MAPPING COLLECTIVE IDENTITY: TERRITORIES AND BOUNDARIES OF HUMAN TERRAIN

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by

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External borders of countries and their internal boundaries regulate how people are governed and taxed, their rights and legal authority, and the freedoms they share within their daily lives. People often form relationships based on where they live and work, their shared history, religion, culture and self identification. This research provides a process to integrate these various spatial elements that define populations and map their identities over geographic areas. When conflict takes place within a country, it often takes place along fault lines between identities. This research introduces the theory of areas of collective identity and describes how geospatial analysis using remote sensing and information from the local population helps to identify these territories and boundaries of human terrain. This research provides a process to map identities within an operational environment as the military conducts humanitarian, reconstruction, and combat operations. This data can then be incorporated into command and control systems; and delineated on map products. These areas and their extents provide a more realistic view of the population, not necessarily defined along historical political-administrative boundaries, but along the territories and boundaries of human terrain.

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ABSTRACT

MAPPING COLLECTIVE IDENTITY: TERRITORIES AND BOUNDARIES OF HUMAN TERRAIN, by Major Michael L. Wood, 103 pages.

External borders of countries and their internal boundaries regulate how people are governed and taxed, their rights and legal authority, and the freedoms they share within their daily lives. People often form relationships based on where they live and work, their shared history, religion, culture and self identification. This research provides a process to integrate these various spatial elements that define populations and map their identities over geographic areas. When conflict takes place within a country, it often takes place along fault lines between identities. This research introduces the theory of areas of collective identity and describes how geospatial analysis using remote sensing and information from the local population helps to identify these territories and boundaries of human terrain. This research provides a process to map identities within an operational environment as the military conducts humanitarian, reconstruction, and combat operations. This data can then be incorporated into command and control systems; and delineated on map products. These areas and their extents provide a more realistic view of the population, not necessarily defined along historical political-administrative boundaries, but along the territories and boundaries of human terrain.

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∞

Te Amo Angélica

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ACRONYMS

ACI	Area of Collective Identity
AGC	Army Geospatial Center
AGI	Advanced Geospatial Intelligence
BCT	Brigade Combat Team
CA	Civil Affairs
CIM	Civil Information Management
COP	Common Operational Picture
CPOF	Command Post of the Future. Computer and software system used within the U.S. Army for command and control of forces.
DEM	Digital Elevation Model
DCSGS-A	Distributed Common Ground System-Army
DTED-2	Digital Terrain Elevation Data Level-2 (30 meters post spacing)
GEOBIA	Geospatial Object Based Image Analysis. Also referred to as OBIA.
GEOINT	Geospatial Intelligence
GIS	Geographic Information System
HTA	Human Terrain Analysis
HTS	Human Terrain System
IEBL	Inter-Entity Boundary Line
LBS	Location-Based Services
MDL	Military Demarcation Line
MAP-HT	Mapping the Human Terrain
NDVI	Normalized Difference Vegetation Index
NGA	National Geospatial-Intelligence Agency

OBIA	Object-Based Image Analysis
POI	Points of Interest
SIGACT	Significant Activity
USACE	U.S. Army Corps of Engineers
UTP	Urban Tactical Planner

ILLUSTRATIONS

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CHAPTER 1

INTRODUCTION

Areas of Collective Identity and Human Terrain

In general, people are defined by their identity. This identity is comprised of where they live and work; the relationships they share; and who they define themselves as. Borders and boundaries are a significant factor in delineating identity because they determine how a population is governed, how they are represented, their freedom of religion and expression, their legal rights,[1] and the laws enforcing taxation, ownership of personal property, and the sale of goods.[2]

Although sovereign states are organized with internal political-administrative boundaries, the population's identity of religion, ethnicity, political alignment, economic wealth, or shared history[3] often does not align with existing boundaries. Geographers and cartographers have sought ways to individually depict varying elements of identity in order to convey specific information regarding the population and infrastructure of society. [4] For example, the Helmand province tribal map, created by the US Naval Postgraduate School, program for Culture and Conflict Studies (CCS), shows the

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[1]Stephen D. Krasner, ―Sovereignty," *Foreign Policy* (January/February 2001): 20-29.

[2]John Eyles, ―Group Identity and Urban Space: The North American Experience," in *Shared Space Divided Space: Essays on Conflict and Territorial Organization,* ed. Michael Chisholm and David M. Smith (London: Unwin Hyman, 1990), 50-51.

[3]Robert L. Solomon, ―Boundary Concepts and Practices in Southeast Asia," *World Politics* 23, no. 1 (October 1970): 1-12.

[4]Loek Halman, Ruud Luijkx, and Marga van Zundert, *Atlas of European Values* (Leiden, Netherlands: Brill Academic Publishing, Tilberg University, 2005), 11.

“dominant ethnicities/tribes across political boundaries.”[5] These maps help to describe the differences between the territory of tribes and the political-administrative boundaries of the government (see figure 1).

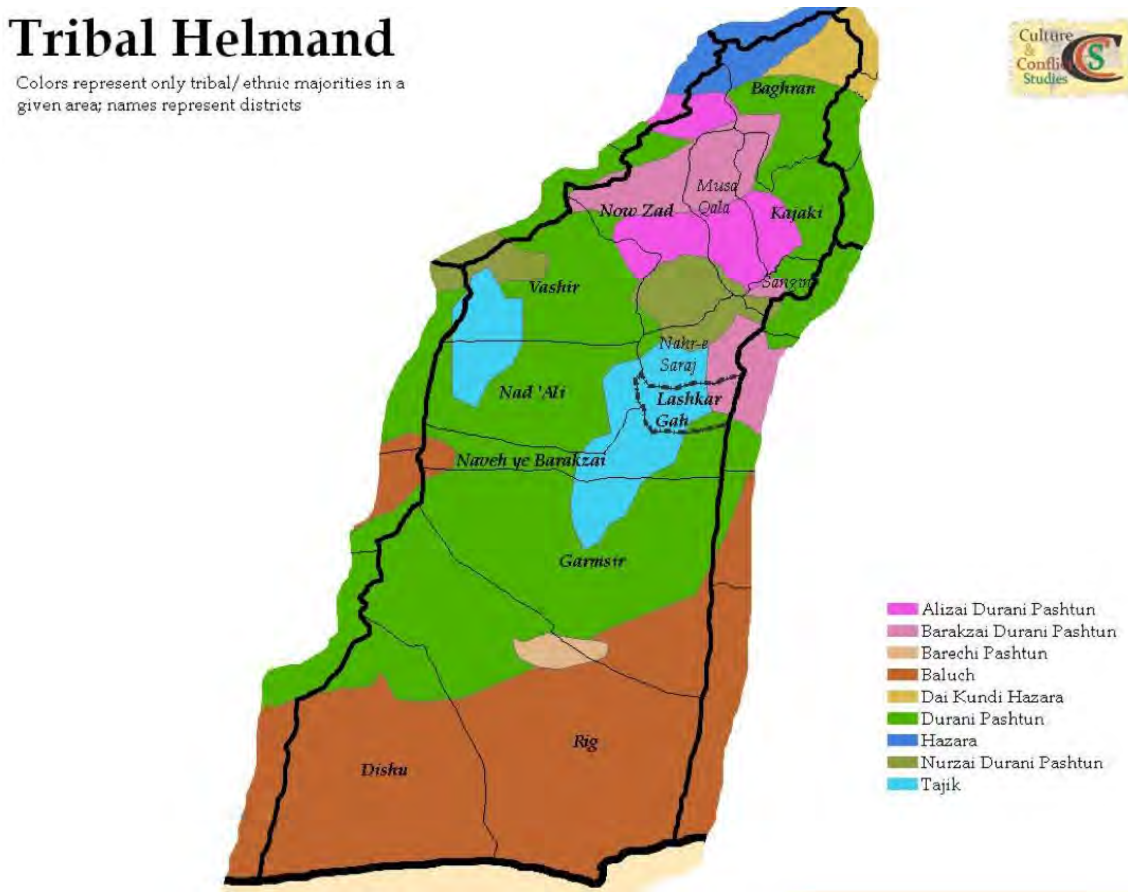

Figure 1. Tribal Map of Helmand Province

Source: Unites States Naval Postgraduate School, “Program for Culture and Conflict Studies,” http://www.nps.edu/programs/ccs/Tribal_maps.html (accessed February 12, 2011).

Note: The tribal map of Helmand Province in Afghanistan depicts the areas that are considered to be the dominant tribes by population.

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[5]Unites States Naval Postgraduate School, “Program for Culture and Conflict Studies,” http://www.nps.edu/programs/ccs/Tribal_maps.html (accessed February 12, 2011).

This research provides a process to understand and identify the boundaries that surround populations based on common attributes and spatial proximity of physical and human geography. These generalized areas of identity, when integrated together form areas of collective identity (ACIs). Often during periods of crisis people align themselves out of desire or necessity towards a particular identity in order to defend themselves, their families and property from threats.[6] Without diplomacy, these boundaries of the population become the fault lines where conflict takes place.[7]

Remote sensing along with information from the local population directly supports the identification and mapping of these areas and their extents. As the military conducts humanitarian, reconstruction, and combat operations; these areas of collective identity (ACIs) better describe a population‘s center of gravity, geographic sphere of control, and their geographic area of influence within a region. By delineating these areas, military forces can better understand, visualize, and describe the human dynamics of their operational environment, not necessarily defined along political-administrative boundaries, but along the territories and boundaries of human terrain.

This first chapter introduces the reader to the concept of ACIs. Chapter 2 provides a comprehensive literature review of the relationship of territories and boundaries to

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[6]Dinka Corkalo, Dean Ajdukovic, Harvey M. Weinstein, Eric Stover, Dino Djipa, and Miklos Biro, ―Neighbors Again? Intercommunity Relations After Ethnic Cleansing," in *My Neighbor, My Enemy: Justice and Community in the Aftermath of Mass Atrocity*, ed. Eric Stover and Harvey M. Weinstein (Cambridge, UK: Cambridge University Press, 2004), 146.

[7]Richard Griggs and Peter Hocknell, ―Fourth World Faultlines and the Remaking of ‗Inter-national' Boundaries," *IBRU Boundary and Security Bulletin* (Autumn 1995): 53-54, 57, http://www.dur.ac.uk/resources/ibru/publications/ full/bsb3-3_griggs.pdf (accessed March 3, 2011).

physical and human geography. It further explains how identity is comprised of property, politics, security, economy, religion, education, and culture; and how these elements are related to geographic areas. Chapter 3 provides a theoretical process using geospatial analysis in order identify ACIs. Chapter 4 presents what the study found, which includes the limitations of this process along with points of clarification. Chapter 5 provides an interpretation of the findings, potential implications, and topics for further research relating to the theory of ACIs.

In order to better understand this theory, this research identified how a country‘s borders and their internal political-administrative boundaries are formed. The formation of these boundaries influences the formation of territorial rights and the formation of identity. Physical geography and the topography of the land form areas that influence where populations and their fault lines exist.

Defining Borders

New borders are often created after periods of conflict, defined by the military front lines where equipment and personnel occupied key terrain with respect to geographic defensive positions. Examples of these boundaries are present between Israel and the Gaza Strip; where the lines between the Israeli and the Egyptian held areas, formed during the Israel-Egypt armistice agreement in 1949,[8] became the present day border. The Military Demarcation Line (MDL) between North and South Korea, along the 38th parallel is delineated along key areas, regarded as defensible positions for South

[8]Chaim Herzog, *The Arab-Israeli Wars: War and Peace in the Middle East from the War of Independence through Lebanon* (New York: Vintage Books, 1983), 105.

Korea.[9] External borders are further defined by the four step boundary evolutionary process of allocation, delimitation, demarcation, and administration.[10] The process of allocation involves the leadership of populations agreeing with regard to who controls the geographic areas, their populations, and their resources. In short, “who controls what territory and people on what terms.”[11] These areas are delimited using descriptions of terrain and infrastructure and mapping boundaries. Surveyors and military forces, from the populations then provide demarcation by emplacing boundary markers or monuments. Then, through administration, the government or population provides legitimacy and authority of the designated areas and their boundaries.

Within countries, internal boundaries dictate how a population is represented within the local government and who has responsibility for areas with regard to executive, legislative, and judicial affairs. Some governments have attempted to allocate their internal boundaries with broad brush strokes as seen in colonial African States, where political boundaries were “bequeathed” and cut across tribal territories.[12] The colonial methods of determining internal boundaries created problems for successor states that tried to work within the confines of the existing boundaries when dealing with

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[9]Matthew B. Ridgeway, *The Korean War* [1967; repr., New York: Da Capo Press, 1986], 202-203.

[10]J. R. V. Prescott, *Political Frontiers and Boundaries* (London: Unwin Hyman, 1987), 68-81.

[11]Samuel Huntington, *The Clash of Civilizations and the Remaking of World Order* (New York: Simon & Schuster, 1996), 292.

[12]Paul Buckholts, *Political Geography* (New York: Ronald Press Company, 1966), 29.

sovereignty;[13] as seen in Sudan along the 10th parallel[14] where a referendum recently passed in order to create a border and a Southern Sudan. In certain circumstances, such as the Dayton Peace Accords, the Inter-Entity Boundary Line (IEBL) delineated the various religious and cultural groups in Bosnia and Herzegovina and created territories and boundaries in-line with faith and cultural identities.[15] In light of this research, the Dayton Peace Accords represent the first well known case of mapping ACIs using GIS.

Territorial Rights

Territories and the rights of property and resource ownership are among the leading reasons of conflict within many parts of the world today.[16] Territories represent a population‘s identification to a geographic area and are influenced by cultural, religious, and historical reasoning. Within the military, the understanding and identification of factions and various competing populations enables commanders to better array their forces in support of full spectrum operations. For example, in Libya in 2011, U.S. Forces must be able to identify which elements of the population are being threatened in order to

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[13]Robert L. Solomon, ―Boundary Concepts and Practices in Southeast Asia," *World Politics* 23, no. 1 (October 1970): 1-12.

[14]Eliza Griswold, *The Tenth Parallel: Dispatches from the Fault Line Between Christianity and Islam* (New York: Farrar, Straus and Giroux, 2010), 4.

[15]William B. Wood, ―GIS as a Tool for Territorial Negotiations," *IBRU Boundary and Security Bulletin* (Autumn 2000): 72-79, http://www.iapad.org/publications/ppgis/gis_tool_for_territorial_negotiations.pdf (accessed March 3, 2011); Mark W. Corson and Julian V. Minghi, ―The Case of Bosnia: Military and Political Geography in SASO," in *Military Geography from Peace to War,* ed. Eugene J. Palka and Francis A. Galgano (New York: McGrawhill, 2005), 257-288; Griggs and Hocknell, ―Fourth World Faultlines and the Remaking of ‗Inter-national' Boundaries," 49-58.

[16]Geoffrey Demarest, *Property and Peace: Insurgency, Strategy, and the Statute of Frauds* (Washington, DC: Defense Intelligence Agency, 2008), 2-10.

provide the proper response and support. As the military conducts humanitarian, reconstruction, and combat operations, understanding the spatially complex layers of human geography enables the ability to identify population centers of gravity and territorial areas and boundaries where people claim control. The military's ability to better understand geographic areas and their relationship to structures, organizations, and people, is a key factor when operating in counterinsurgency (COIN) environments,[17] conventional combined arms,[18] peacekeeping and stability operations.[19]

Dynamics of Mapping Human Geography

Historically, mapping focused on identifying cities, road networks, and the topographic terrain. Maps enable the user to understand how to navigate through complex environments, and identify particular points of interest. Historic maps were not designed to rapidly identify new infrastructure, road networks, agriculture, or newly formed community areas. A 10 year old map showed where features were located over 10 years ago. Maps in the past had difficulty showing the dynamic changes within the environment due to conflict or natural disaster, where buildings were leveled; or refugee communities were newly formed. These changes in the physical and human geography require new technologies in mapping to support the rapid integration and accurate representation of these changes as they occur.

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[17]Department of Defense, Joint Publication 3-24, *Counterinsurgency Operations* (Washington, DC: Government Printing Office, 2009), VII-12.

[18]Mark W. Corson, ―Operation Iraqi Freedom: Geographic Considerations for Desert Warfare," in *Military Geography from Peace to War,* ed. Eugene J. Palka and Francis A. Galgano (New York: McGraw Hill, 2005), 178.

[19]Ibid.

New Technologies

Although anthropologists and human geographers have mapped the locations of religion, linguistics, and tribes for over hundreds of years–within the last ten years, a paradigm shift occurred. People think, access, and use geography in ways never previously considered.[20] Remote sensing is now provided through a wide range of commercial companies. Satellites and aircraft are able to reimage the same or nearby areas in a period of hours, instead of days. Sensors have dramatically increased their radiometric resolution to see and distinguish objects. Geospatial software can better distinguish objects using Geospatial Object Based Image Analysis (GEOBIA).[21] In addition to the advances in remote sensing, in the year 2000 selective availability was turned off enabling civilian and non-cryptographic GPS devices to become more accurate. This led to advances in GPS chip sets and handheld devices. Now phones and various collection devices can automatically geotag information with location data. Many consumers now expect their navigation devices in their cars to get them where they need to go; they expect their camera phones to tag their pictures so they are able to sort their photos by location; and they expect google maps to provide them with accurate routes and information regarding the retail sites in their local area. In short, geospatial

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[20]Thomas Blaschke, ―Object Based Image Analysis for Remote Sensing," *International Society for Photogrammetry and Remote Sensing* (Amsterdam: Elsevier B.V., 2009), http://ispace.researchstudio.at/downloads/2010/Obia_ISPRS_2010_ Blaschke.pdf (accessed March 1, 2010).

[21]Ibid.

information is now more accurate, inexpensive, and more than ever, people are using it within their daily lives through location-based services (LBS) and technology.[22]

Within the military, geographic information systems (GIS) provide the ability to use information collected from satellites, sensors, and people in order to integrate multiple layers of information. GIS enables the ability to have a common operational picture (COP) for commanders to better understand and visualize the intricacies of the physical and human geography.[23] This layered analysis can identify unseen relationships based on spatial, geographic, and temporal attributes. Through the use of Advanced Geospatial Intelligence (AGI)[24] both literal and non-literal data can support the identification of the natural fault lines of human geography. This feature layer, like mean sea level, is able to be delineated on a map in order to successfully navigate and conduct coordinated operations.

Human Terrain

Human geography encompasses a wide range of social sciences regarding people and society;[25] however, within the military, the term human terrain is most often used to

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[22]Jonathan Raper, Georg Gartner, Hassan Karimi, and Chris Rizos, ―A Critical Evaluation of Location Based Services and Their Potential," *Journal of Location Based Services* 1, no. 1 (March 2007): 19.

[23]Department of the Army, Field Manual 3.0, *Operations* (Washington, DC: Government Printing Office, 2011): 4-11, 5-22, 6-72; Kevin R. Golinghorst, ―Mapping the Human Terrain in Afghanistan" (Monograph, School of Advanced Military Studies, Fort Leavenworth, KS, May 2010), 31-32.

[24]Department of Defense, Joint Publication 2-03, *Geospatial Intelligence Support to Joint Operations* (Washington, DC: Government Printing Office, 2007), I-3.

[25]Erin Fouberg, Alexander Murphy, and H. J. de Blij, *Human Geography People, Place, and Culture*, 9th ed. (Hoboken, NJ: John Wiley and Sons, 2009), 33.

describe the culture and ethnicity of a population. It provides the military with a method to expand understanding beyond topographic terrain to enable commanders to focus actions in support of the population when conducting nation building, reconstruction, lethal and non-lethal operations.[26]

Within the military, physical and human geography are intertwined[27] as they provide an understanding of how people use areas; where they live, work, and conduct their daily routines.[28] The military's ability to understand how different areas are used by people can help to identify populations displaced from their homes or territories and describe how they might impact operational environments.[29]

Areas of Collective Identity

Within sociology, people with shared relationships, history, self identification, religion, culture, ethnicity, and values can form a collective identity. While sociological research exists regarding collective identity; there appears to be a gap in tying collective identity to geographic areas, which are independent of political-administrative boundaries. The Area of Collective Identity (ACI) discussed within this research is comprised of integrated elements of social structure, culture, language, interest, power

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[26]Jack Marr, John Cushing, Brandon Garner, and Richard Thompson, ―Human Terrain Mapping: A Critical First Step to Winning the COIN Fight," *Military Review* (March-April 2008): 18-24; Golinghorst, ―Mapping the Human Terrain in Afghanistan," 31-32.

[27]Corson, ―Operation Iraqi Freedom: Geographic Considerations for Desert Warfare," 178.

[28]Department of Defense, Joint Publication 3-24, *Counterinsurgency Operations*, VII-12.

[29]Ibid.

and authority.[30] These elements form spatial relationships that join people together in support of a cause which leads them to action. An area of collective identity could also be described as an ―area of common identity" or an ―area of community identity" depending on the audience or how the territories are portrayed. This research will utilize the term ―area of collective identity" (ACI) in order to reinforce how the data of the physical and human geography are integrated together as a collective element.

Within research involving demographic data, users gather census and cultural information in the form of discrete points. The points are then aggregated along existing political-administrative boundaries enabling the creation of a choropleth map; similar to a map of red and blue states during a presidential election. While this methodology provides an effective means of depicting quantitative data, it is delineated along existing boundaries and can therefore be an inhibiting factor when using spatial analysis where collective identities extend across boundaries. Similarly, when data is collected with regard to a specific point of interest or a person, within a military operational environment, it is often confined to existing boundaries. With the use of new techniques of imagery analysis and feature extraction, POI‘s are tied and related to both a country‘s internal political-administrative boundaries and the ACI. These relational geodatabases can then inform researchers and analysts of shared identity across internal boundaries or

[30]Department of the Army, Field Manual 3-24, *Counterinsurgency* (Washington, DC: Government Printing Office, 2006), 3-4.

external borders such as the Kurdish population in Iraq, Iran, and Turkey, who form a cultural identity across international borders.[31]

Primary Thesis Question

This research answers the question: How can the U.S. Army identify areas of collective identity and their extents by using geospatial analysis? These areas of physical geographic space can also be described as territories. The extents of these areas, their borders and frontiers are their boundaries. Therefore, these Areas of Collective Identity (ACIs) also represent the territories and boundaries of human terrain. Human ecology describes the relationship between the landscape, the natural resources of an area and the human population. These elements of physical and human geography are spatially represented and mapped through the use of remote sensing and information provided by the local population.

Secondary Questions

Within the field of human ecology, what are the factors of physical and human geography that most influence where groups of populations form? How can remote sensing support a military commander's ability to understand the environment with regard to physical and human geography? Finally, what elements of information are needed from the local population in order to increase the reliability of ACIs when they are identified?

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[31]David Newman, *Boundaries, Territory and Postmodernity* (New York: Frank Cass, 2004), 6-7; Robert D. Kaplan, *The Coming Anarchy: Shattering the Dreams of the Post Cold War* (New York: Random House, 2000), 37-43.

Remote sensing provides significant information beyond imagery. Data from spaceborne and airborne sensors can identify elevation and slope, materials, fence lines and boundaries, vegetation types and water. Remote sensing includes various sensors such as multispectral imagery, infrared, thermal, radar and lidar. All of these provide unique characteristics that enable feature extraction, elevation modeling, and the delineation of areas. Remote sensing supports both physical and human geography data collection enabling an analyst to determine where populations currently exist and where they are likely to exist based on terrain types and site selection factors influencing migration and population.

Significance of Study

The study of territories and boundaries is a significant field within diplomacy and military art and science because it provides an understanding of various identities within a population and how they are divided within geographic areas. During conflict commanders can better array limited forces in support of operations when they know where populations exist, why they exist in that area, and who the populations are. These fault lines between ACIs are often where extremist can take advantage of differences in order to leverage resources and bypass authority. Using these areas of isolation and differences, they can store and safeguard weapons and create safe havens. In addition, understanding the factors that influence the formation of ACIs helps to identify possible methods for reconciliation between groups in conflict and promote peace.

The military often aligns operational boundaries with existing internal political or administrative boundaries.[32] This research indicates that while those existing government boundaries may be useful for initially engaging the government, it is more important for maps to indicate where the areas of collective identity exist, which can also be described as the territories of human terrain. Understanding these geographic areas or territories can provide military planners an improved method of assigning forces to geographic areas in order to better conduct humanitarian and combat operations and further understand the people they are supporting.[33]

This research provides a framework for geospatial engineers, imagery analysts, civil affairs, and human terrain teams, to focus their collection and analysis efforts in order to better incorporate areas of human geography within their mission planning and product support. These elements of information and the ACIs can then be incorporated into command and control systems; and delineated on map products, providing the military with a more realistic view of the population; not defined along political boundaries, but along the territories and boundaries of human terrain.

Concluding Remarks

This chapter provided an introduction into how borders are defined and how internal boundaries dictate legal authorities that are often independent of the territorial boundaries. These territorial boundaries are formed based on people‘s relationships,

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[32]Department of the Army, Field Manual 3-05.401, *Civil Affairs Tactics, Techniques, and Procedures* (Washington, DC: Government Printing Office, 2007), para 3-94.

[33]Marr et al., ―Human Terrain Mapping: A Critical First Step to Winning the COIN Fight," 18-24.

where they live, their shared history, self identification, religion, culture, ethnicity, and values. The answer to the research question regarding, ―how can geospatial analysis identify areas of collective identity" is further expanded within chapter 2 as previous research is considered regarding sovereignty, borders and boundaries. Additional work regarding the use of remote sensing and GIS in land cover classification is also reviewed to provide context for this study. Chapter 3 provides a theoretical process that enables a geospatial analyst to derive ACIs, while chapter 4 provides analysis of both the process and the theory of ACIs. Chapter 5, concludes and reinforces the concepts and ideas presented within this research and recommends how this theory could be further expanded and used operationally in order to understand, visualize, and describe the territories and boundaries of identities within a population.

CHAPTER 2

LITERATURE REVIEW

This chapter discusses the contributions of authors, agencies and centers in mapping human terrain. Their work supports the fundamental use of geospatial analysis in order to identify how physical and human geography influence the formation of identities within a population. This chapter begins with contribution from geographers, who have investigated the sovereignty of territories and borders at a strategic level. It then introduces agencies and centers and their efforts at the operational level, and concludes with how human terrain is gathered at the tactical level through Soldiers working with local populations.

National Sovereignty and Borders

Researchers have sought better methods of describing the role of national sovereignty with respect to territories and borders.[34] The difficulty for many scholars however, is that external borders fall within the realm of international relations and geopolitics while internal boundaries are regulated through the national politics of a particular country. External borders of countries are based on Westphalian sovereignty,[35] and therefore enable a state, with a population, and territory of its own, to possess the

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[34]Stephen D. Krasner, ―Sovereignty,” *Foreign Policy* (January/February 2001): 20-29; David Held, ―Democracy: From City-states to a Cosmopolitan Order?,” *Political Studies* 40 (September 1992): 10-39.

[35]Held, ―Democracy: From City-states to a Cosmopolitan Order?,” 10-39; Kaplan, *The Coming Anarchy: Shattering the Dreams of the Post Cold War,* 38-39; Griggs and Hocknell, ―Fourth World Faultlines and the Remaking of ‗Inter-national‘ Boundaries,” 49-58.

right to govern itself and its citizens. This restricts the interference of countries openly investigating internal boundaries of other internationally recognized countries. Most often, countries are not critically looked at unless there is credible evidence of a possible genocide or sectarian violence.

Dr. William Wood, Geographer for the U.S. Department of State, conducted research using GIS as a tool for territorial negotiations. He identified methods used to delineate the boundaries of countries using GIS and described how geospatial data layers are applied to studying and identifying territorial changes.[36] Within his paper presented to the International Boundaries Research Unit (IBRU) at Durham University, UK, Dr. Wood described how GIS provides the ability to ―study patterns of human activities and their consequences."[37] Through his work within the Department of State, he identified that GIS is a ―powerful tool for territorial analysis and mediation decision-making."[38]

Collective Identity and the Fourth World

Alfred Sauvy, a French demographer and economic historian,[39] coined the term ‗Third World' in the early 1950s.[40] This described the geopolitical landscape after World War II. The First World represented capitalism of the United States and its allies known

[36]William B. Wood, ―GIS as a Tool for Territorial Negotiations," *IBRU Boundary and Security Bulletin* (Autumn 2000): 72-79, http://www.iapad.org/publications/ppgis/gis_tool_for_territorial_negotiations.pdf (accessed March 3, 2011).

[37]Ibid., 75.

[38]Ibid., 76-78.

[39]B. C. Smith, *Understanding Third World Politics Theories of Political Change and Development*, 3rd ed. (Bloomington, IN: Indiana University Press, 2009), 16.

[40]Ibid.

as the Western Bloc. The Second World of communism consisted of the Soviet Union and China known as the Eastern Bloc. While the Third World or ‗Third Force,‘[41] represented countries not aligned within ―military and diplomatic spheres"[42] of capitalism or communism.

In 1995, Dr. Richard Griggs, a political geographer for South Africa and Mr. Peter Hocknell, asserted that countries are comprised of ―geographic areas of nationalist-based tensions"[43] and that the people of these areas are recognized through three commonalities that bind them: ‗identity, culture and territory.‘[44] They describe that underlying a country‘s existing borders there is a ―Fourth World";[45] and being able to provide a mapped analysis of these boundaries could help researchers to understand why states collapse and where they may break along natural ‗faultlines‘ between geographic areas of volatility.[46] They describe that through the identification of these areas; there are tools to support conflict resolution.[47] Griggs and Hocknell assert that the geopolitical force of these Fourth World Nations deserve greater consideration from the United Nations and Boundary Scholars because ―Fourth World nations have been both the

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[41]Smith, *Understanding Third World Politics Theories of Political Change and Development*, 16.

[42]Ibid., 17.

[43]Griggs and Hocknell, ―Fourth World Faultlines and the Remaking of ‗Inter-national‘ Boundaries," 49-58.

[44]Ibid., 53.

[45]Ibid., 49.

[46]Ibid.

[47]Ibid.

cultural fault lines along which states break apart and the building blocks for their eventual reconstruction."[48]

<u>Tying Elements of Physical and Human Geography Together</u>

This research incorporates a wide range of geographic studies, both physical and human, in order to provide a theoretical process to identify areas of collective identity. Physical geography includes elevation, slope, soil type, and environmental factors that support life within a particular area. Friedrich Ratzel, a German biologist and geographer, considered to be one of the founders of human geography, published his work on political geography, *Politische Geographie*, in 1897. In it he identified and described the similarity of a state to an organism.[49] Ratzel identified the relationship of geographic space and resources to population.[50] His concepts incorporated how physical geography influences populations to thrive and grow within a particular region. Rudolph Kjellén, a student of Friedrich Ratzel, ―analyzed the spatial and territorial character of the state"[51] and sought to incorporate how a state and the people were intertwined. Both of their concepts, in many ways, led to changes within geography and its relationship to

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[48]Griggs and Hocknell, ―Fourth World Faultlines and the Remaking of ‗International' Boundaries," 57.

[49]Prescott, *Political Frontiers and Boundaries*, 9.

[50]Friedrich Ratzel, *The History of Mankind*, Second German Edition, vol. 3, trans. by A. J. Butler (New York: The MacMillan Company, 1898), 152-156; Buckholts, *Political Geography*, 29.

[51]Virginie Mamadouh, ―Geography and War, Geographers and Peace," in *The Geography of War and Peace From Death Camps to Diplomats*, ed Colin Flint (New York: Oxford University Press, 2005), 29.

sociology and political science. Their theories of human geography influenced the associated values of cost surfaces, which will be discussed further within chapter 3.

Within human geography there are a number of sub-disciples that focus on sociological aspects and their relationship based on location. The key to this research is the ability to use physical geography to provide the foundational elements for analysis that can then incorporate specific points or matrix data regarding a particular person or thing at a specific place. Instead of aggregating information over a specified political-administrative area, this research identifies new boundaries based on relationships and then links the data to these territorial areas. Using multiple layers of information creates independent cost surfaces that, when layered, can delineate areas not seen in one image alone.

This methodology is further elaborated by Ian McHarg who wrote in 1969, *Design with Nature*, and discussed how ecosystems and man influenced each other for site selection and the suitability of populations.[52] Within his book, he further elaborated on the process and form of city‘s ―intrinsic identity” [53] and how it relates to its own ―geological history, climate, physiography, soils, plants and animals.”[54] McHarg further discussed how the area of Washington, D.C. is bound by ―five major elements—the Mall,

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[52]Ian L. McHarg, *Design with Nature* (New York: The Natural History Press, 1969), 175-177.

[53]Ibid., 176.

[54]Ibid.

the Federal Area, the Formal Avenues, the Interstices and the remaining Open Spaces. Each of these elements has a distinct identity."[55]

Dr. Dana Tomlin, considered by many to be one of the founders of map algebra, furthered these concepts by converting information into layers within a software algorithm in order to analyze areas. His research regarding cost surfaces, enables users to aggregate data over units of cartographic space so that the areas are grouped to the extent that they provide ―all-inclusive, but mutually exclusive study area coverage."[56] Through the ability to aggregate these areas of collective identity, they are relationally joined to specific points, informing the user of both the area and the point's relationship to that area. This echoes statements from the Director of the National Geospatial-Intelligence Agency who asserts that NGA is providing ―contextual analysis of places informed not only by the earth's physical features and imagery intelligence, but also by human geography."[57]

In 1854, Dr. John Snow, an English physician and geographer, considered to be the founder of epidemiology, used methods of empirical reasoning to investigate the spread of cholera within a small community in London.[58] Using a map of the area, the

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[55]McHarg, *Design with Nature*, 182.

[56]Dana C. Tomlin, *Geographic Information Systems and Cartographic Modeling* (Upper Saddle River, NJ: Prentice-Hall Inc, 1990), 154.

[57]Letitia A. Long, ―Putting the Power of GEOINT in Your Hands" (Keynote Remarks GEOINT Symposium 2010, New Orleans, LA), https://www1.nga.mil/ Newsroom/PressReleases/Press%20Releases/nga_10_12_speech.pdf (accessed February 1, 2011).

[58]Tom Koch, *Cartographies of Disease Maps, Mapping, and Medicine* (Redlands, CA: ESRI Press, 2005), 129-131.

location of urban infrastructure, and natural resources for the community, he concluded that the spread of the disease, unknown at the time, occurred through the sharing of the same contaminated water supply. His work in epidemiology is largely regarded as one of the first uses of geospatial analysis and human ecology in order to identify a specific area and point derived from multiple points sharing a common feature.[59] Through his work and maps, he demonstrated early methods of tying physical and human geography together in order to demonstrate relationships and commonality with an emphasis on the relationship of the disease, the population, and the environment.[60]

The National Geospatial-Intelligence Agency's Contribution

NGA recently discussed the pivotal aspects of human geography and its impact on intelligence. Within this past year, NGA created a Human Terrain Analysis (HTA) pilot project. Their goal for human terrain analysis was to ―document workflows, define requirements, assess tools and techniques"[61] in order to build and evaluate[62] ―a prototype capability to acquire, manipulate, store, analyze and create human terrain data and products."[63] Various departments within NGA are working in coordination with the pilot

[59]Koch, *Cartographies of Disease Maps, Mapping, and Medicine*, 130; Steven B. Johnson, *The Ghost Map* (New York: Riverhead, 2006).

[60]Koch, *Cartographies of Disease Maps, Mapping, and Medicine*, 130.

[61]Sally S. and Dr. Gary E. Weir, ―Human Terrain Analysis Seeks Deeper Cultural Comprehension," *Pathfinder* (January/February 2010): 19.

[62]Ibid.

[63]Ibid.

project in order to determine the best methods to identify requirements, provide source data, conduct analysis, and provide training to other geospatial analysts.[64]

U.S. Army–Army Geospatial Center

The U.S. Army Geospatial Center provides a wide variety of products and support tailored to the needs of U.S. Army units. They are currently investigating the best methods to support human terrain. Their existing Urban Tactical Planner (UTP) provides tailored geospatial data related to urban area information, which includes both terrain and cultural data.[65] This data covering the urban environment and infrastructure provides buildings, vertical obstructions, bridges, lines of communications, landmarks, ground photos, and architectural drawings when available.[66] The information from AGC regarding remote sensing, lidar, and various sources of data provide unique unclassified information that can directly contribute to a better understanding of the human terrain.

AGC is also tied to deployed civilian professional engineers throughout the world in support of the U.S. Army Corps of Engineers (USACE). These civilian personnel work directly with the local populations to support infrastructure projects within the indigenous communities. In addition, USACE often has a geospatial analysts or personnel who provide local mapping support to projects and activities within the operational environment.

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[64]Ibid.

[65]Urban Tactical Planner Fact Sheet, U.S. Army Geospatial Center, Fort Belvoir, VA, http://www.agc.army.mil/fact_sheet/UTP.pdf (accessed April 11, 2011).

[66]Ibid.

Civil Affairs, Engineer, and Intelligence Branch

The U.S. Army Civil Affairs branch interacts with the local community in order to implement projects and support the commander‘s objectives, establishing peace and stability within an operational environment. Various methods are used to track civil information management regarding urban infrastructure and projects. Civil affairs soldiers are trained in using hand-held GPS/GIS devices to collect field data and then using various mapping software they track projects and share information. Their ability to use Esri[67] mapping software to establish a civil information management geodatabase can significantly enhance the understanding of POI and areas that are most important to the population.

Within the U.S. Army, both engineer and intelligence personnel work together to support the geospatial common operational picture. Engineers, who work with geospatial information and mapping products, provide subject matter expertise on the physical geography and topographic terrain. Intelligence personnel, who work with imagery and various types of geospatial intelligence, provide specific information regarding POI and Significant Activities (SIGACTs) thereby creating an understanding of current events in order to determine future actions.

Esri–Commercial GIS Software Company

Esri is a GIS software company based in Redlands, California. Their name, Environmental Science Research Institute, is derived from their early work regarding

[67]Esri, also spelled ESRI (Environmental Systems Research Institute) is a commercial GIS company that develops various types of mapping software. They are best known for ArcGIS/ArcInfo software.

using GIS to solve problems in environmental science. Their creation of shapefiles and geodatabase are considered to be the standard within the geospatial community. At this time, they are coordinating the development of a human geography geodatabase and analytical methods across civil and military sectors. They are currently creating a point geodatabase with 12 cultural themes (see table 1).

Table 1. Esri Cultural Attribute Geodatabase

Demographics	Medical	Land Use/Cover
Religion	Economy	Transportation
Language	Education	Political/Ideological
Ethnicity	Significant Events	Communications/Media

Source: Created by author. Data provided by Michael Kane, ―Esri Human Geography Approach Presentation" (Presentation to the HSCB (Human Social Cultural Behavior Modeling), Redlands, CA, February 9, 2011).

In addition to creating a geodatabase, Esri is developing tools within a Human Terrain Decision Support System (HTDSS)[68] that would allow military personnel to identify who lives within a particular area and then query where other people may live with the same common attributes. An Esri goal in human terrain mapping is to provide methods of editing and distributing information through an online interface of digital cultural maps.[69] They see the next step of human geography as being able to migrate from ―human groups" to a point data model allowing for further details to be provided about

[68]Michael Kane, ―Esri Human Geography Approach Presentation" (Presentation to the HSCB (Human Social Cultural Behavior Modeling), Redlands, CA, February 9, 2011).

[69]Ibid.

groups or individuals.[70] Within this research, their software tools and models within ArcGIS are used to conduct map algebra, cost-weighting, and data-linking.[71]

U.S. Army–Human Terrain System

The Human Terrain System (HTS) began in 2005 in order to provide a better socio-cultural understanding within a combat environment.[72] In 2006, the Department of the Army validated and funded the Human Terrain System (HTS) as a proof of concept.[73] Within HTS, Human Terrain Teams (HTTs) work at the ground level to gather socio-cultural information in order to enable U.S. Forces to better understand “the local population and apply this understanding to the military decision-making process”[74] (see figure 2).

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[70]Ibid.

[71]Ibid.

[72]United States Army, Human Terrain System, HTS Background, http://humanterrainsystem.army.mil/htsAboutBackground.aspx (accessed February 10, 2010).

[73]Ibid.

[74]United States Army, Human Terrain System, http://humanterrain system.army.mil/Default.aspx (accessed February 10, 2010).

Figure 2. Human Terrain Teams Collect Local Data

Source: Human Terrain System Photo Galleries, http://humanterrainsystem.army.mil/htsImageSliderAfghan.aspx (accessed February 10, 2010).
Note: Human Terrain Teams (HTTs) collect data from elders in Afghanistan in order to better understand the socio-cultural environment.

In addition, HTTs provide continuity and share the knowledge of a particular area with military personnel as they transition in and out of theater. These teams provide brigades with an understanding of the dynamics of human terrain within their operational environment.[75] The Department of Defense (DoD) recognized the success of the HTS program at being able to collect data and provide support to commanders. The program is currently being expanded into other regions of the world in order to deter conflict and support stability operations. In conjunction with the mission of the HTS, the Undersecretary of Defense for Intelligence USD(I) established three complementary

[75]United States Army, Human Terrain System, http://humanterrainsystem.army.mil/Default.aspx (accessed February 10, 2010).

goals:[76] (1) Build the socio-cultural knowledge base; (2) build the human terrain visualization and analysis tools; and (3) recruit, train and deploy human terrain analysts to support operations.

Military Forces Mapping Human Terrain

Soldiers of the 1-15 Infantry, 3d Heavy Brigade Combat Team (BCT), of 3d Infantry Division collected and mapped ethnographic and cultural data within their assigned areas Southeast of Baghdad in 2007.[77] They focused their efforts on working with the local leaders of the community in order to address specific needs. During their preparation, they found very little ethnographic data covering their area of operation.[78] The information they had reflected some historical data, but not the current key personalities or recent changes regarding opinions and loyalties.[79] In addition, they found they were operating along two separate cultural areas that were volatile because in part, their area of operations ―straddled a Sunni/Shi'a fault line."[80]

The human terrain mapping process helped the task force better understand the social conditions of their operational environment. They used both a common database and matrix that included ―information about religious boundaries, key economic

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[76] United States Army, Human Terrain System Background, http://humanterrain system.army.mil/htsAboutBackground.aspx (accessed February 10, 2010).

[77] Marr et al., ―Human Terrain Mapping: A Critical First Step to Winning the COIN Fight," 19.

[78] Ibid.

[79] Ibid., 18-24.

[80] Ibid.

structures, mosques, and important personalities such as sheiks."[81] The soldiers of the 1-15 Infantry integrated this information within their daily activities of providing safety and security for the population. Soldiers understood that when a significant event occurred, they were able to identify the leaders responsible for that particular area and could work with them in order to determine answers to critical questions.[82]

The task force describes in detail how they were able to collect and integrate the culture and ethnographic information to produce maps on their command and control systems and hard copy products. This data provided a graphical depiction of where potential sectarian fault lines existed and enabled the task force to focus initial security efforts quickly both in preparation for actions and in response to serious incidents.[83] 1-15 Infantry found that their interaction with the community in developing and keeping their maps current helped them to understand their assigned area of operation and the population they were supporting with safety and security. They described that through the development of the human terrain map, they understood the population and were therefore able to ―leverage the complex human relationships that make counter insurgencies succeed or fail."[84]

[81]Marr et al., ―Human Terrain Mapping: A Critical First Step to Winning the COIN Fight," 18-24.

[82]Ibid.

[83]Ibid.

[84]Ibid., 24.

Summary

Military efforts by soldiers and civilians, who work directly with the population, are a critical factor in gathering contextual information about the society and their relationship to one another. By working with the local population, analysts can better interpret the geographic relationships identified through remote sensing. The 1-15 Infantry Soldiers, the U.S. Army Human Terrain Teams, and the Civil Affairs Soldiers are all able to work together in order to understand and map the relationships of the population. This supports the process of geospatial analysis and the identification of ACIs presented in the next chapter. NGA, AGC, and Esri have laid the foundation in order to identify the relationships of physical and human geography and their influence on the formation of groups within populations. Their research and studies directly contribute to the creation of a theoretical process in order to determine ACIs using geospatial analysis with the tools of imagery and GIS software.

CHAPTER 3

METHODOLOGY

This research models a theoretical process or work flow that enables geospatial analysts to derive ACIs using remote sensing, information from the population, and existing spatial data. This eight step process is continuously evolving as existing data is refined and as new information is provided (see figure 3).

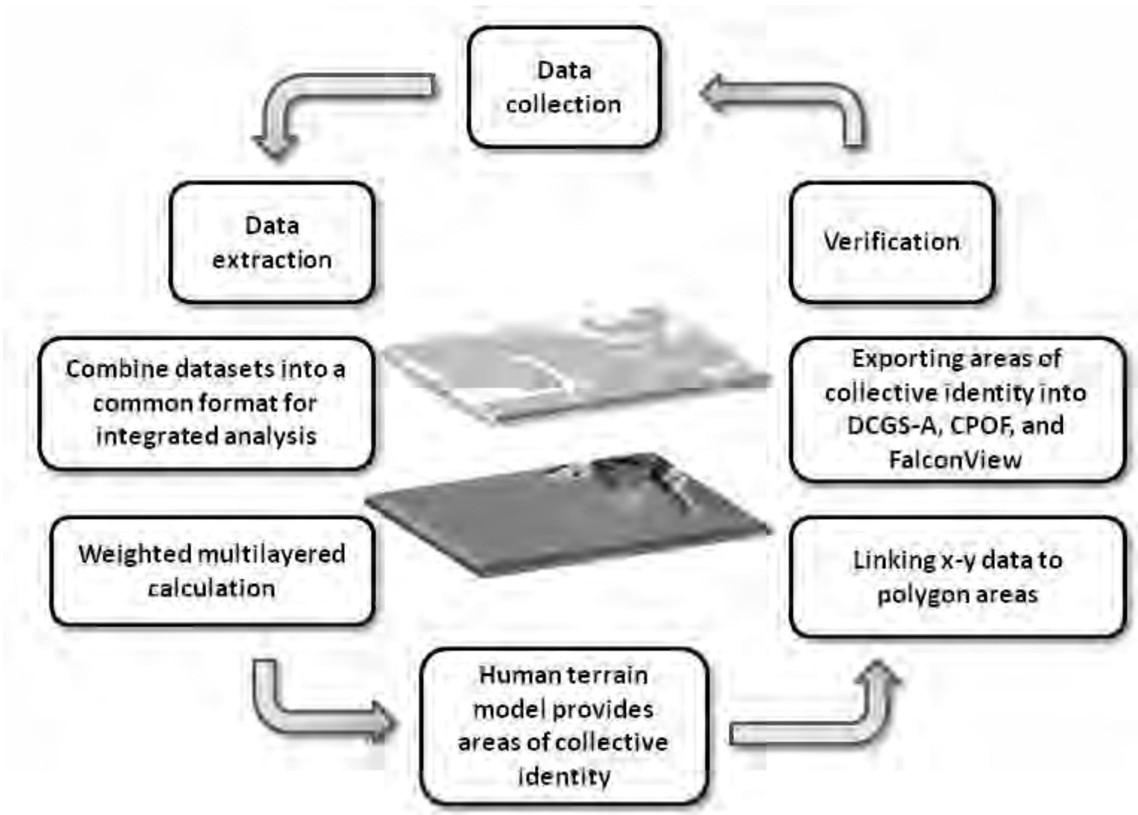

Figure 3. Eight Step Process to Identify Areas of Collective Identity

Source: Created by author. Elevation data provided by the Utah GIS portal, http://agrc.its.state.ut.us (accessed March 26, 2010).
Note: This geospatial analysis process illustrates how remote sensing and information from the local population supports the delineation of ACIs.

The process presented within this chapter uses geospatial analysis, remote sensing, information from the population, and existing spatial data in order to develop ACIs. Data, with regards to the local population, is also collected by military forces through their daily activities. This is seen with the 1-15 Infantry where, as part of their everyday operations, they discussed and worked with the people to verify property, jurisdiction, economic areas, faith, and culture in order to better understand the changes within the environment.

The basis for much of the information within the eight step process is extracted from imagery, elevation data, new geographic cultural information, and existing spatial data. These critical pieces of data are integrated together through raster surface analysis and the information is combined as part of a weighted multilayered calculation to depict the areas of high collective identity and the fault lines between populations. The existing datasets are then linked or attributed with these new ACIs in order to create a relational database. The Points of Interest (POIs) and their respective areas are exported to maps for military operations and verified through ground forces working with the local population. The weighted areas of collective identity are then refined and provided through command control systems and map viewers in order to define the territories and boundaries of human terrain. As information is refined from all dataset, changes are documented and provided back into the model in order to be incorporated into future analysis and products.

Step 1–Data Collection

The first step within the process is the data collection. Various types of data are required in order to successfully conduct analysis of physical and human geography. In figure 4, four categories of data are identified: (1) imagery (2) elevation (3) x-y coordinates with attributes, and (4) existing spatial data. These categories will be explained in greater detail within the following sections.

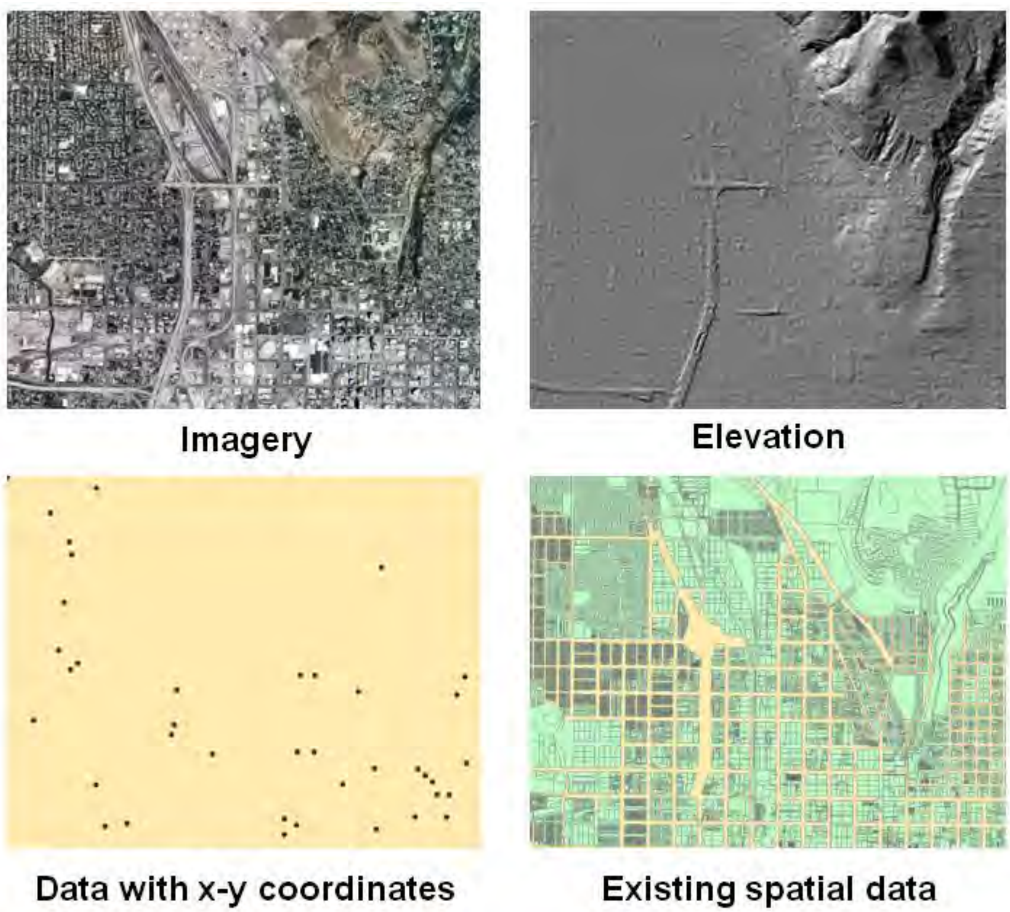

Figure 4. Primary Data Categories Used to Determine ACIs

Source: Created by author using ArcGIS software. Imagery provided by the U.S. Geological Survey-EarthExplorer website, http://edcsns17.cr.usgs.gov/NewEarthExplorer (accessed March 27, 2010); GIS and elevation data provided by the Utah GIS portal, http://agrc.its.state.ut.us (accessed March 26, 2010).
Note: Imagery, Elevation, Data with x-y coordinates, and Existing spatial data (Raster and Vector) are the four primary data formats used to determine ACIs.

Imagery

Multi-Spectral Imagery (MSI) sensors use windows within the electro-magnetic (EM) spectrum to collect groups of wavelengths, or light. These elements of light are combined together in order to produce ‗true color' imagery. MSI sensors can also classify wavelengths outside of the visible spectrum. These wavelengths are used to identify features based on radiometric properties. For instance, using MSI data, analysts can classify areas from chlorophyll in vegetation, which absorbs blue and red light at about 400 and 600 nanometers respectively and reflects green light and near-infrared energy at about 500 and 700 nanometers respectively. MSI can also identify areas of soil, water, and man-made objects using spectral properties not seen within a human's visual perception.[85] Using the capabilities of MSI provides a method to collect and interpret current data within a limited amount of time. Advanced techniques for using these types of imagery sources are currently in development and are described by Mr. Antonio Wolf, a Senior Spectral Analyst at Ball Aerospace and Technologies Corporation.[86] He proposed that using 8 bands of imagery supports the rapid integration of data for land cover classification. His methods, which will be further discussed in this study in the section on feature extraction, are adapted for other imagery sensors in order to identify infrastructure and land use.

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[85]Antonio Wolf, ―Using WorldView 2 Vis-NIR MSI Imagery to Support Land Mapping and Feature Extraction Using Normalized Difference Index Ratios" (Longmont, CO: DigitalGlobe, December 2010), 4. http://dgl.us.neolane.net/res/dgl/survey/_8band challenge_winners.jsp?deliveryId=&id= (accessed March 1, 2011).

[86]Ibid.

Elevation

Although stereo-imagery provides elevation, this data is also independently derived from other systems and sensors such as Synthetic Aperture Radar (SAR) and lidar. Interferometric Synthetic Aperture Radar (IfSAR or InSAR) is able to identify features for extraction in darkness and poor weather conditions; it is also well known for its ability to extract elevation data over large areas. In 2000, the U.S. NASA Space Shuttle conducted a mission to collect elevation data over most of the earth. This data, known as Digital Terrain Elevation Data–Level 2 (DTED-2), provides most elevation data for military command and control systems.[87] DTED-2 provides 30 meter post spacing elevation similar to contours on a 1:50,000 scale map. The commercial company TerraSAR-X now regularly provides SAR data for a wide variety of commercial uses. Companies like Fugro[88] provide SAR data collected from airborne platforms that provides even higher resolution elevation datasets.

The Army Geospatial Center (AGC) created an airborne imagery and lidar sensor called the Buckeye System, which in its lidar capacity, sends pulses of energy and measures their rate of return back to the sensor thereby creating high resolution elevation and building infrastructure information for terrain modeling. When mapping in tropical environments, lidar is used over forested areas to see both the forest canopy and penetrate to the ground in order to determine both elevation changes as well as distinguish paths

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[87]Jet Propulsion Laboratory, ―Shuttle Radar Topography Mission" (Pasadena, CA: California Institute of Technology), http://www2.jpl.nasa.gov/srtm (accessed March 31, 2011).

[88]Fugro Aerial Mapping, http://www.fugro.com/services/other-sectors/urban-water-infrastructure/aerial-mapping (accessed March 31, 2011).

and roads. This form of elevation dataset is used to model built-up areas, how paths and infrastructure are connected within a city, and create high resolution maps of physical borders and divided space within populations. Lidar is now regularly provided by commercial geospatial companies throughout the world and provides the ability to incorporate a high resolution elevation dataset within future models.[89]

Data with X-Y Coordinates

Soldiers from the 1-15 Infantry collected and mapped ethnographic and cultural information through the process of documenting information and geographic coordinates written down in journals. In some cases, with biometric devices and automated tools, they recorded information with x-y coordinates embedded into the data. Collecting boundary information and cultural points of interest enables the ability to create cost surfaces from property boundaries and thiessen polygons from specific points of interest.[90]

Ian McHarg, one of the founders of mapping human ecology, emphasized how the identity of an area is influenced by the value or identity of artifacts regarding specific points or monuments. He used the example of Washington D.C. and its monuments and their influence on the identity of the area.[91] Points of interest (POI) are often collected by U.S. Army human terrain teams (HTTs) that are embedded within U.S. Army Brigade Combat Team (BCTs). These POI identify the where and when with regard to some type

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[89]Airborne 1- LiDAR and Oblique Imagery, http://www.airborne1.com/lidar.html (accessed March 31, 2011).

[90]Marr et al., ―Human Terrain Mapping: A Critical First Step to Winning the COIN Fight," 19.

[91]Ian L. McHarg, *Design with Nature* (New York: The Natural History Press, 1969), 183.

of quantitative or qualitative measure. As points are delineated along paths they form the basis for the nodes within lines or as bounding points to delineate the corners of an area. These points are best identified when communicating with the local population regarding the extent of their areas. This research identified the following points of interest and their areas as significant for determining ACIs. Both Esri and NGA had identified similar points, which are identified by an asterisk or hash (see table 2).

Table 2. Points of Interest and their Areas		
Field	Points	Areas
Security	Police Stations Military Installations	Extent of jurisdiction and patrol areas Installation boundaries
Economy*#	Food Markets, Fuel Stations	Areas of the population they support or provide service
Water	Drinking water or wells; this includes water towers and water purification facilities	Coverage areas of the extended water lines or their service area
Religion*#	Worship/Holy Sites– by Religious group	Extent of wards or catchment areas; Holy sites are included, but in many cases are within a cultural POI
Medical*#	Hospitals, Clinics	Ambulance coverage zone
Education*#	Schools – by age/grade and language	Catchment/coverage area of students based on the language in which they are taught
Political*#	Government or community buildings used to facilitate the functioning of a society	Taxation boundaries and current political/administrative boundaries
Cultural *	Monuments or geographic points significant to the history of a population	Areas include shared space of parks, recreational areas, and monuments that space large distances such as the Washington Mall, this can also include battlefields and holy sites; Burial grounds/cemeteries when they encompass different religious groups
Utilities	Power and natural gas facilities and generation plants	Coverage areas that extend to distribution lines or service areas
Resources	Significant property, mineral, oil, illicit and legal crops	Areas, extents, and property ownership and boundaries

Source: Created by author.
* Indicates fields identified by the GIS company Esri. Michael Kane, ―Esri Human Geography Approach Presentation" (Presentation to the HSCB: Human Social Cultural Behavior Modeling), Redlands, CA: February 9, 2011).
# Indicates fields identified by the National Geospatial-Intelligence Agency, *Human Terrain Analysis Handbook and Reference Guide,* Version 1.0 (Bethesda, MD: National Geospatial-Intelligence Agency, 2009), 35-37.
Education field derived from Dinka Corkalo, et al., ―Neighbors again? Intercommunity Relations After Ethnic Cleansing," in *My Neighbor, My Enemy: Justice and Community in the Aftermath of Mass Atrocity*, ed. Eric Stover and Harvey M. Weinstein (Cambridge, UK: Cambridge University Press, 2004), 156.

Existing Spatial Data

Geospatial analyst within a Brigade Combat Team (BCT) geospatial cell can include the following datasets into their analysis to help confirm collected information:

1. Raster Digital Map Data (Multiple Scales 1:5M–1:12.5K)

2. Raster Commercial Imagery (Multispectral/Panchromatic .5 meter cell-sizes)

3. Vector/Urban Map Data (Points, Lines, and Polygons of urban features of at 1:12.5K)

4. Elevation (DTED-2, DEM, Lidar)

5. International, Provincial, Regional, and District Boundaries

These raster and vector data products provide delineated areas and boundaries that help to interpret the datasets used to form ACIs. Existing raster data sets support the understanding and identification of areas belonging to specific groups or entities. The datasets identified above must be verified based on currency and accuracy to support the mapping of ACIs. Although human terrain may not be consistent with the local boundaries; the existing local boundaries on raster datasets and hardcopy products must be taken into account because the existing systems of regulation use them to establish controls that impact the population and their identity.

Step 2–Data Extraction

This second step of data extraction within the eight step process requires extracting key pieces of information that support the analysis and identification of ACIs. Data extraction uses the four primary data formats of imagery, elevation, data with x-y coordinates, and existing spatial data in order to complete this step. The first data format, imagery, provides both visual and hidden information regarding built-up areas, road networks, and terrain analysis. In most circumstances, using imagery to digitize individual objects and features is extremely time consuming; therefore the following steps within data extraction are used to facilitate the relatively quick extraction of information.

Mr. Antonio Wolf, a Senior Spectral Analyst at Ball Aerospace and Technologies Corporation, provided four index ratios that support land cover classification using the commercial imagery satellite, WorldView-2.[92] The index ratios he proposes are used to identify infrastructure, vegetation, water, and soils[93] (see figure 5).

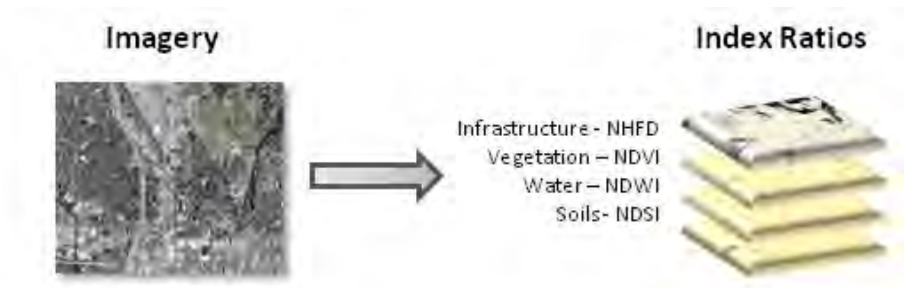

Figure 5. Imagery Provides Key Information Through the Use of Index Ratios

Source: Created by author. Imagery provided by the U.S. Geological Survey-EarthExplorer website, http://edcsns17.cr.usgs.gov/NewEarthExplorer (accessed March 27, 2010); GIS data provided by the Utah GIS portal, http://agrc.its.state.ut.us (accessed March 26, 2010).
Note: Multi-spectral imagery (MSI) from WorldView-2 provides four index ratios of infrastructure, vegetation, water, and soils that are used within step 2 of this process.

The formulas used by Mr. Wolf are directly associated with the WorldView-2 satellite. Other satellites, with further research, may provide similar results and are

[92]Wolf, ―Using WorldView 2 Vis-NIR MSI Imagery to Support Land Mapping and Feature Extraction Using Normalized Difference Index Ratios."

[93]Ibid.

discussed further in chapter 4. WorldView-2 spectral bands are provided below within table 3.

Table 3. WorldView-2 Spectral Sensor Bands	
Coastal	400 – 450 nm
Blue	450 – 510 nm
Green	510 – 580 nm
Yellow	585 – 625 nm
Red	630 – 690 nm
Red Edge	705 – 745 nm
Near-IR1	770 – 895 nm
Near-IR2	830 – 1040 nm

Source: Created by author. Data from DigitalGlobe Feature Classification, http://www.digitalglobe.com/downloads/spacecraft/FeatureClassification-DS-FEAT.pdf (accessed March 26, 2010).

Layer of Infrastructure

Using the index of Non-Homogeneous Feature Data (NHFD) materials such as buildings, cars, and roads are extracted for use in land cover classification.[94] This layer provides the ability to locate urban, built up areas, and paved road networks within an image scene (see figure 6). The infrastructure within this image is depicted in black. Using GIS, nearness to the features are then weighted higher and a cost surface layer is created depicting where populations are converging and forming areas of identity. This is further discussed within step 3 of this process.

[94]Wolf, ―Using WorldView 2 Vis-NIR MSI Imagery to Support Land Mapping and Feature Extraction Using Normalized Difference Index Ratios.”

$$\sum\frac{(\text{Red Edge} - \text{Coastal})}{(\text{Red Edge} + \text{Coastal})} = \text{NHFD}$$

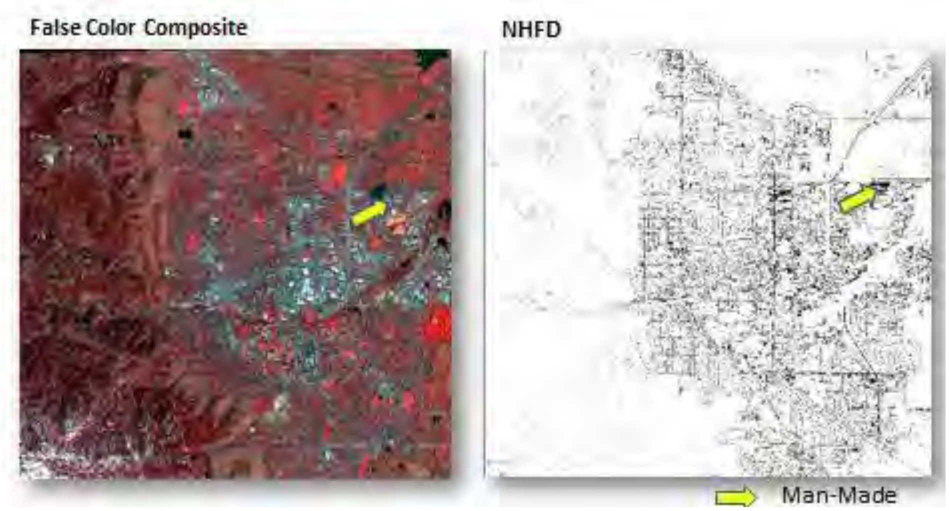

Figure 6. False Color Composite and Non-Homogeneous Feature Data Layer

Source: Used by permission from DigitalGlobe. Graphics from Mr. Antonio Wolf‘s research entitled ―Using WorldView 2 Vis-NIR MSI Imagery to Support Land Mapping and Feature Extraction Using Normalized Difference Index Ratios.”
Note: The first image is a false color composite that emphasizes both vegetation and building infrastructure. Within the first image, the infrastructure and buildings are depicted as cyan. The second image extracted the man-made features and provided a layer for land cover classification and cost surface analysis.

Layer of Vegetation

The Normalized Difference Vegetation Index (NDVI) uses the red band to represent the low reflectance from vegetation and the expanded near infrared spectrum to provide greater delineation of agricultural areas. This layer highlights different fields, crops, and their boundaries. NDVI layers are regularly used for agricultural mapping in order to determine where healthy vegetation areas exist. This NDVI layer is represented by shade of darkness indicating areas of healthier vegetation. Like the infrastructure layer the nearness to their vegetation features creates a cost surface that will form the second index layer of vegetation.

$$\sum\frac{(\text{Red}-\text{NIR2})}{(\text{Red}+\text{NIR2})} = \text{NDVI}$$

Layer of Water

In response to Hurricane Katrina in 2005, the Advanced Geospatial Intelligence (AGI) node of the U.S. Army Space and Missile Defense Command (SMDC) provided maps for recovery teams using the ratio of the blue band to the near infrared band in order to identify areas that had been flooded.[95]

The Normalized Difference Water Index (NDWI) is similar to the ratio used by the AGI node, but using Wolf‗s Water Index, the coastal blue band of the WorldView-2 satellite provides ―a more discrete threshold for detecting areas of standing water.‖ [96] This water feature layer provides the ability to determine where rivers and streams exist. The features like the previous two infrastructure and water layers create a surface indicating where nearness the water forms the third cost surface layer.

$$\sum\frac{(\text{Coastal}-\text{NIR2})}{(\text{Coastal}+\text{NIR2})} = \text{NDWI}$$

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[95]Tara Burkey, ―Rapid Mapping Analysis Helps Disaster Victims,‖ *GIS for Decision Support and Public Policy Making* (Redlands, CA: ESRI Press, 2009), 89.

[96]Wolf, ―Using WorldView 2 Vis-NIR MSI Imagery to Support Land Mapping and Feature Extraction Using Normalized Difference Index Ratios.‖

Layer of Soil

The Normalized Difference Soil Index (NDVI), like the previous three index layers, uses the difference between the bands in order to highlight the soil within the image scene. This is done by using the green and yellow bands in order to identify the soils.[97] In other algorithms image analysts use a short-wave infrared band (SWIR) to normally identify soils within an image. Mr. Wolf found however, that NDSI using the green and yellow band of the WorldView-2 sensor provides a new and relatively accurate soil layer without using the SWIR band. This soil layer can support the identification of open soil and bare areas. In contrast to the previous three layers, this layer creates a negative cost surface, where the farther away from the bare soil, the higher the value of the surface areas.

$$\sum\frac{(\text{Green}-\text{Yellow})}{(\text{Green}+\text{Yellow})}=\text{NDSI}$$

Feature Extraction–X-Y Coordinate Points into Areas

When specific areas of influence are unknown, the points of interest are used to identify where potential natural fault lines exist based on the proximity of one point to another. This is done through the use of theissen polygons.[98] Theissen polygons are closely related to proximity analysis, but instead of relating objects based on distance, areas are geographically proportioned based on common characteristics. This means that

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[97]Ibid., 5.

[98]Tom Koch, *Cartographies of Disease Maps, Mapping, and Medicine* (Redlands, CA: ESRI Press, 2005), 139-140.

common points are used to identify areas they are related to when there are no definitive boundaries.

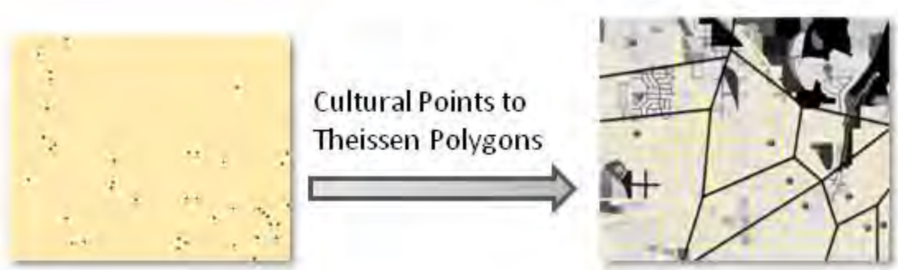

Figure 7. Cultural Points to Theissen Polygons

Source: Created by the author. GIS data provided by the Utah GIS portal, http://agrc.its.state.ut.us (accessed March 26, 2010).
Note: Cultural points of interest are queried and individual layers such as religious facilities are extracted in order to determine where the areas of influence or responsibility are most likely to exist.

These polygons also referred to as Focal Neighbors, Dirichlet regions, proximal zones, Voronoi diagrams, and Wigner-Seitz cells.[99] They provide a calculated method to delineate areas based on their relationship to three or more geographic points. Theissen polygons provide a technique to approximate areas derived from specific distinguished points. The theissen polygon layer containing areas can then be weighted within the multilayered analysis in order to improve the reliability of the area of collective identity.

Step 3–Combining Data for Analysis

Proximity analysis provides the ability to use disparate forms of data and tie them together using their geographic relationship to one another. Researchers such as Dr.

[99]Tomlin, *Geographic Information Systems and Cartographic Modeling*, 128.

Tobler, in his work on economic geography,[100] emphasized the use of algorithms based on geographic space to show similarities of population based on euclidean distance. He used mathematical algorithms for proximity in order to create models for urban population expansion.[101] His analysis provides a structure for linking disparate types of data together based on their distance from one another.[102] Dr. Tobler's work is built upon within this research because he focused only on quantitatively measuring distance, and not on environmental or demographic factors such as "employment opportunities, topography, transportation, and other distinctions between site qualities."[103] Within today's technology GIS provides the ability to extract features from imagery, these elements are integrated into an overall analysis, providing a more informed proximity algorithm.

The process of combining data requires the same cell size for the various cost surface layers. A cost surface is where features, representing the real world, are converted into a layer of data with numerical values. These values, within this research, represent an affinity or avoidance to a physical area. For instance, a geographic space of 5 meters by 5 meters when layered over the same area with different values provides a new surface that includes the total affinity or avoidance to an area. An example of two layers (5 meter cell

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[100] Waldo Tobler, "A Computer Movie Simulating Urban Growth in the Detroit Region," *Economic Geography* 46, no. 2 (1970): 234-240.

[101] Ibid.

[102] Ayşe Pamuk, *Mapping Global Cities: GIS Methods in Urban Analysis* (Redlands, CA: ESRI Press), 85.

[103] Tobler, "A Computer Movie Simulating Urban Growth in the Detroit Region," 234.

size) overlaid together provide a new raster surface indicating affinity or avoidance based on numerical values.

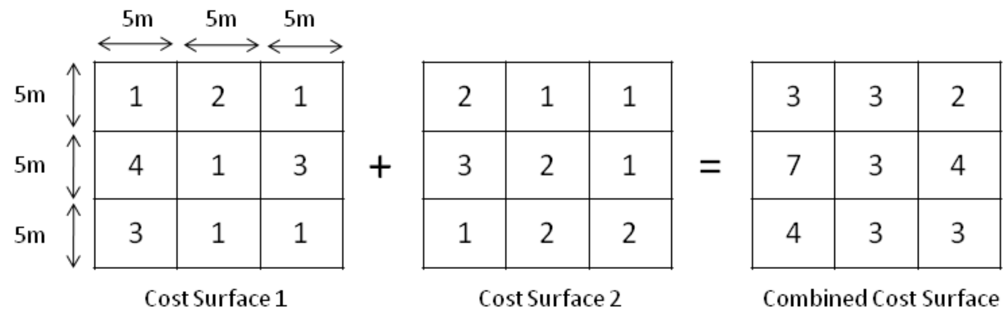

Figure 8. Using Cost Surface Layers in Geospatial Modeling

Source: Created by author.
Note: A cost surface can represent any type of geographic space. In this example 5 meter cells over a 15x15 meter area are combined with a second cost surface layer with attributes over the same area. The new surface on the far right combines both values in order to create a new surface in which analysis is conducted.

In preparing cost surfaces, values of areas are identified, as well as the attracting or opposing relationship to features. For example, from the feature extraction of the imagery there are four raster layers of infrastructure, vegetation, water, and soils. The first layer of instruction uses the density of the infrastructure to create a cost surface where areas near each other have higher values. This means that the values within the surfaces closer to the features of infrastructure will be higher than the values of the cells which are farther away. In this research higher values indicate an affinity for the area.

Layers of vegetation and water cause the same effect. A layer of soil however, has an opposite effect and creates a relationship where the farther away the cell is from areas of bare soil, the higher the cell value. When these cost surface layers are combined, they create a final cost surface that is used to identify areas based on their overall cell values. This then goes to step four of the process.

Step 4–Weighted Multilayered Calculation

Multilayered analysis takes independent layers of information and spatially combines them with weighting metrics in order to identify areas within a certain region. Ian McHarg, considered to be a founder of ecological planning, conducted environmental analysis in order to determine where to locate power lines.[104] He used overlays and shading to indicate where features were located in relation to one another. By stacking the layers, the most suitable areas were the lightest features on his map.

The cost surface, derived from the various feature layers, provides an informed framework that enables users to incorporate additional data collected from people or sensors on the ground. These layers each show a natural linking of people, places, and things. They include tax and property zones, power utilities infrastructure, and oil and gas pipelines. These layers when overlaid create a more informed perspective that links the identities of the population through their everyday activities (see figure 9).

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[104]Ayşe Pamuk, *Mapping Global Cities: GIS Methods in Urban Analysis* (Redlands, CA: ESRI Press), 85.

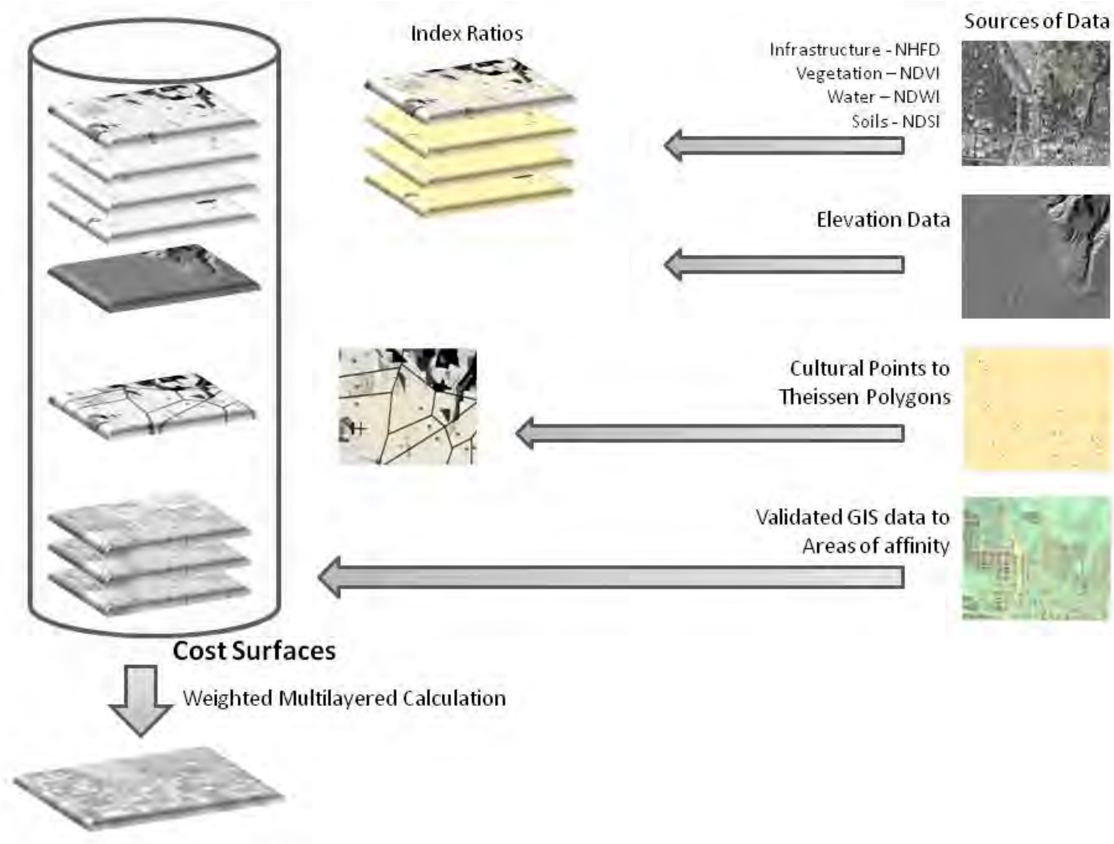

Figure 9. Diagram of Data that Integrates Cost Surfaces

Source: Created by author. Imagery, elevation, and map data compiled using ArcGIS software. Imagery of Salt Lake City, Utah provided by the U.S. Geological Survey, EarthExplorer website, http://edcsns17.cr.usgs.gov/NewEarthExplorer (accessed March 27, 2010); Elevation and GIS data provided by the Utah GIS portal, http://agrc.its.state.ut.us (accessed March 26, 2010).
Note: Cost surfaces when integrated together and weighted using a multilayered calculation, provide a new surface that incorporates the various values of independent layers into a final surface where cells with high values indicate high collective identity.

Step 5–Human Terrain Model Provides ACIs

Multilayered analysis takes independent layers of information and spatially combines them using weighted metrics. Combining source data and elements of information collected from the local population, creates a human terrain model, depicting how information is related to geographic space, and delineating where areas with high collective identity are located. Within this visual human terrain model, the formations of mountains or peaks represent areas of high collective identity, while the lower values create valleys. These valleys then represent areas where low collective identity exist and therefore create boundaries between various populations.

In other words, the model is created by the independent cell values that represent collective identity. The higher the cell value, the higher the representation of the elevation within the visual model. This value is derived from the intensity of each cell and their overall spatial relationship with the cells around them. Within ArcInfo, the GIS software created by Esri, there are existing methods using their spatial analyst extension, to extract valleys within a terrain model. This method is based on hydrology modeling and the determination of where natural watersheds are located. These low valley areas within the human terrain model then represent the boundaries of the ACIs.

Step 6–Linking X-Y Data to Polygon Areas

GIS provides the ability to link or join points of information within a database to the geographic areas identified through layer information. The method of analysis may also be referred to as spatial association analysis.[105] This provides the ability to tie one location within a geographic area to the ACI as well as keep its association with other independent factors within the database. The database is then joined to show the relationship existing between the administrative boundaries and the elements of human geography that are provided within this research. Using GIS and data linking, an analyst

[105] Jon A. Kimerling, Aileen R. Buckley, Phillip C Muehrcke, and Juliana O. Muehrcke, *Map Use Reading and Analysis*, 6th ed. (Redlands, CA: ESRI Press, 2009), 404-406.

can query a map to determine where similar areas share attributes common characteristics.

Step 7–Exporting ACIs into Command and Control Systems

Once the ACIs are derived from the model, they are exported into map viewers and command and control systems so that they, and their foundational data, can be verified. The ACI layers are exported in the form of shapefiles for use in Distributed Common Ground System–Army (DCGS-A) and the Command Post of the Future (CPOF) software. In addition, data is shared with the Mapping the Human Terrain (MAP-HT) software and the Tactical Ground Reporting (TIGR) database used by HTS. As these layers are exported, the smaller areas are joined in order to assign responsibility for common areas to military forces. These new areas of responsibility (AORs) provide a way to track the cultural and ethnographic differences within a region. Using GIS, their data integrity is retained within DCGS-A in the form of a geodatabase file because they both share a common mapping language using C/JMTK (Commercial/Joint Mapping Toolkit.)[106] Data is also exported into a shared server for CPOF, FalconView,[107] C2PC,[108]

[106]U.S. Army Engineer Research and Development Center, Commercial Joint Mapping Toolkit (C/JMTK), http://www.erdc.usace.army.mil/pls/erdcpub/www_welcome.navigation_page?tmp_next_page=64120 (accessed April 4, 2011).

[107]FalconView is map viewing software developed by Georgia Tech Research Institute for the Department of Defense, http://www.falconview.org/trac/FalconView (accessed April 4, 2011).

[108]Command and Control Personal Computer (C2PC)-is a system to track friendly units and display a common operating picture (COP). The Battle Command Training Center, http://www-bctc.army.mil/c2pc.htm (accessed April 4, 2011).

and JADOCS (Joint Automated Deep Operations Coordination System)[109] in order to provide a common and shared understanding of the operational environment.

Step 8–Verification

After data is exported into command and control systems, hand held devices, and onto map products, it is verified through U.S. military forces communicating with the local population. The depicted points of interest (POI) and their areas identified on table 2 are corrected as the local community leaders and site reconnaissance provides feedback. As the information is gathered from the population and corrected, these layers of information and POI are updated and the model is improved and further refined to higher degree of accuracy and validity.

Summary

The geospatial methods, identified within this process provide a faster method of identifying infrastructure and the physical geography. Once the data is prepared for analysis, it is integrated into a weighted multilayered calculation producing values indicating the relationship of identity. As further research is pursued on the weighting of geospatial layers of property, jurisdiction, economic areas, faith, and culture–the areas will be better distinguished according to their strongest aligning factors influencing the collective identity. This 8 step process provides ACIs that are used in map viewers, command and control systems, and paper maps that are refined by personnel on the ground working with the local population. Through the construction of this virtual human

[109]U.S. Army Geospatial Center–JADOCS Program Manager, https://www.iec.belvoir.army.mil/jadocs/about.htm (accessed April 4, 2011).

terrain model using data regarding people, places, and things–areas of high collective identity and the fault lines between populations are seen facilitating the identification of territories and boundaries of human terrain for U.S. military operations.

CHAPTER 4

ANALYSIS

This research provides a theoretical process using geospatial analysis with remote sensing, information from the population, and existing spatial data in order to derive ACIs. Using the techniques and procedures outlined within the previous chapter, a geospatial analyst can better identify the infrastructure that forms the human geography of an area. The elevation and barriers of physical geography are used to classify where homogeneity and heterogeneity occur. These areas are then given meaning, or context with attribute data provided by the local population in form of specific points and associated information. These defined areas often are independently represented by ethnic, religious, economic, political, ideological, and cultural points and boundaries. Through this process these areas are brought together to identify individual areas of collective identity. The data is then distributed and verified by Soldiers, civilians, humanitarian workers, and through the local population. As data is updated it goes back into the existing sources of data and as the process continues through each iteration-the degree of confidence and the level of accuracy improves. This model provides a viable framework for using geospatial analysis in order to determine ACIs. This chapter will present the findings of this research, which includes the limitations of this process along with points of clarification that need to be considered when delineating ACIs.

Analysis and Critiques of the Model

As outlined in chapter 2, the Soldiers of the 1-15th Infantry, through a concerted effort, demonstrated the importance of gathering information through interaction with the population in order to provide safety, security and special assistance with projects for the community. They identified the local leaders, their geographic boundaries, and critical items important to the population. Human Terrain Teams (HTTs) and Civil Affairs Soldiers provide this support to many Brigade Combat Teams (BCT), but in order to have the significant level of accuracy within the model, additional efforts regarding who owns property are required from the local government and tribes. The most accurate source data is gathered through regular interaction and confirmation with the local civic leaders who coordinate activities regarding: religion, education, healthcare, markets, and media.

Step 1–Data Collection

The first step of the model, data collection, consists of (1) imagery, (2) elevation, (3) x-y coordinates with attributes, and (4) existing spatial data. Each element is discussed below with regard to applicability to the model, constraints or limitations, and important points to consider.

Imagery

There is a wide range of geospatial analysis tools and data sources available in order to determine ACIs and map populated areas. Within this research, imagery is considered to be fundamental sources of information. This research uses 8 bands of sensor data in order to classify potential ACIs. The advanced techniques for these types of imagery sources are still in development, but are similar to the characterization methods used in Landsat satellites to classify vegetation areas.[110] The 8 bands of the

[110]National Aeronautics and Space Administration, Landsat Program, http://landsat.gsfc.nasa.gov/ (accessed April 17, 2011).

WorldView-2 satellite described in chapter 3 enable the ability to using index layers identified by Antonio Wolf, in order to determine infrastructure, vegetation, water, and soils.[111] This land cover classification can then be used to identify homogenous and heterogeneous areas as described within the 8 step process of this research.

This 8 band imagery used within this research is uniquely suited for land cover classification and feature extraction, however, it may not be available over particular areas due to cost or competing image requirements. For example, higher priority images are often required from the same sensor along a limited amount of time within a flight-path. This means that four-band imagery, such as GeoEye-1 (seen in table 4) will need to be adapted in order to provide similar information regarding vegetation, water, soils, and infrastructure.

Table 4. GeoEye-1 Spectral Sensor Bands

Blue	450 – 510 nm
Green	510 – 580 nm
Red	655 – 690 nm
Near-IR	780 – 920 nm

Source: Created by author. GeoEye-1 image specification data provided by GeoEye, http://www.geoeye.com/CorpSite/products-and-services/imagery-sources/ (accessed April 17, 2011).

Current imagery is the primary source of data within this process because it provides new information in order to determine the impact on the physical and human

[111]Wolf, ―Using WorldView 2 Vis-NIR MSI Imagery to Support Land Mapping and Feature Extraction Using Normalized Difference Index Ratios.”

geography.[112] Based on the dynamics of changes within the environment and of human geography, the imagery used for source data should not be older that one year in order to map the current environment.[113] Older imagery is still relevant for change detection and should be used to conduct forensic analysis and identify where populations were previously located. In some regions of the world, older imagery may be especially critical in order to build cases regarding property ownership, genocide or ethnic cleansing.

The U.S. Army and military forces must consider how imagery and geospatial analysts are being trained in order to conduct feature extraction using index layers from multispectral imagery. In addition, imagery files require additional hardware, software, and training in order to process data. These files take great amounts of memory and processor speed in order to run the calculations. Current laptops at the BCT level may not be suitable for conducting this analysis and therefore other hardware and software systems should be investigated in order to minimize the time required to process the ACI data. Training soldiers on these systems and software must also be factored into the process of military occupation specialty (MOS) training and professional development.

Other sources of imagery not included as part of the model, but with great potential to be used for landcover classification and feature extraction are hyperspectral imagery (HSI) and radar. HSI is similar to Multi-Spectral Imagery (MSI) in the way features are classified using spectral signatures along the windows of the spectral bands.

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[112]Ibid.

[113]John R. Jensen and Dave C. Cowen, ―Remote Sensing of Urban/Suburban Infrastructure and Socio-Economic Attributes," *Photogrammetric Engineering & Remote Sensing* 65, no. 5 (May 1999): 611-620.

MSI can have 8 spectral bands, while HSI, using narrow bands, can have 200+ bands,[114] and can significantly support the distinguishing of similar objects within an image scene. Using hyperspectral imagery, an analyst can identify features with great confidence in order to classify objects based on their spectral signatures.

Although not covered within this research, Synthetic Aperture Radar (SAR) data is able to provide new techniques with regards to land cover classification. This is important because there are more situations where airborne and spaceborne SAR are available over areas in periods of poor weather conditions or natural disasters where smoke may obscure a standard image scene.

Although imagery can quickly identify populated areas and boundaries of human infrastructure, it is limited in its ability to understand the context and relationships of the population. This means that solely using remote sensing to determine spatial connections results in the possibility of making the wrong connections in relation to why people are in a particular area and what identity factors are most critical to them as they align themselves with others of similar identities.

Elevation Data

Elevation datasets are used to derive altitudes for features and areas, determine cost surfaces based on slope, and conduct aspect and line of site analysis.[115] This study used elevation in order to determine its influence on the potential formation of ACIs at

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[114]Nicholas Short, ―Remote Sensing Tutorial," *National Aeronautics and Space Administration,* http://rst.gsfc.nasa.gov/Intro/Part2_24.html (accessed April 17, 2011).

[115]Tomlin, *Geographic Information Systems and Cartographic Modeling*, 132-135.

similar altitudes. This is based on previous research on settlements and tribes that formed communities at similar altitudes.[116] Research conducted by Utah State University using GIS and economic data over the city of Logan, also concluded that a direct correlation existed regarding home and property values at higher elevations[117] which could further be used to describe economic grouping based on elevations. These economic groups however, may not always be classified as wealthier at higher elevation, because in some communities economically disadvantaged groups live at higher elevations. The difference as identified by Mukherjee and Caplan may also conclude that the hedonic view over the scenery or landscape (viewshed), and the intrinsic social value of the land regarding its placement and distance away from stagnant streams,[118] provides a significant role in determining the economic value of the property.

This research did not incorporate slope, aspect angles or line of site analysis to cultural points of interest. However, it is expected that many smaller ACIs form based on their line of site to similar groups and cultural objects. This reflects research that boundaries such as hills can create natural borders separating different groups, thereby creating separate ACIs.[119]

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[116]Kent V. Flannery, ―The Ecology of Early Food Production in Mesopotamia," in *Cultural Geography: Selected Readings*, ed. Fred E. Dohrs and Lawrence M. Sommers (New York: Thomas Y. Crowell Company, 1967), 107-108.

[117]Shibashis Mukherjee and Arthur J. Caplan, ―GIS-Based Estimation of Housing Amenities: The Case of High Grounds and Stagnant Streams," *Letters in Spatial and Resource Sciences* 4, no. 1 (2011): 49-61, http://www.springerlink.com/content/kr337701382glq03/fulltext.pdf (accessed April 7, 2011).

[118]Ibid.

[119]Robert W. Paterson and Kevin J. Boyle, ―Out of Sight, Out of Mind? Using GIS to Incorporate Visibility in Hedonic Property Value Models," *Land Economics* 78,

X-Y Coordinates with Attributes

Collecting data is a very time intensive process. This model did not include how time should be factored into the collection of data, but tried to minimize extraneous sources where available. The amount of time also varies depending on the resources and collection methods already in place. When information is collected from people on the ground, it is often written in books, and created through the use of handwritten notes and sketch maps. Depending on what handheld device is available, the data is recorded in the Military Grid Reference System (MGRS) or in varying forms of geographic coordinates of latitude and longitude. Point data is created through the use of excel spreadsheets, saved as database files and then imported into ArcGIS. The process for inputting this type of raw data is tedious, but essential to understanding the population and where territories exist. In addition, through gross errors of transposing numbers or incorrectly writing a piece of information–data may be attributed to the wrong location.

Automated systems and GPS devices could use waypoints or recording methods to help facilitate data collection. This is done through devices such as the *ike,* a handheld GPS/GIS device, fielded through the U.S. Army Corps of Engineers to support data collection. This tool is part of the system called the GATER (Geospatial Assessment Tool for Engineering Reachback), enabling information to be collected at a local level and

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no. 3 (2002): 417-425, 417-418; Mukherjee and Caplan, ―GIS-Based Estimation of Housing Amenities: The Case of High Grounds and Stagnant Streams," 49-61.

uploaded into GIS software to “extract shapefiles and generate reports that depict their data collection(s).”[120]

Figure 10. The ikeGPS Handheld Collection Device

Source: Image used by permission from SAIC, http://www.saic.com/products/geospatial/ike-504 (accessed May 18, 2011).
Note: The image shows the commercial handheld device that is a rugged PDA, GPS, camera, and laser range finder.

Once the field-work collection is completed, each day the users must import that data back into GIS software and confirm the accuracy and metadata of the associated

[120]United States Army Corps of Engineers, “ike with GATER (Geospatial Assessment Tool for Engineering Reachback),” http://www.usace.army.mil/CEMP/ffe/Documents/GATER%20Fact%20Sheet%2021OCT09.pdf (accessed April 17, 2011).

information. The collectors become the authoritative source while their supervisor ensures a quality control check on the data.

Although only points are discussed; when they are combined along a route they represent the nodes that form polylines or boundaries. When these points are used as bounding coordinates, they become polygons or areas. The information collected, through the use of commercial GPS devices and handwritten journals, by personnel such as the Soldiers of the 1-15th Infantry, U.S. Army Human Terrain Teams (HTTs), Civil Affairs Soldiers, Engineer Soldiers, and members of the local population provide context and meaning about points and areas within an operational environment. These points of information (POI) and their respective areas, which are identified in table 2, provide a frame of reference for data required to best support this model.

Existing Spatial Data

Although imagery can help identify potential boundaries of a property; the existing spatial data, cadastral records, and land ownership documents will ultimately provide the understanding of who owns the property. Property parcels are indications of identity, the smaller the parcels are grouped together often indicate that within a particular area the population is more related based on the common economic property and housing types, supporting the theory that areas which are spatially closer together are more similar than areas that are farther away. Dr. Waldo Tobler, one of the pioneers of spatial analysis within the GIS community, coined the first law of geography regarding his work on urban growth. He stated: ―Everything is related to everything else, but near things are more related than distant things."[121] Within the model presented in chapter 3, when data is processed into a cost surface layer the features that are near the infrastructure represent areas of higher collective identity. Further research is needed in order to properly group similarities and shared identity that are seen by remote sensing such as common roof types, driveways, and yards. These factors within the United States typically form subdivision and areas that share similar economy, property and sales taxes, and similar housing ordnances and covenants. This therefore creates a shared geographic identity linking various attributes to one area based on property.

Geospatial analysis provides the ability to document many layers of information associated with an area of property in order to de-conflict and build the history of the property ownership in order to settle potential conflict. Within civil war, property in itself creates a legal requirement overseen by a judge or leader to identify who owns what property and how it is recorded as part of a legal document in order to settle disputes. The challenges of identifying and recording property ownership are discussed by Dr. Geoff Demarest, an analyst and author with the U.S. Foreign Military Studies Office (FMSO), within his book: *Property & Peace*. He discusses that ―Property lies between law and land, land and economics and between military strategy and human rights."[122]

Douglas Batson, an NGA regional analyst and author of *Registering the Human Terrain: A Valuation of Cadastre,* describes how conflicts over land, housing, and other

[121]Tobler, ―A Computer Movie Simulating Urban Growth in the Detroit Region," 234.

[122]Geoffrey Demarest, *Property & Peace: Insurgency, Strategy, and the Statute of Frauds* (Washington, DC: Defense Intelligence Agency, 2008), 309-313.

land-related rights are exploited by insurgency groups[123] and how many different populations returning to lands they once owned could possibly ―destabilize areas one thought stable."[124] This applies to the model because data collection for land and property records must be collected, adjudicated, and administered by the local government as the U.S. and Coalition Forces interact with the population.

This record of property ownership may not be available during the first iterations of this model, however as data is continuously collected, a geospatial database provided by a legal system will help to determine who has sole or shared rights to a specific area, especially during repatriation.

Step 2–Data Extraction

This model focused on data extraction through the use of imagery. If different sources and AGI can provide relevant and useful information, they should be incorporated into the model. The independent layers provided to the population as part of the verification process must remain unclassified.

The soils layer within the index matrix provides bare ground features and areas where barren land exists. In agricultural areas however, farmers and geologists are able to classify soil according to its level of fertilization and crop sustainability. This is done through samples of soil taken on the ground and then through the creation of isopleth

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[123]Douglas E. Batson, ―Registering the Human Terrain: A Valuation of Cadastre," (National Defense Intelligence College Press: 2008), http://www.ndic.edu/press/10279.htm# (accessed February 1, 2011), 2.

[124]Ibid., 20.

maps.[125] This is where the points are interpolated over an area indicating where different soil types exist. An isopleth map is created using specific points where data is collected in order to identify common areas using contour lines that are usually found in elevation models. This concept of using soil data to determine where people are likely to settle coincides with work provided by Ian McHarg, a founder of human ecology. The data layer of individual samples at specific locations could be used in coordination with the NDSI layer in order to help identify where soil areas influence population settlements.

Another difficulty within the creation of cost surface layers using the index of Non-Homogeneous Feature Data (NHFD) is that relationship of infrastructure influences the cost surface layer. Within the current model, the cost surface creates attraction to all elements within this index layer. Using other forms of geospatial analysis however, cost surface are better identified by the attributes of the features and the knowledge regarding the affinity towards the feature. For example, some physical infrastructure layers create boundaries which join communities, while others separate. In the case of parks and golf courses, their boundaries represent where people would like to live near and therefore the cost surface is higher or better closer to their features. On the other hand, railroad tracks, which can join cities by providing resources, also represent a danger to children, noise from many trains, and sometimes polluted areas. Therefore the tracks become a negative boundary thereby splitting areas and creating a negative value where the cost surface is lower or worse closer to their features. By creating a negative boundary two different types of groups often live on opposite sides of the track. This is not accounted for within

[125] Terry A. Slocum, Robert B. McMaster, Fritz C. Kessler, and Hugh H. Howard, *Thematic Cartography and Geovisualization*, 3rd ed. (Upper Saddle River, NJ: Pearson Princeton Hall), 282.

the NHFD index cost surface, but future research could help to provide methods of updating this information with automated rules. The current model requires existing x-y data and spatial data to overcome deviations created by the index cost surfaces. If the analyst has knowledge of the features and their affinity towards the population then he or she can increase or decrease the cost surface within the existing spatial data layer. An example of this would be that an electric tram, that has multiple stops, with fencing or walls, that is well kept, with no noise and high speed access to various social points would create a positive feature for a population to live near and therefore the closer to the feature the higher the cost surface.

Theissen Polygon

The fault lines between theissen polygons, identified within this model, are based on the proximity of points and their relationship spatially to each other within a region. The theissen polygons can result in significant differences between areas depending on the number of points included in the creation of the polygons. The weighting of the areas is also subjective and may cause analysts to look at a particular factor when other factors are perhaps more influential depending on the geographic region where analysis is conducted. This needs to be further researched in order to provide methods that could help control the influence created when point data is missing from the dataset.

The theissen polygons provide an excellent source of information, but in order to conduct calculation, cost distance, and multilayered analysis the analyst needs to convert the features to raster surfaces and reclassify the polygons according to which ones are more likely to represent the areas of conflict within a population. The theissen polygons are most related to catchment areas: these are the geographic areas where populations are related to one specific point or the point provides a service to a particular area or region. The problem however with this model and the weighting, is that theissen polygons can influence the overall results of the ACIs and create boundaries that are out of alignment to the real catchment zones identified by the school, church, or emergency services. A step to rectify this problem is to interact with the local population in order to confirm their areas related to the points identified within table 2. This would then create an independent cost layer that better defined the catchment areas in question, creating a more accurate ACI. In many ways theissen polygons provide an approximation for planning, but when better data is available in the form of polygon areas, that data should be used in order to improve the overall results of the geospatial analysis.

Additional Datasets

Social scientists, linguists, politicians, human geographers and many others have sought ways to identify how people are similar or different to the groups around them. Incorporating their data can provide layers of cost surfaces that are weighted together in order to determine ACIs.

For example, if you were to take points of data with different languages over a geographic area, and created an isopleth map, then these areas could roughly identify where these languages existed. The contour layer could then provide values converted into a cost surface. The further away individuals are from the boundaries the more the homogeneity within the central area and the higher the collective identity. This linguistic layer could be combined with the school catchment zones in order to identify the relationship between the schools, their languages and writings, and the interrelated relationship within the community to these educational identities.

Step 3–Combining Data for Analysis

Proximity analysis provides the ability to use disparate forms of data to tie layers together using their geographic relationship to one another. As discussed within this research, there were multiple datasets not incorporated into the model due to time constraints regarding the identification of ACIs. These various types of imagery, elevation, and GIS data could assist with feature identification and improvement with regard to the ACIs as the cycle model continues.

Step 4–Weighted Multilayered Calculation

The multilayered analysis step within this model takes independent layers of information and combines them using a weighted calculation where areas are essentially overlaid on top of each other. The weighting contributed to variations in the overall model. Further research is needed in order to determine how to mitigate influencing factors in determining areas of identity. Although the model as a whole uses geospatial analysis to identify areas, step 4 is subjective in that someone must determine what is the most influencing factor, or the cost surface layer, because its borders are likely to significantly influence the overall outcome.

For example, if religion were to be identified as the dividing factor within a particular region, the layers that contribute to the overall ACI would still be included, but the weighting of the religion would have a higher weighting. Therefore, other layers would influence the analysis and contribute to the how these areas of religion are formed, but the weighting and the fault lines would reflect more along the lines of religion. Although the model for ACI is used, the importance of religion would therefore change the name of the output layer to: Areas of Religious Identity or the religious identity layer.

Similarly, the areas reflecting different economies could be referred to as the economic identity layer.

In other words, using faith identity within Sudan may help to identify the connection between faith and property, but using the same weighting within Libya may not provide the best results. In Libya for example, the national identity could be the most important factor, identifying the connection between nationalism, property and economy as provided within table 5. The key distinction is that these areas are not represented by political-administrative boundaries, but represent the complex relationships based on many factors identified within the model. Therefore, the ACI model provides a layer more reflective of the population (see table 5).

The identities presented within table 5 reflect a sliding scale where populations are influenced by the identities most important to them and around them, based on spatial proximity. These identities represent elements that influence people to fight in order to defend their identity. For example, resources represent the foundation for property identity. When people are displaced, they still retain the identity of that location and therefore are likely to gravitate back to that location and share a common identity with others in similar circumstances.

Regional culture is learned values, attributes, and beliefs of a population. Therefore, populations based on their region or history may have features or areas that are significant to them and not significant to other populations. Knowing the culture helps identify these cultural features and factors that could be emplaced within the model in order to support the creation of a cost surface that is more representative of the population and their affinity for particular areas. Some monuments, which may be identified through remote sensing, cannot fully be understood without direct interaction with the population, because a particular culture or group places more emphasis on the importance of the area and what it means historically to a particular culture and their identity. Examples of this include the Pearl Roundabout in Bahrain, a site used for protests against the local government, destroyed on March 18, 2011. In Cairo, Egypt, Tahrir Square also represents a geographic location historically important to the culture and identity of the population. The importance of this area, when used to depict cost surfaces, requires knowing the importance the population places on the cultural identity of this area, which is not likely to be seen by remote sensing alone.

Table 5. Areas of Collective Identity–Map Layers		
Greatest Influencing Layers	Areas of Collective Identity	Description
Resources	Property Identity	Areas of land ownership including areas of natural resources such as water, oil, natural gas, minerals, and the ownership of urban infrastructure.
Political*#	National Identity	Areas where populations delineate where they are from. The extent of tribes, towns, cities, or countries.
Security	Jurisdictional Identity	Areas where formal militaries are established and paramilitaries exist. Government security, local police, gangs, or judicial elements that view the extents of their authority and responsibility.
Economy*#	Economic Identity	Areas of service and influence regarding markets, fuel stations, and businesses involved in trade within their areas of service. This also includes areas of economic levels of the population.
Religion*#	Faith Identity	Areas predominantly identified by religious groups. But identity is not limited to major religions, but also denominations or factions, populations that are agnostic, atheistic, or have various belief systems.
Education*#	Educational Identity	Areas where schools associate themselves with the populations they serve. Geographic relationship between parents and students to the school and to other families who attend the school. Areas reflecting the population's languages, writing and scripts, dialect and colloquial words.
Cultural*	Cultural Identity	Areas that tie people together not only through monuments and memorial sites but include the geography of groups formed around areas relating to sports, arts, and community activities.

Source: Created by author.

* Indicates fields identified by the GIS company Esri. Kane, ―Esri Human Geography Approach Presentation" (Presentation to the HSCB: Human Social Cultural Behavior Modeling, Redlands, CA: February 9, 2011).

# Indicates fields identified by the National Geospatial-Intelligence Agency. National Geospatial-Intelligence Agency, *Human Terrain Analysis Handbook and Reference Guide,* Version 1.0. (Bethesda, MD: National Geospatial-Intelligence Agency, 2009), 35-37; Demarest, *Property & Peace: Insurgency, Strategy, and the Statute of Frauds*, 7-8, 29-32, 351-353; Griswold, *The Tenth Parallel: Dispatches from the Fault Line Between Christianity and Islam*, 8-13, 278, 282; Forward Thinking, http://www.forward thinking.org/default.asp?id=14&ver=1 (accessed April 20, 2010); Kalervo Gulson, ―Renovating Educational Identities: Policy, Space and Urban Renewal," *Journal of Education Policy* 20, no. 2 (March 2005): 141-158; Akhil Gupta and James Ferguson ―Beyond ―Culture": Space, Identity, and the Politics of Difference," *Cultural Anthropology* 7, no. 1, 6-23 (February 1992): 8.

Identity

Researchers studying the effects of ethnic cleansing integrated themselves into the cities of Mostar and Prijedor (Bosnia and Herzegovina) and in the city of Vukovar in Croatia. In the city of Mostar the ethnic divide occurred along the River Neretva, with Bosniaks living on the east bank and Croats living on the west joined together by a centuries-old bridge called the called the Stari Most, a cultural POI, destroyed by the Croat Army in 1993[126] and rebuilt in 2004. The authors describe that inside of the other two cities a ―psychological wall" existed between the populations.[127] The researchers found the relationships formed dividing lines before the war began, viewed as small and inconsequential. Leaders ―revived and reconstructed national identities by introducing cultural elements of ethnicity."[128] This included the use of writing styles and specific words within a language; the use of songs, and the incorporation of religious and political symbols.[129] These leaders emphasized debts and the discrimination or abuses of other ethnic groups.[130] Due to the volatility and sense of threat within the region, people ―willingly or unwillingly, sought refuge in the confines of their own ethnic group."[131]

[126]Corkalo et al., ―Neighbors again? Intercommunity relations after ethnic cleansing," 151.

[127]Ibid., 143.

[128]Ibid., 146.

[129]Ibid.

[130]Ibid.

[131]Ibid.

Step 5–Human Terrain Model Provides ACIs

The human terrain model represents a cost surface layer with higher cell values within the cost surface, becoming higher elevations within the virtual human terrain model. Using 3D analyst software in ArcGIS provides a visual representation of the elevation modeling. The difficulty with extracting the ACIs within this layer is that the hydrology model is limited in defining a contiguous area. It creates a watershed surface where the hydrology model looks for the physical valleys within the model to create stream networks. These stream networks are along the valleys and provide a common area of lower elevation, but converting these polylines into solid areas and fixing the topology is still difficult. Although this method of identifying the areas provides an important method for identify high areas of collective identity, additional work is needed on automated methods for extracting the lowest elevations and the topology of the contiguous areas.

Step 6–Linking X-Y Data to Polygon Areas

Using GIS software, geographic areas of ACIs, represented by polygons, are linked or joined x-y data points. This is important because it provides the ability to delineate areas with regard to the population and is not confined to delineating information along political-administrative boundaries. For instance when someone describes the areas of Economic Identity, they are not restricted to show the areas within city or census boundaries. The data from the points that they represent can show the economic areas describing where the markets are located, where the population is served, and the economic status of that population. This provides the ability to analyze information related to areas and quantify data associated with how it may relate to multiple ACIs. The complexity of the data are reflected using spatial analysis tools in order to distinguish these geographic points of information and using spatial association analysis.[132]

Step 7–Exporting ACIs into Command and Control Systems

Although the exporting of ACIs into Command and Control Systems or Mission Command systems may seem straightforward, there are a number of issues related to how data is exported. The polygon layers can hold large amounts of data and attributes, however when exporting to a shape files and then opening within other systems, the shape files can possibly lose their attributes. Through simple identification the layers can retain the geographic area and exported into map viewing systems. Geospatial analysts and mapmakers can use the entire geodatabase in order to update their products information and analysis and produce the ACIs for visual depiction on the maps.

Step 8–Verification

Once data is in the hands of Soldiers, civilians, and the population it must be corrected and verified at the lowest level. As information is provided through feedback, the layers of information are updated and new products with new and more accurate information are distributed. This verification process enables the cycle to continue to be refined with changes as they occur and supports the documentation of temporal information as changes occur within the environment and population. This final step provides refined data that is then part of the existing spatial data layer as the eight step process continues.

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[132]Kimerling et al., *Map Use Reading and Analysis*, 404-406.

Summary

This chapter discussed the strengths of the theory and process that could further the use of geospatial analysis in identifying the territories and boundaries of human terrain. It also provides points where additional work is needed in order to refine the geospatial techniques presented within this research. The process as a whole provides a viable framework in order to conduct analysis and map areas that are formed from information not constrained to existing boundaries, but by using current information and historical understanding to delineate the spatial relationships of identity. The theory presented within this research provides new ways to use imagery and analysis to identify populations and their boundaries. It also helps to better understand where and why people fight. The theory of ACIs and the geospatial analytical methods used to derive these areas provides resources for understanding and describing the operational environment.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

This final chapter reinforces the importance of geospatial analysis to determine and map areas of collective identity (ACIs) in order to support a true understanding of the environment. The term, “area of collective identity” could also be used interchangeably to describe an “area of common identity” or an “area of community identity.” The delineation of ACIs provides a mental and physical model to depict the common relationships of populations within a particular area. These areas may further be used to identify new internal political-administrative boundaries for countries as they are represented by their local community leaders.

U.S. Army Human Terrain Teams (HTTs), Civil Affairs Soldiers who provide Civil Information Management (CIM), Engineer Soldiers providing engineer reconnaissance, and Geospatial Engineer and the Intelligence Imagery Analysts provide the coordinated effort to identify and build a database of critical points and areas within the operational environment. This database provides the Common Operational Picture (COP) of these territories and boundaries of human terrain.

This chapter provides interpretations and findings of the ACIs and the implications of this research. Recommendations for future study are presented along with potential questions for future research. In conclusion, future actions of this research are presented in order to implement new methods of geospatial analysis.

Interpretation and Findings

The results of this research help to solidify the theory of ACIs and provide tools that are used within geospatial analysis to identify and map these areas. Refined techniques are still required in order to reduce the amount of time and effort to identify these areas, but the theory provides a tool to map the spatial relationship of identities that represent where populations exist. The U.S. military‘s ability to conceptualize human geography and identify these areas and their relationships to the operational environment provide methods for understanding the population; why and where they fight; and possible resources that can be used to mediate peace within a region or area.

Areas are influenced by ―place identity" which describes a particular area or site and its relationship to the environment; the infrastructure of a community; its cultural history; and the population‘s relationship to that location. Once a population establishes itself within a particular area, they change the environmental landscape and provide visual cues to enable a geospatial analyst to delineate the urban infrastructure and the boundaries of the population. This is seen in how the infrastructure is developed; how the roads and path are built; and how the population develops the areas in which they live. These changes can cultivate or inhibit future population growth leading to further changes within the ACI.

Applications of the Research

The results of this research provide a usable framework, using unclassified satellites, systems, and data from the local population to develop a common understanding of the environment and populations from with a common identity. The areas of human terrain can then be delineated and used on maps in order to resolve disputes and conflicts regarding the control, representation, and administration of an ACI. This research provides new ways of looking at the physical and human geography of a region. As new sensors and geospatial software are developed, researchers and analysts could use this process further reduce the time it takes to identify ACIs. Many of the mission command systems within the military could use these areas to better define the populations of human terrain and share that information for diplomacy and economic development. As handheld devices that record and provide information increase, the capabilities of this model will also increase. Violence throughout many countries is occurring along 4th World Faultlines. As new ways of understanding the environment are required, both technology and resources can work together in order to provide a new understanding of the common operational environment, and help to reduce violence between identities.

This theory of ACIs could be further expanded in order to provide a framework or mental model tied to geographic space regarding the fact that people fight each other in order to preserve, assert, and sometimes redefine their identities of property, nationalism, jurisdiction, economics, faith, education, and culture. The ACI process could also be used to identify areas where people may try to take advantage of ungoverned space. This is particularly important for counter insurgency operations. For example, Carl Von Clausewitz, the famous military strategist, stated that insurgent forces concentrated along the boundaries of areas[133] where the fog of war forms along the ―flanks of the enemy‘s

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[133]Carl Von Clausewitz, *On War*, ed. and trans. by Michael Howard and Peter Paret (Princeton, NJ: Princeton University Press, 1989), 481.

theater of operations."[134] This research helps to identify the boundaries described by Clausewitz and model the human terrain in a virtual environment in order to better understand where and why these boundaries exist.

Implications

As systems continue to transition and cuts are made to the military budget, it is important that geospatial analysts have the tools, imagery, and spatial data available to conduct analysis and map making for command and control systems as well as host nations and the populations the military works within. These continuously updated maps provide the ability to share information to support understanding and accountability throughout the operational environment. As seen within the Dayton Peace Accords, it is possible the military may be called upon to help identify boundaries in support of other countries establishing peace. It is therefore important that geospatial analysts refine their skills and techniques in analyzing data and creating visualization and high quality cartographic products that accurately reflect the current truth of the population.

Second, the importance of property rights and resources are a major contributing factor when considering where boundaries exist. In conflicts around the world today, resource identity is a major influencing factor in ―contested territories or in countries suffering from ethnic conflict or political factionalism."[135] It would significantly increase the capabilities of US forces to understand who owns the property and resources of an area. Remote sensing and geospatial analysis provide methods to identify property and

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[134]Clausewitz, *On War*, 481.

[135]Michael T. Klare, *Resource Wars The New Landscape of Global Conflict* (New York: First Owl Books, 2002), 215.

natural resources, but local leaders, lawyers, and judges working in coordination with the creation of cadastral or parcel maps can help to identify the rightful owners of contested property and thereby help to resolve conflict through arbitration instead of weapons.

For Further Study

This theory and process presented within this research can help spatially represent population areas in the fields of political and cultural ecology, and ecological anthropology. This research supports further examination within the field of cultural geography regarding how ethnicity, ideology, and national identity form these areas of collective identity. Although personalities may be independent, in times of crisis, people work together to overcome disasters or an enemy. Therefore, areas of collective identity can exist through the common defense of an area and by partnership towards a common objective. Dr. Douglas Gibler, an associate professor at the University of Alabama, writes that centralization is a common response to external threats and that "few theories develop the mechanisms by which domestic centralization occurs."[136] Gibler argues that the level of "centralized political authority" is often a result of the threat against the state.[137] Although not included within this research, this theory may transfer to geographic areas that contain a shared relationship based on a common enemy.

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[136]Douglas M. Gibler, "Outside-In: The Effects of External Threat on State Centralization," *Journal of Conflict Resolution* 54, no. 4 (August 2010): 519.

[137]Ibid.

Conclusions

This research provides geospatial methods that delineate areas of collective identity, enabling the layers of property, economics, faith, education, nationalism and culture to be better understood as they relate to the physical and spatial properties of geography. It provides a way for U.S. Army forces to identify these areas and their extents through geospatial analysis, using remote sensing and information from the local population. The geospatial analysis is conducted using human ecology and factors such as water, food, shelter, and resources; the topography and elevation factors of the physical landscape; and the elements of identity that are shared with others over a geographic area. The complex identities within an ACI form the human terrain and the boundaries of these areas represent the fault lines where conflicts occur and insurgent forces are likely to occupy.

As the military conducts humanitarian, reconstruction, and combat operations, this research provides a geospatial solution to identify identities and territories for use in command and control systems in order to delineate areas and shape the environment. The data is then incorporated within intelligence analysis systems and delineated on map products for work with the local population.

Dr. Samuel Huntington, the author of the book, *The Clash of Civilizations and the Remaking of World Order*, describes how during periods of conflict the identities described within this research become hardened and the war could be described as an identity war.[138] He proposes both understanding of these identities where the distinction

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[138]Samuel Huntington, *The Clash of Civilizations and the Remaking of World Order* (New York: Simon & Schuster, 1996), 266.

between people is contained within their values, beliefs, institutions, and social structure.[139] He further states that the ability to resolve a conflict is based on the leadership of that population and outside support of populations of similar identities being able to understand where these fault lines exist[140] and influencing the populations to lay down their arms and negotiate with their counterparts.[141] These areas are represented not just by the current governments in power, but by their 4th World populations, whose identity is linked to population's land, resources, culture and beliefs regarding a territory.

Robert Kaplan, who wrote *The Coming Anarchy*, critiqued the map makers of Turkey and Africa, for not depicting the many ―city-states or shantytown-states" located within their borders. He further went on to describe his expectation that future maps, as discussed within this research, will be ever changing; providing a visual depiction of centers of gravity and the boundaries of the populations as they move based on the changes within the physical and human geography.[142]

Both Huntington and Kaplan provide varying perspectives on what comprises identities and which identities are the most critical in terms of defining how populations view each other. What both authors agree upon is that future societies will not necessarily

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[139]Huntington, *The Clash of Civilizations and the Remaking of World Order*, 42.

[140]Ibid., 298, 308.

[141]Ibid., 292.

[142]Robert D. Kaplan, *The Coming Anarchy. Shattering the Dreams of the Post Cold War* (New York: Random House, 2000), 50-53.

be defined by political boundaries, but by the identities of the populations.[143] This research provides a theory and process to map a population's geographic area of collective identity. As the techniques provided within this research are refined, military leadership is better able to understand how geographic areas are related to structures, organizations, and people as they operate in counterinsurgency (COIN) environments, conventional combined arms, peacekeeping and stability operations. This theory of ACIs provides military forces with a perspective of the society and the people, not merely defined along existing political boundaries, but also along the territories and boundaries of human terrain.

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[143]Kaplan, *The Coming Anarchy. Shattering the Dreams of the Post Cold War*, 130-131, 161, 182-183; Huntington, *The Clash of Civilizations and the Remaking of World Order*, 125-126, 266-267, 270, 272-273, 308.

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