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**City System of Systems Intelligence**

  
May 26, 2016

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**Abstract**

Recent trends toward urbanization decrease the effectiveness of the current military targeting cycle and challenge the military intelligence enterprise when innovative opportunists present themselves as terrorists within cities. A new analytical methodology, unbound from state sovereignty presumptions, is necessary for the intelligence community to understand and identify vulnerabilities that exist within the structure of cities so as to preempt innovative opportunists from disrupting social order. The City System of Systems Intelligence (CSSI) framework is a transferable, scalable methodology to analyze complex adaptive social environments where conflict is likely to be concentrated in the future. As is the case with terrorism, effects must be focused on influencing the structure of the environment and not solely eradication of terrorists. Application of this methodology will present decision makers with better understanding of sovereignty and clarify proportional response options when faced with intra-state conflict's cascading deterioration that metastasizes into insurgency.

## Introduction

Complex adaptive systems pose challenges to both analytic functions and effects based measures. Terrorism and cities both appear to be complex adaptive systems that are capable of threatening the existing social order of sovereign nation-states. Terrorism aimed at advancing foreign agendas and beneficiaries has originated and been carried out by resident actors within cities; consider the recent attacks in and by residents within the urban hearts of Brussels and Paris. A new analytical methodology, unbound from state sovereignty presumptions, is necessary for the intelligence community to understand and identify vulnerabilities that exist within the structure of cities so as to preempt innovative opportunists from disrupting social order. Recent trends toward urbanization decrease the effectiveness of the current military targeting cycle and challenge the military intelligence enterprise when innovative opportunists present themselves as terrorists within cities. The intertwining growth of cities as systems and global terrorism events emerging from these systems challenges United States counter- and anti-terrorism resolve and military capacity.

Over half of all people currently live in cities, and the rate of migration is accelerating. By 2030, cities will account for 60% of the world's population and 70% of the world's GDP. Each day, an estimated 180,000 people across the globe migrate to cities. In the next century, the urban environment will be the locus where drivers of instability will converge. By the year 2030, 60% of urban dwellers will be under the age of 18. As resources become constrained, illicit networks could potentially fill the gap left by over-extended and under-capitalized governments. Analytical portfolios in the DOD Intelligence Community are not focused on cities. There does not exist any analytical arm dedicated to understanding cities to support the war fighter.<sup>1</sup>

Given this trend of migration toward urban environments and the stresses associated with urbanization, the intelligence community should have an analytic methodology to apply to

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<sup>1</sup> (U) Harris, M., et. al. (2014). *Megacities and the United States Army: Preparing for a Complex and Uncertain Future*. Megacities Concept Team, Strategic Studies Group, Arlington, VA.

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understanding and analyzing both the city as a complex adaptive system as it affects the potential vulnerabilities where equally complex, adaptive terrorist networked organizations can capitalize and complicate United States strategic aspirations and disrupt social order. The City System of Systems Intelligence (CSSI) framework is a transferable, scalable methodology to analyze complex adaptive social environments where conflict is likely to be concentrated in the future. As is the case with terrorism, effects must be focused on influencing the structure of the environment and not solely eradication of terrorists. However, due to the complex adaptive nature of the system, new measures of complexity outcomes must be devised. Traditional, probabilistic mechanical cause-and-effect approaches will remain difficult to measure as well as traditional measures of terrorism prevention and mitigation success.<sup>2</sup>

### City Framework Defined

City resiliency is core concept in determining vulnerabilities and in understanding feedback loops related to how city system adaptation, since “Human wellbeing in cities relies on a complex web of interconnected institutions, infrastructure, and information.”<sup>3</sup> The humans, as actors within the complex adaptive city system have intrinsic motivations to nurture and grow the city system. While the city resilience framework is aimed at providing a lens through which city resiliency can be understood, the model has analytic value to the intelligence community.<sup>4</sup>

The Rockefeller Foundation and Arup together published the City Resilience Framework with updates as recent as December 2015. The corollary City Resilience Index consists of 4 categories, 12 goals, 52 indicators, and 156 variables.<sup>5</sup> “The 12 goals fall into four categories: the

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<sup>2</sup> (U) Bjorgo, T. (2005). 20 Conclusions. In *Root Causes of Terrorism* (pp. 257). New York, NY: Routledge.

<sup>3</sup> (U) da Silva, J., Morera, B. (2015). *City Resilience Framework*. City Resilience Index, Creative Commons Attribution 4.0.

<sup>4</sup> (U) Ibid.

<sup>5</sup> (U) Ibid.

health and wellbeing of individuals (people), urban systems and services (place), economy and society (organization), and leadership and strategy (knowledge).”<sup>6</sup> The goals are akin to the immune system of the human body. The indicators are an attempt to summarize complexity, and the variables are designed to be aggregated to produce simple and informative values that are easy to understand.<sup>7</sup>

In contrast, the urban triad organizes into 3 categories, 17 system objects, and 119 variables.<sup>8</sup> The intent of using the analytical approach supplied through elaborating the urban triad is that this methodology offers an analyst the ability to focus on requirements necessary to achieve commander’s intent when faced with human dynamics in an urban environment. Caerus Associates offers the “City as a System Analytical Framework,” in an effort to fill a gap in urban operations doctrine guiding analysis and planning efforts.<sup>9</sup>

While each model is fascinating in its own right, the author assesses the best analytical framework for CSSI is where the two frameworks intersect and key variables overlap. Before merging and defining the relevant categories, objects, indicators, and variables, key aspects requiring observation to discovery of constraints that may contribute to enabling terrorism must be further explored.

### **Preconditions, Precipitants, and Emergence of Terrorism**

Social order consists of communication vectors which enable interaction. Social interaction typically aligns to functions of authority, submission, and oneness. It is through this

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<sup>6</sup> (U) Ibid.

<sup>7</sup> (U) da Silva, J. (2014). *Research Report Volume 3: Urban Measurement Report*. City Resilience Index, Ove Arup & Partners International Limited 2014.

<sup>8</sup> (U) U.S. Joint Chiefs of Staff. *Joint Urban Operations*. Joint Publication 3-06. Washington, DC: U.S. Joint Chiefs of Staff, 2013.

<sup>9</sup> (U) Lomedico, M. and Bartels, E. (2015). The Small Wars Journal. *City As a System Analytical Framework: A Structured Analytical Approach to Understanding and Acting in Urban Environments*, 11(8).

triad organization where unity of a society formulates normal and abnormal behavior. Typical communication and organization vectors are associated with the following seven categories: Law, Politics, Art, Media, Economics, Music, and Literature.

Bjorgo lists preconditions and precipitants of terrorism to be “lack of democracy, civil liberties, and the rule of law; failed or weak states; rapid modernization; extremist ideologies; historical antecedents of political violence, civil wars, revolutions, dictatorships or occupation; hegemony and inequality of power; illegitimate or corrupt governments; powerful external actors upholding illegitimate governments; repression by foreign occupation or by colonial powers; the experience of discrimination on the basis of ethnic or religious origin; failure or unwillingness by the state to integrate dissident groups or emerging social classes; the experience of social injustice; the presence of charismatic ideological leaders; and triggering events.”<sup>10</sup>

While Bjorgo’s list of preconditions and precipitants to terrorism is extensive he states, “Many of the causes of terrorism are also the causes of rebellious guerrilla warfare, riots and other forms of political violence.”<sup>11</sup> This comment leads the author to question what we define as terrorism. Terrorism in a complex adaptive systems approach amounts to an alternative communication vector. Terrorism is the indirect communication of violence as a means for influence. To clarify, a traditional messenger of violence (A) attacks a target (a) with the intent on message (m) being received that target (a), the effect is either influence due to elimination of message receiver (R<sub>e</sub>) or acceptance of message by receiver (R<sub>a</sub>) due to fear and management of violence.

$$A: m + a = R_e \text{ [OR] } R_a$$

In contrast, a terrorist messenger of violence (T) attacks a target (a) with the intent on message (m) being received by audience (R<sub>b</sub>) not inclusive of target (a), the effect is influence and acceptance of message by receiver (R<sub>b</sub>) due to fear and management of violence.

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<sup>10</sup> (U) Bjorgo, T. (2005). 20 Conclusions. In *Root Causes of Terrorism* (pp. 258-260). New York, NY: Routledge.

<sup>11</sup> (U) Ibid, pg 261.

$$T: m + a = R_b \text{ where } R_b \neq a$$

If terrorism, as well as other traditional forms of violence emerges from similar preconditions and precipitants, then it would benefit the intelligence community to monitor and highlight to decision makers when such an environment presents itself, where it presents itself, and why it presented. It is for this reason the intelligence community must adopt a method of analysis for complex adaptive systems such as the CSSI presented for cities.

### The Methodology for Cities

For a target system to be built, it must adhere to an analytic structure that is comprehensive and efficient. Below are two city structures based on Resilience framework (Figure 1) and City as System framework (Figure 2). Each city has objects as the first sub-structures or systems and attributes or variables indicated as the second sub-structures or systems.

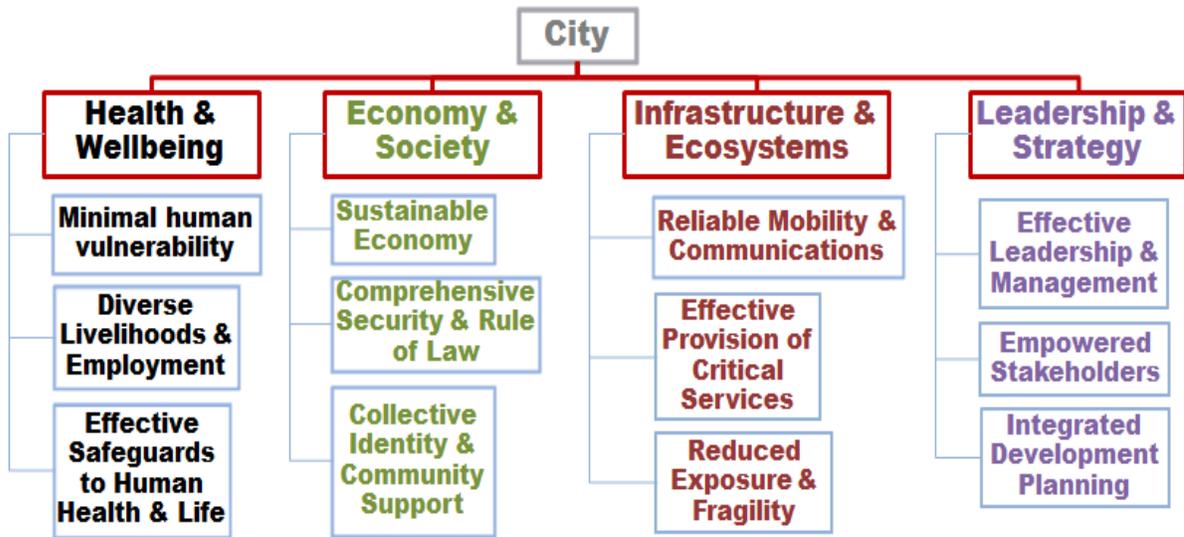
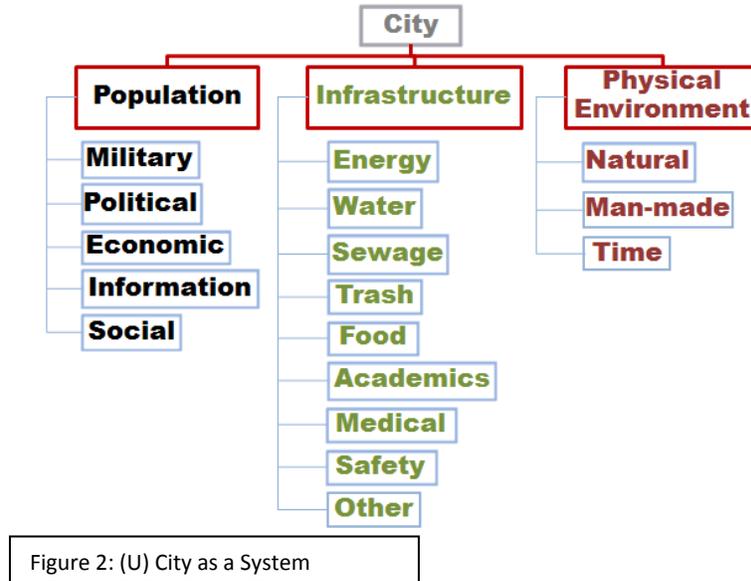


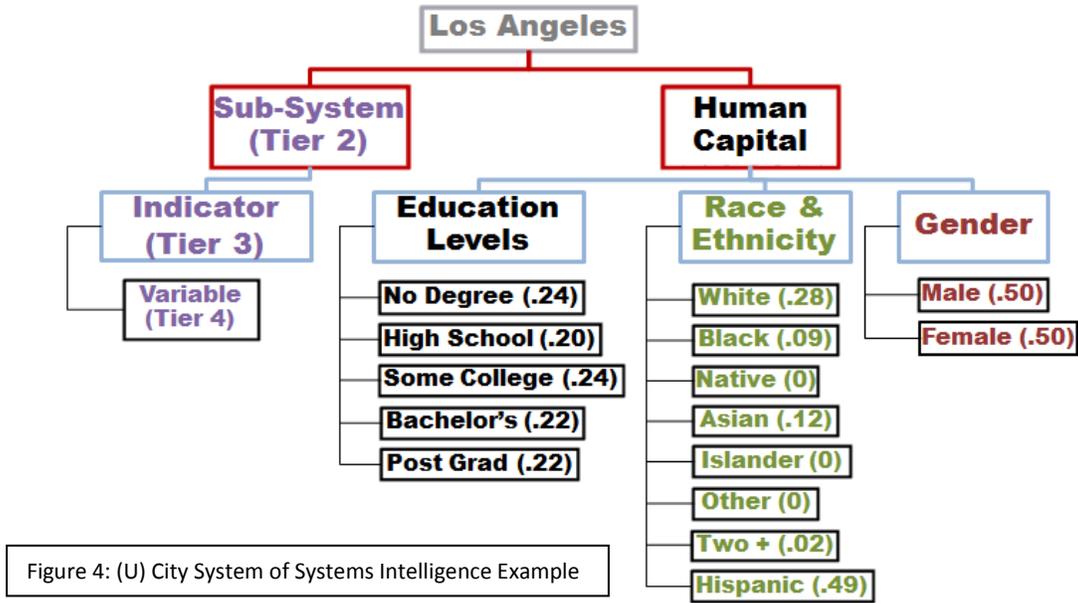
Figure 1: (U) City Resilience Framework



While both of these frameworks are valuable in their own right, for the purpose of developing CSSI, a hybrid framework will be required. The structure of the framework for CSSI is worthwhile to note. The city system itself will be labeled on tier one. The tier one label will be “Los Angeles” in the example below (Figure 4). The sub-system on tier two of the example below will be labeled “Human Capital”. Below each sub-system are indicators on tier three. The indicators are aggregated to indicate the health of the sub-system. The examples of indicators will be labeled “Education Levels”, “Gender”, and “Race & Ethnicity” below. Beneath each indicator reside variables on tier four, that are both weighted and aggregated to determine the health of the indicator. The weights for each variable should scale from 0 to 1. Below is a chart (Figure 3) offered in Intelligence Community Directive (ICD) 203 to be used to determine subjective weights for each variable within the system. The example variables for “Race & Ethnicity” will be labeled

almost no chance	very unlikely	unlikely	roughly even chance	likely	very likely	almost certain(ly)
remote	highly improbable	improbable (improbably)	roughly even odds	probable (probably)	highly probable	nearly certain
01-05%	05-20%	20-45%	45-55%	55-80%	80-95%	95-99%

Figure 3: (U) Intelligence Community Directive 203, Jan 2015



“White”, “Black”, “Native”, “Asian”, “Islander”, “Other”, “Two +”, and “Hispanic”. The weights for each of these variables will be representative of the percentage of population based on Census Data: ACS 2014.

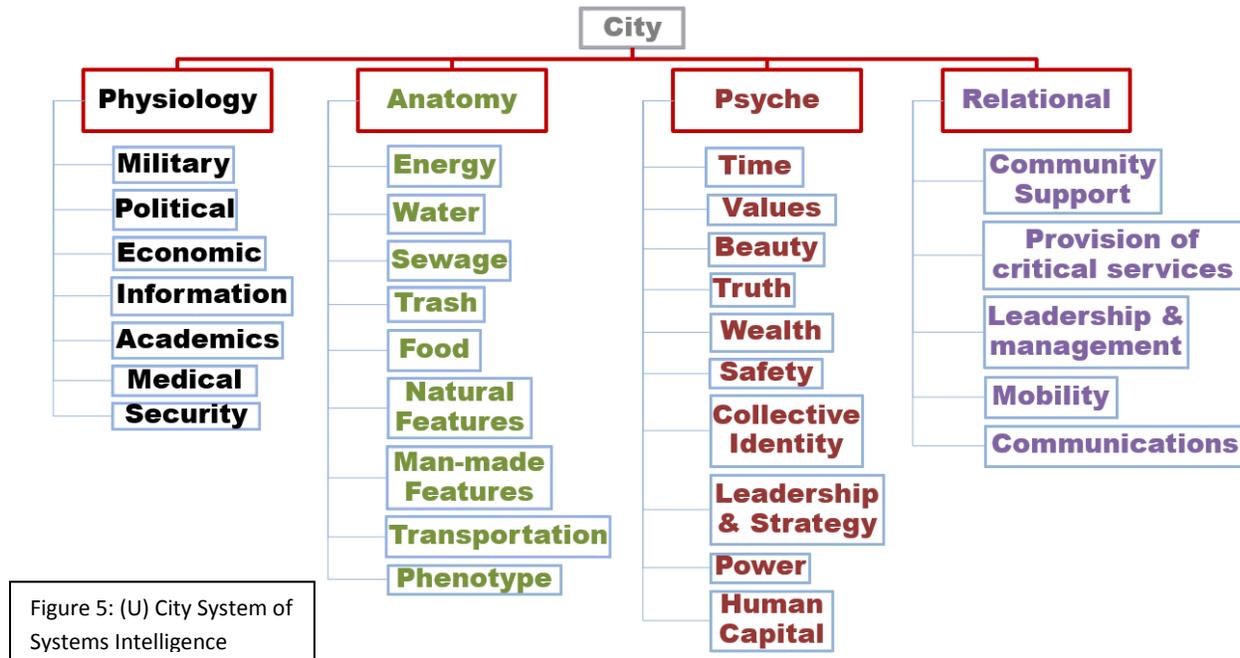
### System Accelerants/Decelerates and Data Presentation

Feedback loops are a unique feature of complex adaptive systems that require particular attention during analysis. The better the analyst understands the drivers and directions of feedback loops, the more accurate the overall city system of systems intelligence model. System feedback loops are the portion of the model that must be maintained over time. When an analyst applies the CSSI framework to a particular problem set or area of concern, the output is represented as a snapshot in time (T<sub>1</sub>). At a designated point in the future, another analysis should be performed and snapshot in time (T<sub>2</sub>) should be recorded.

The snapshots offer a vector check that allows for analysis in multiple facets and provides influencers information to determine whether any actions taken are having impact or influencing in an intended manner.

## CSSI Methodology Defined

The CSSI model consists of a framework for analysts and is defined by sub-systems, indicators, and variables. The author perceives a city akin to a living organism and has chosen to describe the sub-systems through terms associated with living organisms. The model's (Figure 5) sub-systems consist of four: Physiology, Anatomy, Psyche, and Relational.



The Physiology sub-system (Figure 6) is the organic processes and phenomena of the city organism or any of its parts or of a particular city process.<sup>12</sup> The Anatomy sub-system (Figure 7) is the structural makeup of the city organism or any of its parts.<sup>13</sup> The Psyche sub-system (Figure 8) is mental or behavioral characteristics of the city.<sup>14</sup> The Relational sub-system (Figure 9) is the properties that hold between an ordered pair of objects.<sup>15</sup>

<sup>12</sup> (U) *Merriam-Webster's Collegiate Dictionary*, 11th ed. (Springfield: Merriam-Webster, Inc., 2014), s.v. "Physiology."

<sup>13</sup> (U) *Merriam-Webster's Collegiate Dictionary*, 11th ed. (Springfield: Merriam-Webster, Inc., 2014), s.v. "Anatomy."

<sup>14</sup> (U) *Merriam-Webster's Collegiate Dictionary*, 11th ed. (Springfield: Merriam-Webster, Inc., 2014), s.v. "Psychology."

<sup>15</sup> (U) *Merriam-Webster's Collegiate Dictionary*, 11th ed. (Springfield: Merriam-Webster, Inc., 2014), s.v. "Relation."

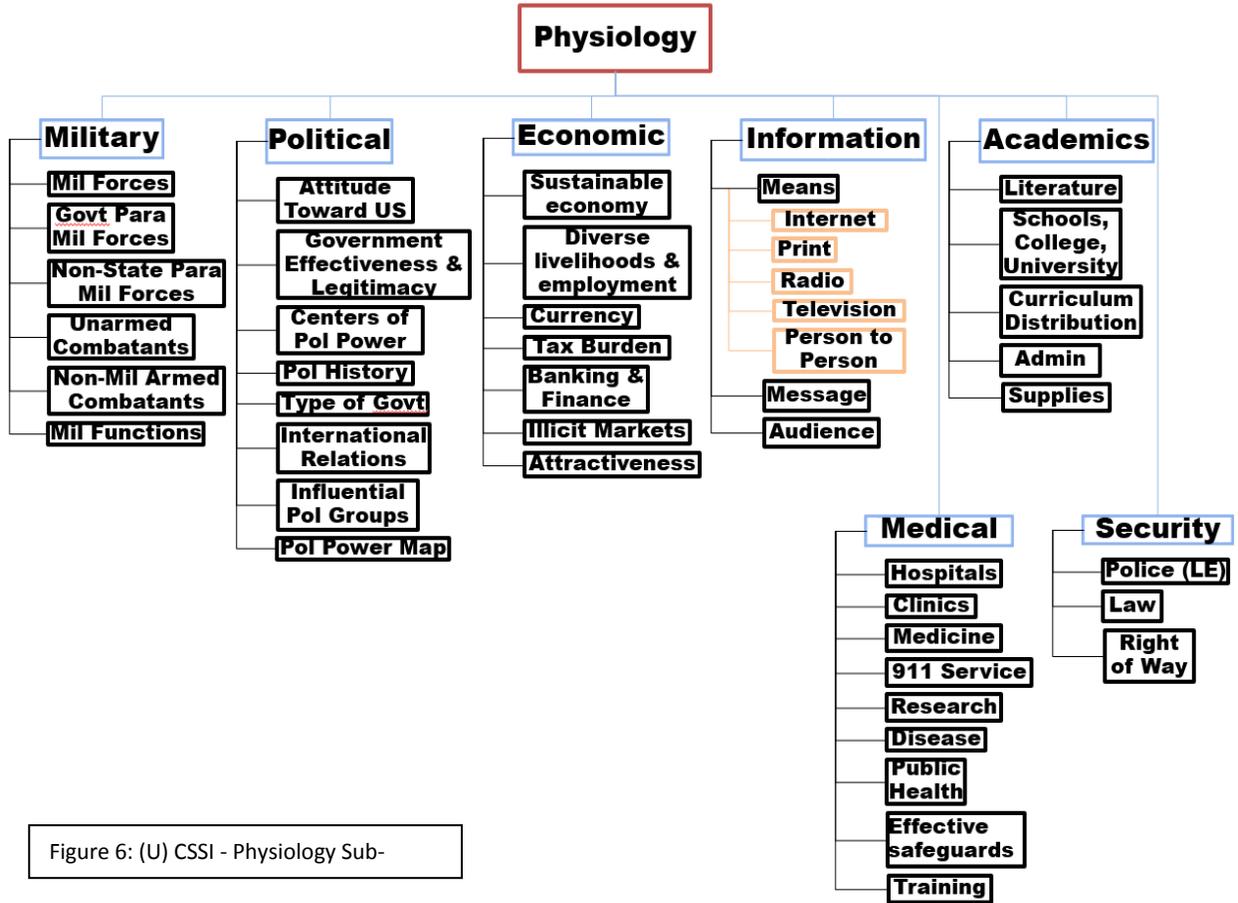


Figure 6: (U) CSSI - Physiology Sub-

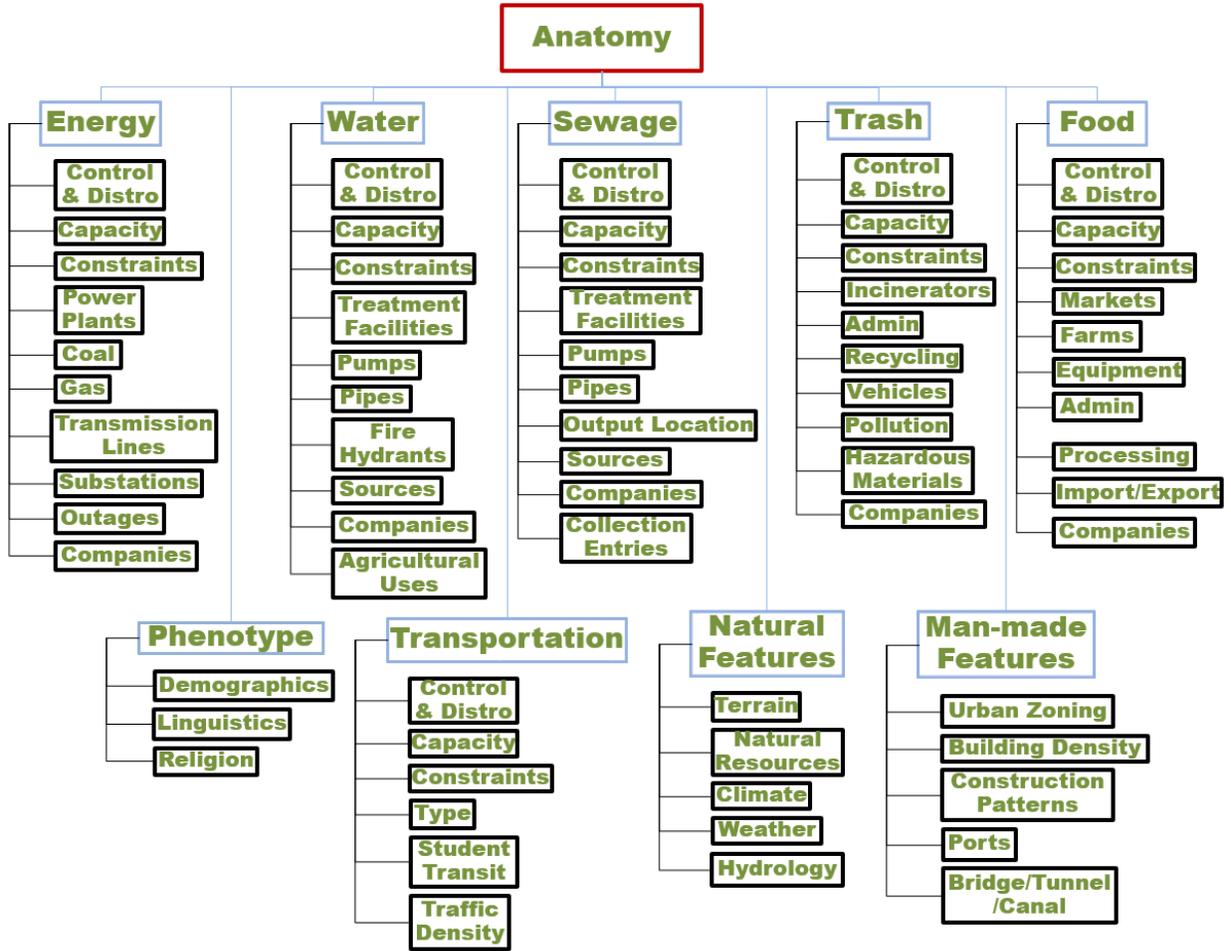


Figure 7: (U) CSSI - Anatomy Sub-System

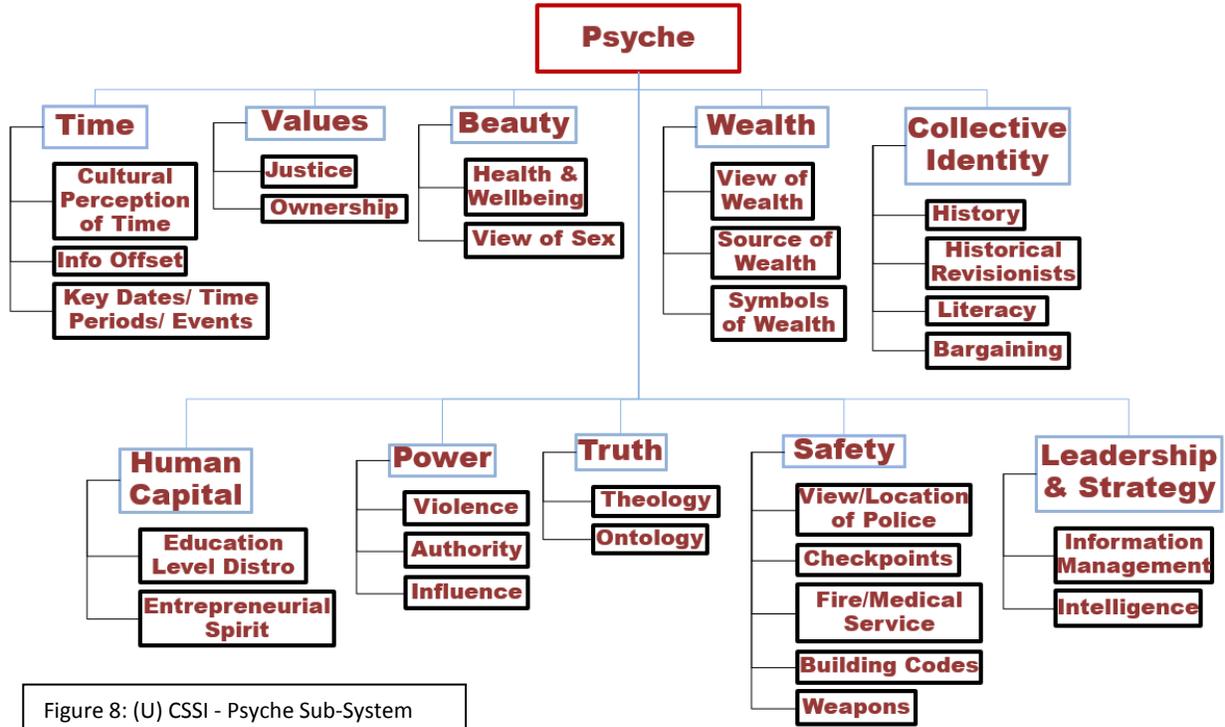


Figure 8: (U) CSSI - Psyche Sub-System

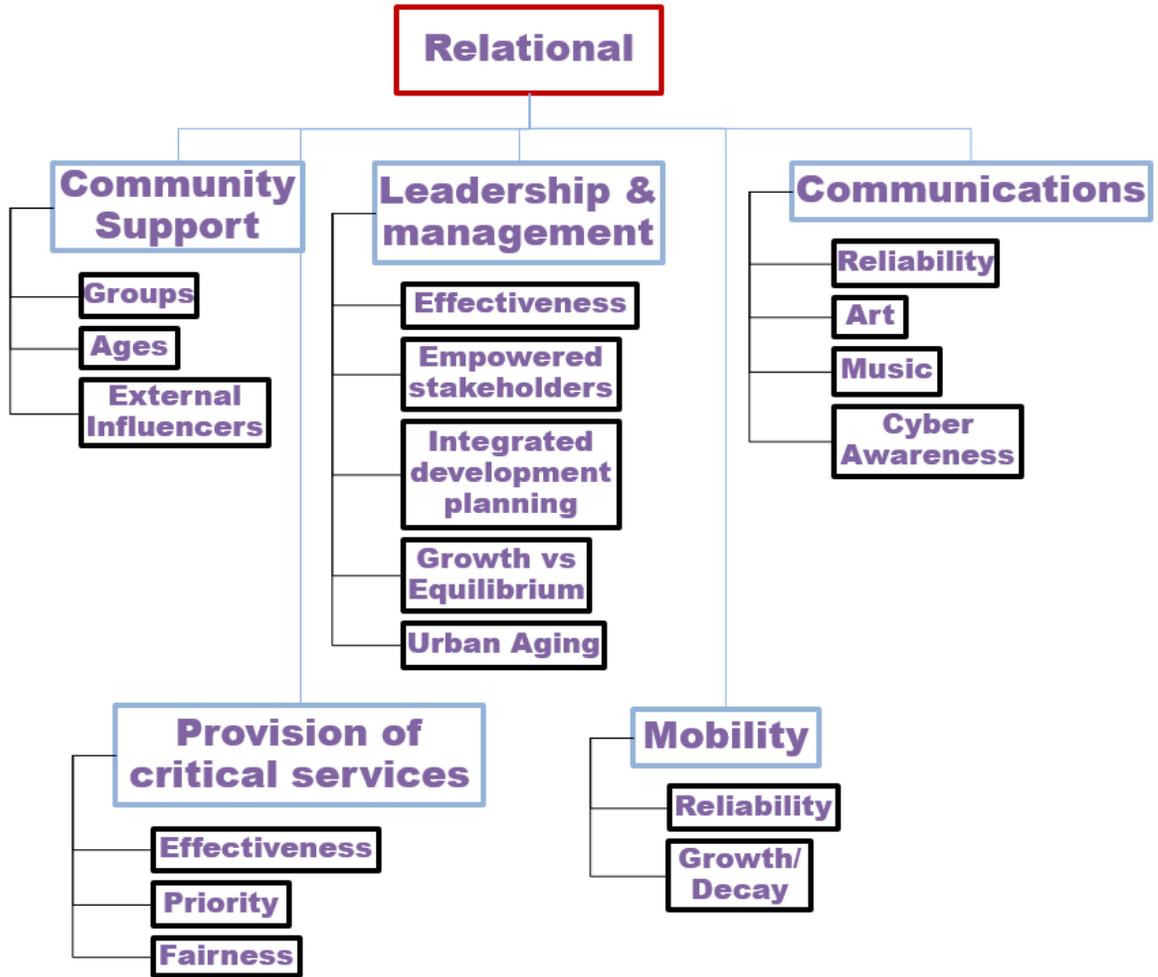


Figure 9: (U) CSSI - Relational Sub-System

Visualization for Decisions

The CSSI methodology presented illustrates the complex adaptive system of a city evolves over time. How does one gauge the effectiveness of a city? How does one gauge the ineffectiveness of a city? How does one forecast areas that may provide opportunity for terrorism? Analysis should be employed to develop a baseline identity for the city. Identity is a term that requires a relational aspect and each city has a unique identity. Cities are not static systems, they are instead complex adaptive systems that change over time and should be examined through lenses similar to those in which people attempt to understand other people.

In the sociological tradition of thinking about identity, especially that of the symbolic interactionists, we do not come into the world as formed individuals, but are constructed out of the interaction between our individual genetic makeup and the various social structures in which we develop . . . Identity – who *I* really think I am / who one actually believes one is / who they think they are / what makes us believe we are the same and them different – is basic to many aspects of the discussion...<sup>16</sup>

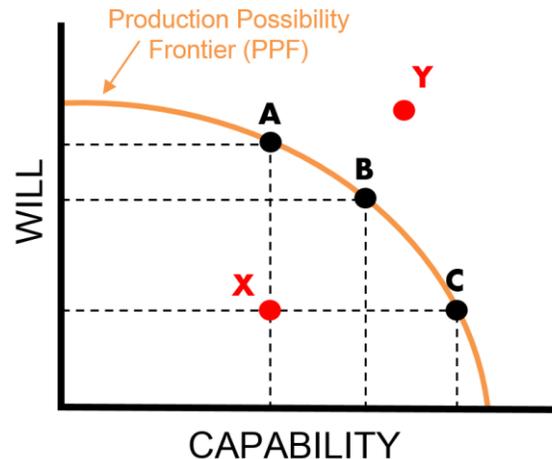


Figure 10: (U) Production Possibility Frontier

The art of intelligence must be mixed with the science of intelligence when determining a baseline identity of a city. Caution must be taken to clarify the baseline is only a snapshot in time of an evolving, complex adaptive system. Using a visualization known to economists as the Production Possibility Frontier (PPF) with the goods representing the Will and Capability of a City is recommended. As indicated above (Figure 10), points A, B and C represent the points at which production of Will and Capability is most efficient. Point X demonstrates the point at which resources are not being used efficiently in the production of both goods; point Y demonstrates an output that is not attainable with the given inputs. The orange curve (PPF) may expand to encompass the location of Y, only after something has modified the constraints of the system, i.e. a technological leap.

<sup>16</sup> (U) Ken Booth, “*Security and Self Reflections of a Fallen Realist*” (paper presented at the conference Strategies in Conflict: Approaches to Security Studies, York University, Toronto, May 12-14 1994), 4.

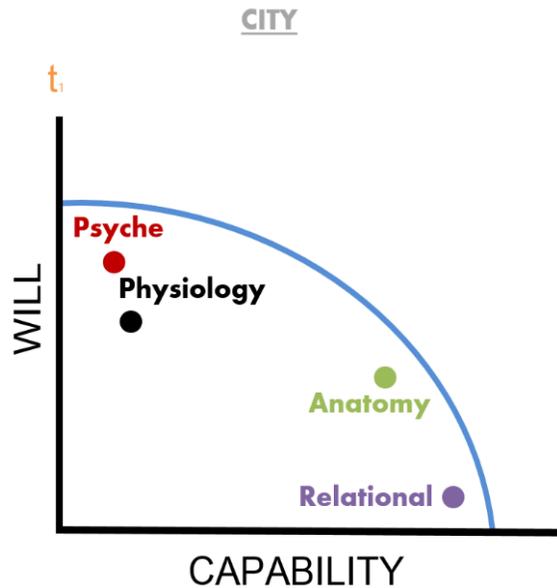


Figure 11: (U) City Frontier at  $t_1$

A notional city is presented above for example. The baseline assessment is illustrated at time  $t_1$  (Figure 11). The X axis represents Capability of the City and the Y axis represents the Will of the City. A key assumption is the City seeks to grow and each of the sub-systems will attempt to migrate toward the point of optimal efficiency. Efficiency is depicted by the blue line. Each sub-system receives its location on the graph through defined analysis. The sub-system Psyche is notionally represented having high Will and low Capability, perhaps this could represent the City's high natural talent but lack of ability to harness their talent for growth. The sub-system Physiology is notionally represented having higher Will and lower Capability as well, perhaps this could represent the City's desire for stable democratic governance but the lack of stable power relationships and history of peaceful transfer of power. The sub-system Anatomy is notionally represented having higher Capability and lower Will; perhaps this could represent the City's infrastructure being built by colonial power leaving the maintenance of said infrastructure lacking. The sub-system Relational is notionally represented having high Capability and low Will, perhaps

this could represent the City's highly social nature but lack of deliberate efforts to co-opt its citizenry.



Figure 12: (U) City Frontier at  $t_2$

A follow-up assessment is illustrated at time  $t_2$  (Figure 12). The sub-system Psyche is notionally represented as having increased in Capability, perhaps this could represent the City's new talent management start-up. The sub-system Physiology is notionally represented having increased in both Will and Capability; perhaps this could represent the City's continued desire for stable democratic governance and recent success in peaceful transfer of power between mayors. The sub-system Anatomy is notionally represented having slightly increased in Will and significantly decreasing in Capability; perhaps this could represent the City's response to a recent hardship of experiencing an earthquake that damaged one-quarter of its infrastructure. The sub-system Relational is notionally represented having slightly decreased in Capability and increase in Will, perhaps this could represent the City's bonding in response to the recent earthquake.

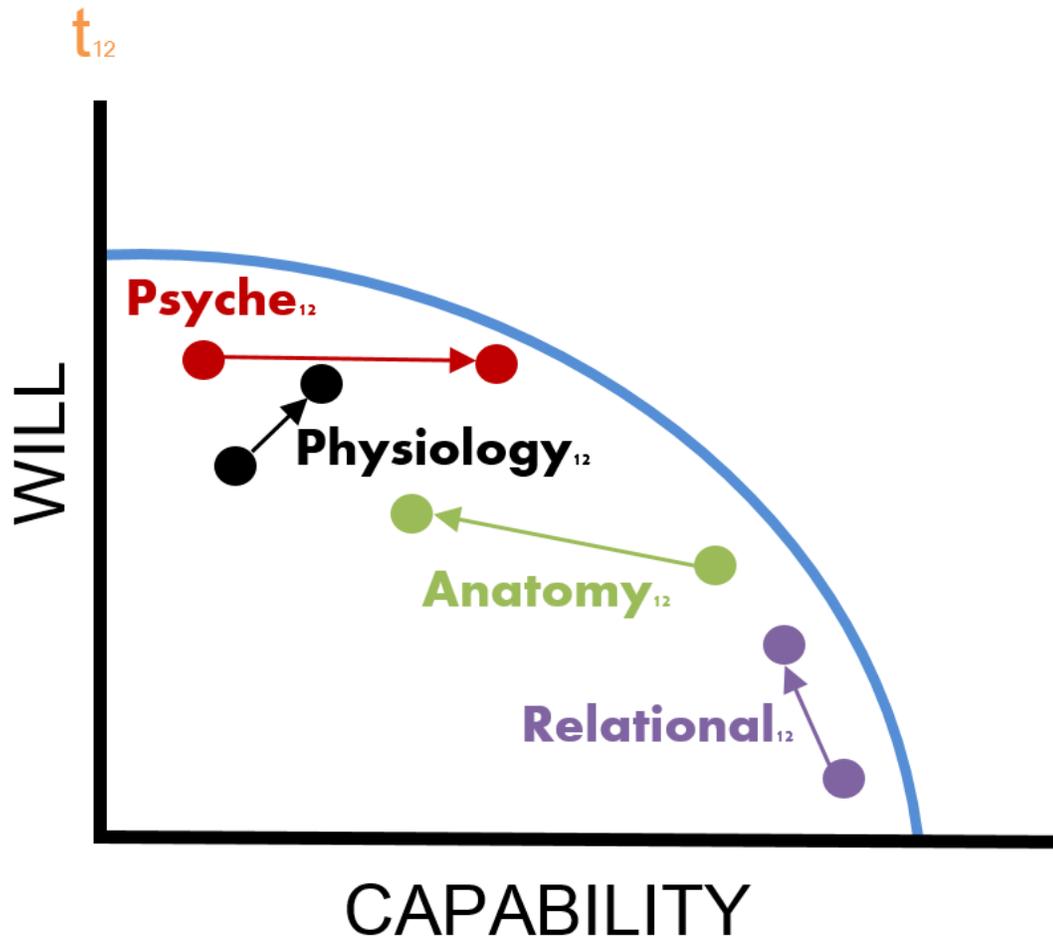
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Figure 13: (U) City Frontier Change Over Time

The City's evolution, or assessed changes from  $t_1$  to  $t_2$  when graphically represented (Figure 13) allows the analyst to understand how an effect such as the notional earthquake affects the respective systems within the City. This type of analytical approach allows the analyst to recommend solutions that would be more effective than others. It would also allow the analyst to highlight those areas within the City complex adaptive system that are vulnerable to challenge by malicious actors. Areas the analyst highlights may provide the source for negative sentiment within a city. If these city deficiencies persist, grievances may develop and terrorism could result.

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The CSSI model is a transferable, scalable methodology to analyze complex adaptive social environments where conflict is likely to be concentrated in the future.

### Conclusion

Through analytic application of the CSSI model presented in this paper, the intelligence community will be able to monitor cities and better understand the phenomena of emergence. It is only after the intelligence community consistently monitors the physiology, anatomy, psyche, and relations of cities will the ability to treat the disease that is terrorism become a viable option. The geo-strategic environment is in the midst of a paradigm shift away from powerful sovereign nation-states toward powerful sovereign city-states. The erosion of central government's ability to monopolize violence exacerbates the problem of terrorism. New solutions must be crafted on a city-scale that secure populations and territory from terrorism. The City System of Systems Intelligence model offers analysts a methodology to understand the complex adaptive system that is a city and offers planners the ability to measure effectiveness of efforts. Application of this methodology will present decision makers with better understanding of sovereignty and clarify proportional response options when faced with intra-state conflict. This methodology offers understanding of cascading deterioration that is able to metastasize into insurgency that may jeopardize state sovereignty. It is through this understanding that plans can be crafted in an efficient manner so as to promote the strategic goals of the United States.

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