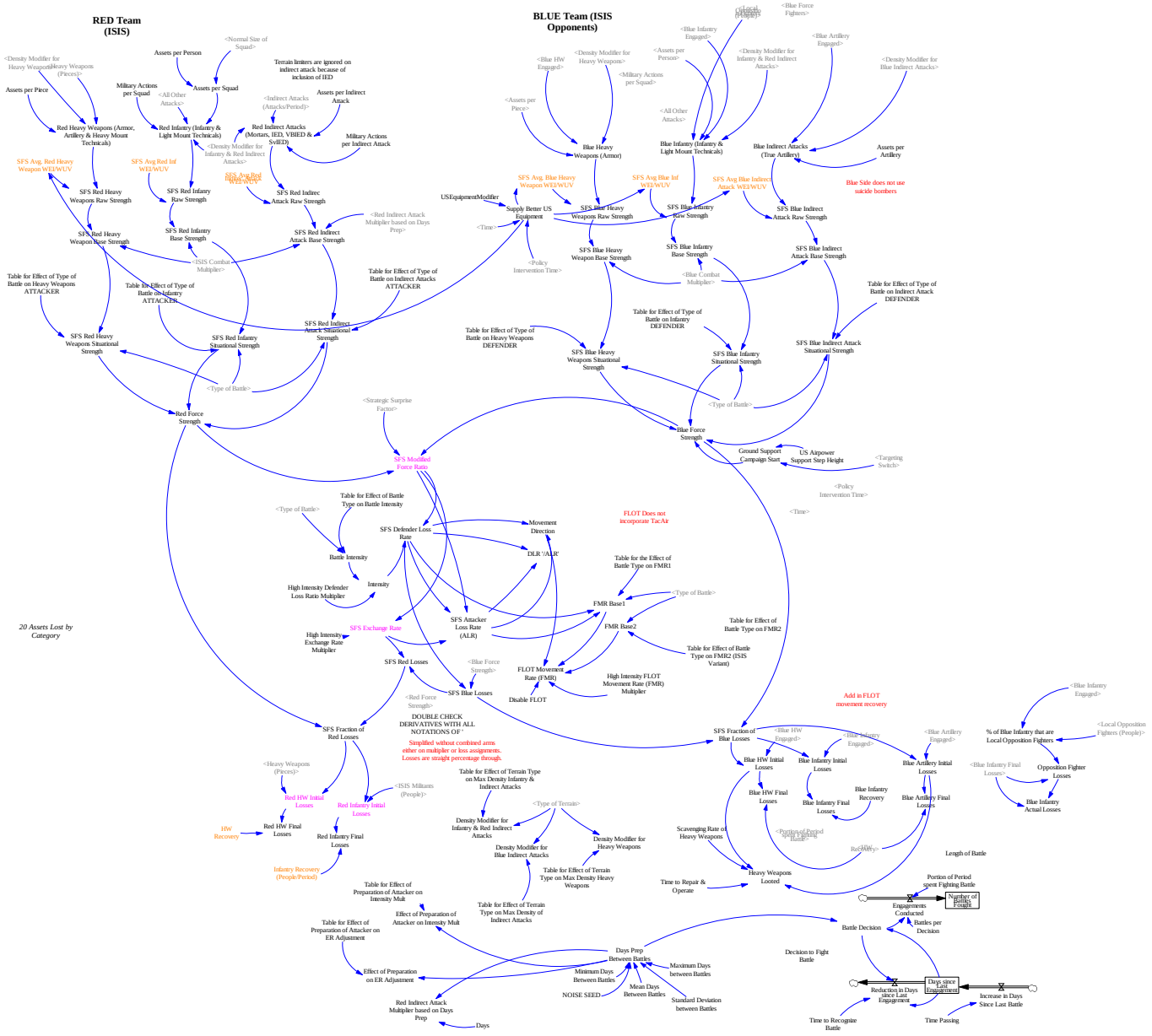
(412) "ZScenaroi1: Table of Blue Artillery Engaged based on Location of ISIS on Territorial Map"
( [(0,0)-(1,1600)],(0.00317,26),(0.00322,39),(0.0566,121)
,(0.08828,68),(0.08844,58),(0.08866,216),(0.31224,36),(0.3725,53),(0.41247,78),(0.41263,31),(0
.41885,23),(0.45652,9),(0.45657,150),(0.48642,144)
,(0.48672,403),(0.50235,17),(0.50251,150),(0.51686,100),(0.51702,42),(0.5852,264),(0.61432,1
32),(0.61465,1585),(0.61482,1057) )
Units: Pieces/Percentage

(413) "ZScernario1: Table for Battle Type based on Location of ISIS on Territorial Map" ( [(0,0)-(0.7,6)],(0.00317,1),(0.00322,1),(0.0566,3),(0.08828,3)
,(0.08844,4),(0.08866,2),(0.31224,1),(0.3725,1),(0.41247,1),(0.41263,3),(0.41885,1),(0.45652,6),(0.45657,5),(0.48642,6),(0.48672,5),(0.50235,6)
,(0.50251,5),(0.51686,1),(0.51702,6),(0.5852,5),(0.61432,2),(0.61465,5),(0.61482,5) )
Units: Dmnl
Scenario 1

(414) "ZScernario1: Table for the Percentage of Oil Production based on Location of ISIS on Territorial Map" ( [(0,0)-(1,0.2)],(0,0),(0.039,0.01307),(0.343,0.0382)
,(0.46467,0.11783),(1,0.11783) )
Units: Percentage
Scenario 1

(415) "ZScernario1: Table for the Terrain Type Vased on Location of ISIS on Territorial Map" ( [(0,0)-(0.7,5)],(0.00317,4),(0.00322,4),(0.0566,1),(0.08828,1)
,(0.08844,4),(0.08866,4),(0.31224,1),(0.3725,1),(0.41247,1),(0.41263,4),(0.41885,2),(0.45652,5),(0.45657,4),(0.48642,1),(0.48672,4),(0.50235,1)
,(0.50251,4),(0.51686,1),(0.51702,2),(0.5852,4),(0.61432,2),(0.61465,4),(0.61482,4) )
Units: Dmnl
Scenario 1

# *Combat Simulator (Situational Force Scoring) Sector Structure*



## *Combat Simulator (Situational Force Scoring) Sector Equations*

(004) TIME STEP = 0.0055
Units: Period [0,?]
The time step for the simulation.

(011) "% of Blue Infantry that are Local Opposition Fighters" = "Local Opposition Fighters (People)" / ( Blue Infantry Engaged + "Local Opposition Fighters (People)"
)
Units: Percentage

(027) All Other Attacks = Actual Military Actions - "Ethnic Cleansing Actions (Military Actions/Period)" - "Indirect Attacks (Attacks/Period)"
Units: Military Actions/Period

(028) Assets per Artillery = 1
Units: Assets/Pieces

(029) Assets per Indirect Attack = 1
Units: Assets

(030) Assets per Person = 1
Units: Assets/Person

(031) Assets per Piece = 1
Units: Assets/Pieces

(032) Assets per Squad = Assets per Person * Normal Size of Squad
Units: Assets/Squad

(041) Battle Decision = ( IF THEN ELSE ( Days since Last Engagement > Days Prep Between Battles , 1, 0) )
Units: Days

(042) Battle Intensity = Table for Effect of Battle Type on Battle Intensity ( Type of Battle )
Units: Dmnl

(043) Battles per Decision = 1
Units: Battle/Day

(047) Blue Artillery Engaged = "ZScenaroi1: Table of Blue Artillery Engaged based on Location of ISIS on Territorial Map" ( Current Location of ISIS on Territorial Map
)
Units: Pieces

(048) Blue Artillery Final Losses = ( Blue Artillery Initial Losses - ( Blue Artillery Initial Losses * HW Recovery ) )
Units: Pieces

(049) Blue Artillery Initial Losses = Blue Artillery Engaged * SFS Fraction of Blue Losses
Units: Pieces

(050) Blue Combat Multiplier = 1 + ( Blue Morale Multiplier + Blue Combat Multiplier from Experience )
Units: Dmnl

(052) Blue Force Fighters = INTEG( Increase in Blue Force Fighters - Rate of Blue Force Deaths , Starting Blue Force Fighters Actively Opopsing ISIS )
Units: People

(053) Blue Force Strength = ( SFS Blue Heavy Weapons Situational Strength + SFS Blue Indirect Attack Situational Strength + SFS Blue Infantry Situational Strength
) + ( ( SFS Blue Heavy Weapons Situational Strength + SFS Blue Indirect Attack Situational Strength + SFS Blue Infantry Situational Strength
) * Ground Support Campaign Start )
Units: Dmnl

(054) "Blue Heavy Weapons (Armor)" = Blue HW Engaged * Assets per Piece * Density Modifier for Heavy Weapons
Units: Assets

(055) Blue HW Engaged = "ZScenario1: Table of Blue HW Engaged based on Location of ISIS on Territorial Map" ( Current Location of ISIS on Territorial Map
)
Units: Pieces

(056) Blue HW Final Losses = ( Blue HW Initial Losses - ( Blue HW Initial Losses * HW Recovery ) )
Units: Pieces

(057) Blue HW Initial Losses = Blue HW Engaged * SFS Fraction of Blue Losses
Units: Pieces

(058) "Blue Indirect Attacks (True Artillery)" = ( Blue Artillery Engaged ) * Assets per Artillery * Density Modifier for Blue Indirect Attacks
Units: Assets

(059) "Blue Infantry (Infantry & Light Mount Technicals)" = ( Blue Infantry Engaged + "Local Opposition Fighters (People)" ) * Assets per Person * "Density Modifier for Infantry & Red Indirect Attacks"

Units: Assets

(060) Blue Infantry Actual Losses = Blue Infantry Final Losses - Opposition Fighter Losses
Units: People/Period

(061) Blue Infantry Engaged = "ZScenario1: Table of Blue Infantry Engaged based on Location of ISIS on Territorial Map" ( Current Location of ISIS on Territorial Map
)
Units: People

(062) Blue Infantry Final Losses = Blue Infantry Initial Losses * Blue Infantry Recovery
Units: People/Period

(063) Blue Infantry Initial Losses = Blue Infantry Engaged * SFS Fraction of Blue Losses
Units: People

(064) Blue Infantry Recovery = 0.25
Units: Fraction/Period

(086) Days = 1
Units: Days

(088) Days Prep Between Battles = RANDOM NORMAL ( Minimum Days Between Battles , Maximum Days between Battles , Mean Days Between Battles , Standard Deviation between Battles , NOISE SEED )
Units: Days

(089) Days since Last Engagement = INTEG( Increase in Days Since Last Battle - Reduction in Days since Last Engagement , 5)
Units: Days

(095) Decision to Fight Battle = 1
Units: Days

(098) Density Modifier for Blue Indirect Attacks = Table for Effect of Terrain Type on Max Density of Indirect Attacks ( Type of Terrain )
Units: Dmnl

(099) Density Modifier for Heavy Weapons = Table for Effect of Terrain Type on Max Density Heavy Weapons ( Type of Terrain )
Units: Dmnl

(100) "Density Modifier for Infantry & Red Indirect Attacks" = "Table for Effect of Terrain Type on Max Density Infantry & Indirect Attacks" ( Type of Terrain
)
Units: Dmnl

(108) Disable FLOT = 1
Units: Dmnl
Used to test Proposition 1. Normal value =1 , disabled value = 0.

(112) "DLR '/ALR'" = ZIDZ ( SFS Defender Loss Rate , "SFS Attacker Loss Rate (ALR)" )
Units: Dmnl

(116) Effect of Preparation of Attacker on Intensity Mult = Table for Effect of Preparation of Attacker on Intensity Mult ( Days Prep Between Battles
)
Units: Dmnl

(117) Effect of Preparation on ER Adjustment = Table for Effect of Preparation of Attacker on ER Adjustment ( Days Prep Between Battles )
Units: Dmnl

(127) Engagements Conducted = ( Battle Decision * Battles per Decision ) / Portion of Period spent Fighting Battle
Units: Battles/Period

(139) "FLOT Movement Rate (FMR)" = ( ( ( FMR Base1 + FMR Base2 ) * "High Intensity FLOT Movement Rate (FMR) Multiplier" ) * Disable FLOT ) * Movement Direction

Units: "km^2"

(140) FMR Base1 = Table for the Effect of Battle Type on FMR1 ( Type of Battle ) * ZIDZ ( SFS Defender Loss Rate , "SFS Attacker Loss Rate (ALR)" )
Units: Dmnl

(141) FMR Base2 = "Table for Effect of Battle Type on FMR2 (ISIS Variant)" ( Type of Battle )
Units: Dmnl

(148) Ground Support Campaign Start = IF THEN ELSE ( Targeting Switch = 0, US Airpower Support Step Height , 0)
Units: Dmnl

(150) "Heavy Weapons (Pieces)" = INTEG( "Heavy Weapon Additions (Pieces per Period)" - "Heavy Weapon Losses (Pieces per Period)" , 0)
Units: Pieces

(151) Heavy Weapons Looted = ( ( Blue HW Initial Losses * Scavenging Rate of Heavy Weapons ) + ( Blue Artillery Initial Losses * Scavenging Rate of Heavy Weapons
) ) / "Time to Repair & Operate"
Units: Pieces/Period

(152) High Intensity Defender Loss Ratio Multiplier = 1.5

Units: Dmnl

(153) High Intensity Exchange Rate Multiplier = 1
Units: Dmnl

(154) "High Intensity FLOT Movement Rate (FMR) Multiplier" = 1.5
Units: "km^2"

(155) HW Recovery = 0.1
Units: Fraction
Placeholder rate at which initial losses are recovered after the battle.

(163) Increase in Days Since Last Battle = Time Passing
Units: Days/Period

(167) "Indirect Attacks (Attacks/Period)" = Actual Military Actions * "% of Actions that are Indirect: IED, VBIED or SVIED"
Units: Military Actions/Period

(168) "Infantry Recovery (People/Period)" = 0.25
Units: Fraction

(172) Intensity = High Intensity Defender Loss Ratio Multiplier * Battle Intensity
Units: Dmnl

(173) ISIS Combat Multiplier = 1 + ( Combat Multiplier from Experience + ISIS Morale Multiplier )
Units: Dmnl

(178) "ISIS Militants (People)" = INTEG( "Additions (People per Period)" - "Lossess (People per Period)" , ( "Scenario 1 Switch (1 = On)" * ZScenario1 Starting Militants
) )
Units: People
Scenario Determines starting value.

(186) Length of Battle = 0.0055
Units: Period

(188) "Local Opposition Fighters (People)" = INTEG( Rate of Local Opposition Fighters Joining Uprising - Rate of Local Fighter Deaths , 0)
Units: People

(212) Maximum Days between Battles = 20
Units: Days

(213) Mean Days Between Battles = 6
Units: Days

(216) Military Actions per Indirect Attack = 1
Units: Military Actions/Period

(217) Military Actions per Squad = 1
Units: Military Actions/(Period*Squad)

(221) Minimum Days Between Battles = 0.5
Units: Days

(223) Movement Direction = IF THEN ELSE ( SFS Defender Loss Rate - "SFS Attacker Loss Rate (ALR)" >= 0, 1, -1)
Units: Dmnl

(224) NOISE SEED = 0
Units: Dmnl
Set to 0 noise seed. Can be varied.

(229) Normal Size of Squad = 11
Units: People/Squad

(231) Number of Battles Fought = INTEG( Engagements Conducted , 0)
Units: Battles

(233) Opposition Fighter Losses = Blue Infantry Final Losses * "% of Blue Infantry that are Local Opposition Fighters"
Units: People/Period

(244) Policy Intervention Time = 2013.5
Units: Period

(252) Portion of Period spent Fighting Battle = 0.0055
Units: Period

(276) Red Force Strength = ( SFS Red Heavy Weapons Situational Strength + SFS Red Indirect Attack Situational Strength + SFS Red Infantry Situational Strength
)
Units: Dmnl

(277) "Red Heavy Weapons (Armor, Artillery & Heavy Mount Technicals)" = "Heavy Weapons (Pieces)" * Assets per Piece * Density Modifier for Heavy Weapons

Units: Assets

(278) Red HW Final Losses = ( Red HW Initial Losses - ( Red HW Initial Losses * HW Recovery ) )
Units: Pieces

(279) Red HW Initial Losses = MIN ( "Heavy Weapons (Pieces)" , "Heavy Weapons (Pieces)" * SFS Fraction of Red Losses )
Units: Pieces
Added minimum function

(280) Red Indirect Attack Multiplier based on Days Prep = IF THEN ELSE ( Days Prep Between Battles > 10, 1.1, 0.9 + ( 0.02 * Days Prep Between Battles
/ Days ) )
Units: Dmnl

(281) "Red Indirect Attacks (Mortars, IED, VBIED & SvIED)" = ( "Indirect Attacks (Attacks/Period)" / Military Actions per Indirect Attack ) * Assets per Indirect Attack
* "Density Modifier for Infantry & Red Indirect Attacks"
Units: Assets

(282) "Red Infantry (Infantry & Light Mount Technicals)" = ( All Other Attacks / Military Actions per Squad ) * Assets per Squad * "Density Modifier for Infantry & Red Indirect Attacks"

Units: Assets

(283) Red Infantry Final Losses = ( Red Infantry Initial Losses - ( Red Infantry Initial Losses * "Infantry Recovery (People/Period)" ) )
Units: People

(284) Red Infantry Initial Losses = MIN ( "ISIS Militants (People)" , "ISIS Militants (People)" * SFS Fraction of Red Losses )
Units: People
Added minimum function

(286) Reduction in Days since Last Engagement = IF THEN ELSE ( Battle Decision = 1, Days since Last Engagement / Time to Recognize Battle , 0)
Units: Days/Period

(295) Scavenging Rate of Heavy Weapons = 0.1
Units: Percentage

(297) "SFS Attacker Loss Rate (ALR)" = IF THEN ELSE ( SFS Modified Force Ratio > 0, ( SFS Defender Loss Rate * SFS Exchange Rate ) / SFS Modified Force Ratio
, 0)
Units: Dmnl

(298) "SFS Avg Blue Indirect Attack WEI/WUV" = 1 + Supply Better US Equipment
Units: Dmnl/Assets

(299) "SFS Avg Blue Inf WEI/WUV" = 1 + Supply Better US Equipment

Units: Dmnl/Assets

(300) "SFS Avg Red Indirec Attack WEI/WUV" = 1
Units: Dmnl/Assets

(301) "SFS Avg Red Inf WEI/WUV" = 1
Units: Dmnl/Assets

(302) "SFS Avg. Blue Heavy Weapon WEI/WUV" = 1 + Supply Better US Equipment
Units: Dmnl/Assets

(303) "SFS Avg. Red Heavy Weapon WEI/WUV" = 1 + Supply Better US Equipment
Units: Dmnl/Assets

(304) SFS Blue Heavy Weapon Base Strength = SFS Blue Heavy Weapons Raw Strength * Blue Combat Multiplier
Units: Dmnl

(305) SFS Blue Heavy Weapons Raw Strength = "SFS Avg. Blue Heavy Weapon WEI/WUV" * "Blue Heavy Weapons (Armor)"
Units: Dmnl

(306) SFS Blue Heavy Weapons Situational Strength = Table for Effect of Type of Battle on Heavy Weapons DEFENDER ( Type of Battle ) * SFS Blue Heavy Weapon Base Strength

Units: Dmnl

(307) SFS Blue Indirect Attack Base Strength = ISIS Combat Multiplier * SFS Blue Indirect Attack Raw Strength * Blue Combat Multiplier
Units: Dmnl

(308) SFS Blue Indirect Attack Raw Strength = "SFS Avg Blue Indirect Attack WEI/WUV" * "Blue Indirect Attacks (True Artillery)"
Units: Dmnl

(309) SFS Blue Indirect Attack Situational Strength = Table for Effect of Type of Battle on Indirect Attack DEFENDER ( Type of Battle ) * SFS Blue Indirect Attack Base Strength

Units: Dmnl

(310) SFS Blue Infantry Base Strength = SFS Blue Infantry Raw Strength * Blue Combat Multiplier
Units: Dmnl

(311) SFS Blue Infantry Raw Strength = "Blue Infantry (Infantry & Light Mount Technicals)" * "SFS Avg Blue Inf WEI/WUV"
Units: Dmnl

(312) SFS Blue Infantry Situational Strength = Table for Effect of Type of Battle on Infantry DEFENDER ( Type of Battle ) * SFS Blue Infantry Base Strength

Units: Dmnl

(313) SFS Blue Losses = Blue Force Strength * SFS Defender Loss Rate
Units: Dmnl

(314) SFS Defender Loss Rate = IF THEN ELSE ( SFS Modified Force Ratio > 0, Intensity * ( 0.03 * SFS Modified Force Ratio ^ 0.64) , 0)
Units: Dmnl

(315) SFS Exchange Rate = MIN ( 5, IF THEN ELSE ( SFS Modified Force Ratio > 0, High Intensity Exchange Rate Multiplier * ( 4.5 * ( SFS Modified Force Ratio
^ ( -0.57) ) ) , 0) )
Units: Dmnl
Added minimum function for now to capp exchange rate losses. MIN(5,IF THEN ELSE(SFS Modified Force Ratio>0,High Intensity Exchange Rate
Multiplier*(4.5*(SFS Modified Force Ratio^(-0.57)) ),0))

(316) SFS Fraction of Blue Losses = ZIDZ ( SFS Blue Losses , Blue Force Strength )
Units: Dmnl

(317) SFS Fraction of Red Losses = ZIDZ ( SFS Red Losses , Red Force Strength )
Units: Dmnl

(318) SFS Modified Force Ratio = ZIDZ ( Red Force Strength , ( Strategic Surprise Factor * Blue Force Strength ) )
Units: Dmnl

(319) SFS Red Heavy Weapon Base Strength = SFS Red Heavy Weapons Raw Strength * ISIS Combat Multiplier
Units: Dmnl

(320) SFS Red Heavy Weapons Raw Strength = "SFS Avg. Red Heavy Weapon WEI/WUV" * "Red Heavy Weapons (Armor, Artillery & Heavy Mount Technicals)"
Units: Dmnl

(321) SFS Red Heavy Weapons Situational Strength = Table for Effect of Type of Battle on Heavy Weapons ATTACKER ( Type of Battle ) * SFS Red Heavy Weapon Base Strength

Units: Dmnl

(322) SFS Red Indirec Attack Raw Strength = "SFS Avg Red Indirec Attack WEI/WUV" * "Red Indirect Attacks (Mortars, IED, VBIED & SvIED)"

Units: Dmnl

(323) SFS Red Indirect Attack Base Strength = ( ISIS Combat Multiplier * SFS Red Indirec Attack Raw Strength ) * Red Indirect Attack Multiplier based on Days Prep

Units: Dmnl

(324) SFS Red Indirect Attack Situational Strength = Table for Effect of Type of Battle on Indirect Attacks ATTACKER ( Type of Battle ) * SFS Red Indirect Attack Base Strength

Units: Dmnl

(325) SFS Red Infanry Raw Strength = "Red Infantry (Infantry & Light Mount Technicals)" * "SFS Avg Red Inf WEI/WUV"
Units: Dmnl

(326) SFS Red Infantry Base Strength = SFS Red Infanry Raw Strength * ISIS Combat Multiplier
Units: Dmnl

(327) SFS Red Infantry Situational Strength = Table for Effect of Type of Battle on Infantry ATTACKER ( Type of Battle ) * SFS Red Infantry Base Strength

Units: Dmnl

(328) SFS Red Losses = SFS Blue Losses * SFS Exchange Rate
Units: Dmnl

(332) Standard Deviation between Battles = 1
Units: Days

(335) Strategic Surprise Factor = "ZScenario1: Table for Strategic Surprise Based on Location of ISIS on Territorial Map" ( Current Location of ISIS on Territorial Map
)
Units: Dmnl

(341) Supply Better US Equipment = IF THEN ELSE ( Time > Policy Intervention Time , USEquipmentModifier , 0)
Units: Dmnl/Assets
0 is normal value. .25 indicates a 25% increase in Weapon Value/Weapon Effectiveness by supplying US Arms. Note, the incease in Weapon
Value/Weapon Effectiveness translates over to ISIS HW as well.

(344) Table for Effect of Battle Type on Battle Intensity ( [(0,0)-(7,1.2)],(1,1.05),(2,1.05),(3,1),(4,0.95),(5,0.8),(6,0.85) )
Units: Dmnl

(345) Table for Effect of Battle Type on FMR2 ( [(0,-0.5)-(7,30)],(1,30),(2,0),(3,0),(4,0),(5,-0.5),(6,0) )
Units: Dmnl

(346) "Table for Effect of Battle Type on FMR2 (ISIS Variant)" ( [(0,-300)-(7,1250)],(1,1000),(2,25),(3,25),(4,25),(5,10),(6,500) )
Units: Dmnl

(350) Table for Effect of Preparation of Attacker on ER Adjustment ( [(0,0)-(20,1.25)],(0,1.15),(1,1.1),(3,1.05),(5,1),(7,0.95),(20,0.95) )
Units: Dmnl

(351) Table for Effect of Preparation of Attacker on Intensity Mult ( [(0,0)-(20,1.25)],(0,0.65),(1,0.75),(3,0.85),(5,0.95),(7,1),(20,1) )
Units: Dmnl

(355) Table for Effect of Terrain Type on Max Density Heavy Weapons ( [(0,0)-(5,1.5)],(1,0.8),(2,1),(3,0.5),(4,0.4),(5,0.2) )
Units: Dmnl

(356) "Table for Effect of Terrain Type on Max Density Infantry & Indirect Attacks" ( [(0,0)-(10,10)],(1,0.8),(2,1),(3,0.8),(4,1.2),(5,0.6) )
Units: Dmnl

(357) Table for Effect of Terrain Type on Max Density of Indirect Attacks ( [(0,0)-(6,1.1)],(1,1),(2,1),(3,0.8),(4,0.7),(5,0.4) )
Units: Dmnl

(359) Table for Effect of Type of Battle on Heavy Weapons ATTACKER ( [(0,0)-(6,1.5)],(1,1.4),(2,1.2),(3,1),(4,0.95),(5,0.9),(6,0.8) )
Units: Dmnl

(360) Table for Effect of Type of Battle on Heavy Weapons DEFENDER ( [(0,0)-(6,1.3)],(1,0.8),(2,0.8),(3,1),(4,1.1),(5,1.2),(6,0.8) )
Units: Dmnl

(361) Table for Effect of Type of Battle on Indirect Attack DEFENDER ( [(0,0)-(6,1.5)],(1,0.5),(2,0.8),(3,1),(4,1.1),(5,1.2),(6,0.5) )
Units: Dmnl

(362) Table for Effect of Type of Battle on Indirect Attacks ATTACKER ( [(0,0)-(6,1.3)],(1,0.4),(2,1.2),(3,1),(4,0.95),(5,0.9),(6,0.8) )
Units: Dmnl

(363) Table for Effect of Type of Battle on Infantry ATTACKER ( [(0,0)-(6,1.3)],(1,0.4),(2,1.2),(3,1),(4,0.95),(5,0.95),(6,1) )
Units: Dmnl

(364) Table for Effect of Type of Battle on Infantry ATTACKER 0 ( [(0,0)-(6,1.3)],(1,0.4),(2,1.2),(3,1),(4,0.95),(5,0.95),(6,1) )
Units: Dmnl

(365) Table for Effect of Type of Battle on Infantry DEFENDER ( [(0,0)-(7,1.5)],(1,0.5),(2,0.7),(3,1),(4,1.3),(5,1.4),(6,0.7) )
Units: Dmnl

(366) Table for the Effect of Battle Type on FMR1 ( [(0,0)-(7,15)],(1,5),(2,9),(3,12.5),(4,12),(5,10),(6,5) )
Units: Dmnl
Multiplier to multiply against (DLR/ALR)

(368) Targeting Switch = IF THEN ELSE ( Cummulative Air Strikes against BPD > ( ISIS Oil Production before Attacks / Effect of Strike on BPD ) , 0, 1)
Units: Dmnl

(377) Time Passing = 1
Units: Days/Period

(382) Time to Recognize Battle = 1
Units: Period

(383) "Time to Repair & Operate" = 1
Units: Period

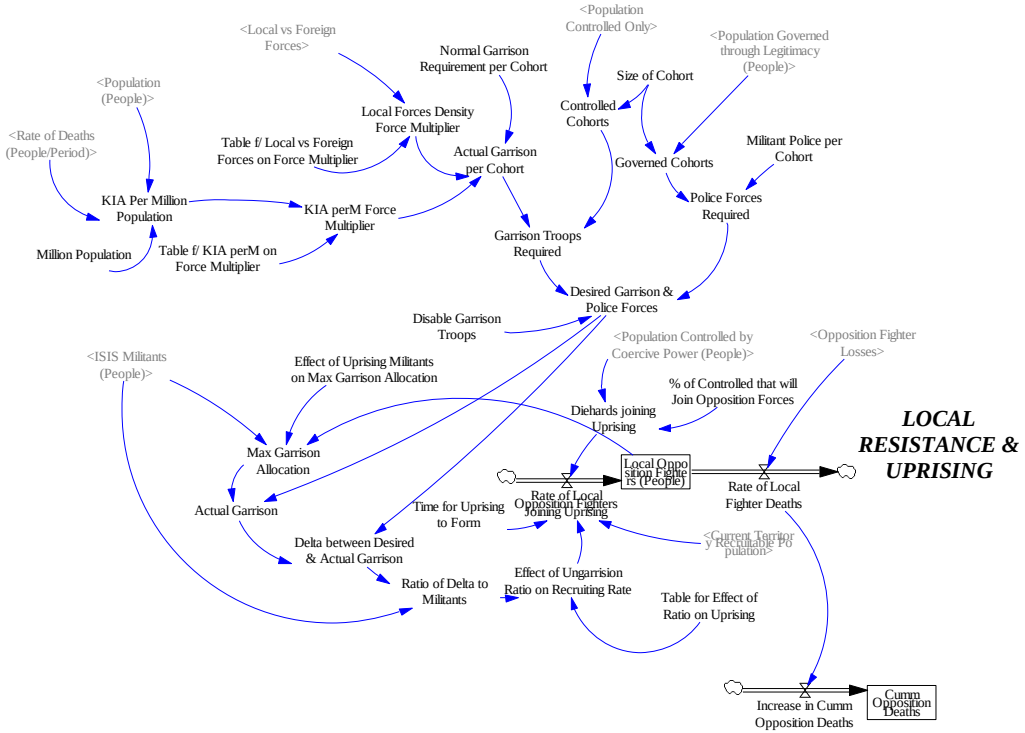
(391) Type of Battle = ( "Scenario 1 Switch (1 = On)" * "ZScernario1: Table for Battle Type based on Location of ISIS on Territorial Map" ( Current Location of ISIS on Territorial Map
) )
Units: Dmnl

(392) Type of Terrain = ( "Scenario 1 Switch (1 = On)" * "ZScernario1: Table for the Terrain Type Vased on Location of ISIS on Territorial Map" ( Current Location of ISIS on Territorial Map
) )
Units: Dmnl

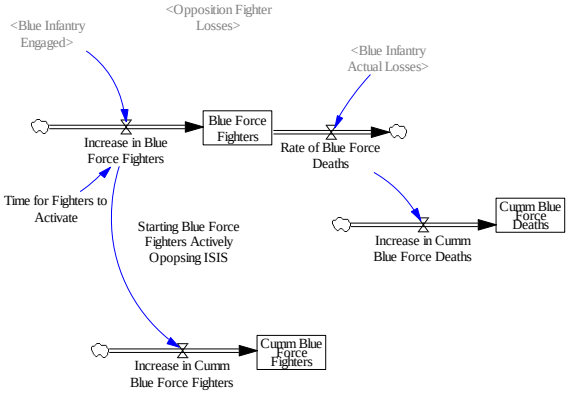
(394) US Airpower Support Step Height = 0
Units: Dmnl
1 is normal. 1.01 is minimal, 1.10 is significant and 1.5 is intensive.

(395) USEquipmentModifier = 0.25
Units: Dmnl/Assets

## *Resistance & Uprising Sector*




***LOCAL RESISTANCE & UPRISING***



## *Resistance & Uprising Sector Equations*

(013) "% of Controlled that will Join Opposition Forces" = 0.001
Units: Percentage/Period
Diehard opposition will fight against ISIS regardless of state of Garrison. This may also account for tribal rivalries. Should be approximately 1,000 per 1m controlled pop.

(019) Actual Garrison = MIN ( "Desired Garrison & Police Forces" , Max Garrison Allocation )
Units: People

(020) Actual Garrison per Cohort = Normal Garrison Requirement per Cohort * Local Forces Density Force Multiplier * KIA perM Force Multiplier
Units: People/Cohort

(052) Blue Force Fighters = INTEG( Increase in Blue Force Fighters - Rate of Blue Force Deaths , Starting Blue Force Fighters Actively Opopsing ISIS )
Units: People

(060) Blue Infantry Actual Losses = Blue Infantry Final Losses - Opposition Fighter Losses
Units: People/Period

(061) Blue Infantry Engaged = "ZScenario1: Table of Blue Infantry Engaged based on Location of ISIS on Territorial Map" ( Current Location of ISIS on Territorial Map
)
Units: People

(062) Blue Infantry Final Losses = Blue Infantry Initial Losses * Blue Infantry Recovery
Units: People/Period

(075) Controlled Cohorts = Population Controlled Only / Size of Cohort
Units: Cohort

(079) Cumm Blue Force Deaths = INTEG( Increase in Cumm Blue Force Deaths , 0)
Units: People

(080) Cumm Blue Force Fighters = INTEG( Increase in Cumm Blue Force Fighters , Starting Blue Force Fighters Actively Opopsing ISIS )
Units: People

(081) Cumm Opposition Deaths = INTEG( Increase in Cumm Opposition Deaths , 0)
Units: People

(085) Current Territory Recruitable Population = "ZScenario1: Table for Cumm Total Recruitable Population based on Location of ISIS on Map" ( Current Location of ISIS on Territorial Map
)
Units: People

(097) "Delta between Desired & Actual Garrison" = "Desired Garrison & Police Forces" - Actual Garrison
Units: People

(102) "Desired Garrison & Police Forces" = ( Garrison Troops Required + Police Forces Required ) * Disable Garrison Troops
Units: People

(107) Diehards joining Uprising = "Population Controlled by Coercive Power (People)" * "% of Controlled that will Join Opposition Forces"
Units: People/Period

(109) Disable Garrison Troops = 1
Units: Dmnl

(122) Effect of Ungarrision Ratio on Recruiting Rate = Table for Effect of Ratio on Uprising ( Ratio of Delta to Militants )
Units: Fraction
This determines the what % of the population will join the die-hard opposition as ISIS is unable to garrison effectively.

(123) Effect of Uprising Militants on Max Garrison Allocation ( [(0,0)-(50000,2)],(0,0.5),(10000,0.75),(20000,0.8),(30000,0.9),(40000,0.95),(50000,1) )
Units: Dmnl

(146) Garrison Troops Required = Controlled Cohorts * Actual Garrison per Cohort
Units: People

(147) Governed Cohorts = "Population Governed through Legitimacy (People)" / Size of Cohort
Units: Cohort

(158) Increase in Blue Force Fighters = Blue Infantry Engaged / Time for Fighters to Activate
Units: People/Period

(159) Increase in Cumm Blue Force Deaths = Rate of Blue Force Deaths
Units: People/Period

(160) Increase in Cumm Blue Force Fighters = Increase in Blue Force Fighters
Units: People/Period

(161) Increase in Cumm Opposition Deaths = Rate of Local Fighter Deaths
Units: People/Period

(178) "ISIS Militants (People)" = INTEG( "Additions (People per Period)" - "Lossess (People per Period)" , ( "Scenario 1 Switch (1 = On)" * ZScenario1 Starting Militants
) )
Units: People
Scenario Determines starting value.

(183) KIA Per Million Population = "Rate of Deaths (People/Period)" / ( "Population (People)" / Million Population )
Units: People/Period

(184) KIA perM Force Multiplier = "Table f/ KIA perM on Force Multiplier" ( KIA Per Million Population )
Units: Dmnl

(187) Local Forces Density Force Multiplier = "Table f/ Local vs Foreign Forces on Force Multiplier" ( Local vs Foreign Forces )
Units: Dmnl

(188) "Local Opposition Fighters (People)" = INTEG( Rate of Local Opposition Fighters Joining Uprising - Rate of Local Fighter Deaths , 0)
Units: People

(199) Local vs Foreign Forces = ZIDZ ( Total Recruited , ( Total Recruited + "Total Foreign Recruits (People)" ) )
Units: Percentage

(207) Max Garrison Allocation = "ISIS Militants (People)" * Effect of Uprising Militants on Max Garrison Allocation ( "Local Opposition Fighters (People)"
)
Units: People

(210) Militant Police per Cohort = 2.8
Units: People/Cohort

(220) Million Population = 1e+006
Units: People

(225) Normal Garrison Requirement per Cohort = 8
Units: People/Cohort

(233) Opposition Fighter Losses = Blue Infantry Final Losses * "% of Blue Infantry that are Local Opposition Fighters"
Units: People/Period

(243) Police Forces Required = Governed Cohorts * Militant Police per Cohort
Units: People

(245) "Population (People)" = INTEG( "Births & Immigration (People/Period)" - "Deaths, Recruiting & Emmigration (People/Period)" , Initial Population
)
Units: People
Combined population of all Syrian and Iraqi Provinces. “Provinces of Syria”, Administrative Divisions of Countries, Statoids, last
modified September 22, 2004, accessed September 19th, 2014, http://www.statoids.com/usy.html. “Provinces of Iraq”, Administrative
Divisions of Countries, Statoids, last modified March 16, 2014, accessed September 19th, 2014, http://www.statoids.com/uiq.html.

(246) "Population Controlled by Coercive Power (People)" = INTEG( "Gain in Control (People/Period)" - "Loss of Control (People/Period)" , ( "Scenario 1 Switch (1 = On)"
* "ZScenario1: Starting Population Controlled" ) )
Units: People

(248) Population Controlled Only = "Population Controlled by Coercive Power (People)" - "Population Governed through Legitimacy (People)"
Units: People

(250) "Population Governed through Legitimacy (People)" = INTEG( "Rate of Transition to Governance (People/Period)" - "Rate of Loss of Governance (People/Period)"
, 0)
Units: People

(258) Rate of Blue Force Deaths = Blue Infantry Actual Losses
Units: People/Period

(262) "Rate of Deaths (People/Period)" = "Deaths (People/Period)"
Units: People/Period

(266) Rate of Local Fighter Deaths = Opposition Fighter Losses
Units: People/Period

(267) Rate of Local Opposition Fighters Joining Uprising = Diehards joining Uprising + ( Effect of Ungarrision Ratio on Recruiting Rate * Current Territory Recruitable Population
) / Time for Uprising to Form
Units: People/Period

(273) Ratio of Delta to Militants = "Delta between Desired & Actual Garrison" / "ISIS Militants (People)"
Units: Fraction

(331) Size of Cohort = 1000
Units: People/Cohort

(333) Starting Blue Force Fighters Actively Opopsing ISIS = 10000
Units: People

(342) "Table f/ KIA perM on Force Multiplier" ( [(0,0)-(460,3)],(28,1),(50,1.23),(67,1.36),(120,1.67),(298,2.36),(460,2.8) )
Units: Dmnl

(343) "Table f/ Local vs Foreign Forces on Force Multiplier" ( [(0,0)-(1,3)],(0.1,2.38),(0.65,1.14),(1,1) )
Units: Dmnl

(352) Table for Effect of Ratio on Uprising ( [(0,0)-(1.5,0.15)],(0,0),(0.5,0.01),(0.75,0.02),(0.8,0.03),(1,0.05),(1.2,0.1) )
Units: Fraction

(373) Time for Fighters to Activate = 1
Units: Period

(376) Time for Uprising to Form = 1
Units: Period