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Understanding the human domain: Modification and utilization of a leopold matrix to assess the impact of activity based intelligence and open source information or other proposed solutions

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Understanding the Human Domain: Modification and Utilization of a Leopold Matrix to Assess the Impact of Activity Based Intelligence and Open Source Information or other Proposed Solutions

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JAMES MADISON UNIVERSITY

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Dedication

This paper is dedicated to my wife Julia and my beloved daughter Vivian. Without the two of you and your love and patience, none of this would be possible. I am forever indebted to you and look forward to our future together now that my “pre-school work” is done. This paper is also dedicated to the many family and friends who have provided their support and encouragement throughout the years as I undertook this adventure. Lastly, this paper is dedicated to a dear friend, Eugene Murphy, without whose encouragement and persistence I may not have achieved this goal. Thanks amigo.
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I would like to thank the members of my committee, Dr. Tim Walton, Dr. Ming Ivory and Dr. Nicole Radziwill for their bountiful patience and wise counsel during this process. Your efforts will forever be appreciated and have led to my growth and appreciation for the ISAT course of study. I would also like to thank the ISAT faculty for the thought-provoking academic selections that have opened my eyes and made me a more well-rounded and analytical observer of real world problems and their solutions.
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Abstract

The emphasis on understanding the Human Domain (HD) over the last decade of war, counterterrorism, and counterinsurgency operations has provided opportunities to test multiple new tools, data sources and analytical approaches to age-old intelligence problems. While these tools were utilized in Iraq and Afghanistan with varying degrees of success, a comprehensive analytical method was not developed to assess the benefits of the proposed solutions and their impact on understanding the Human Domain. Given the paradigm shift away from an academic or scholarly way of viewing the Human Domain towards a nomenclature and understanding denoted in “physical” geography-type terms, what tool could be used to assess the impact of these proposed solution on understanding the Human Domain?

Based on a review of the publicly available literature, this paper will recommend modifications to the Leopold Matrix, common in Environmental Impact Assessments, to provide a framework for assessing a proposed solution’s impact on our understanding of the Human Domain. This paper will review and submit two proposed solutions, Activity Based Intelligence and Open Source Information, to the Leopold matrix framework and assess their impact on understanding the Human Domain. Additionally, this paper will offer unique insights into the impacts and relationships detected for these two solutions while completing this matrix and provide an understanding of Leopold framework. This methodology could be further refined by defense and intelligence experts, diplomats, peace keepers or aid workers as they assess their needs in an area of interest and the Human Domain that may be encountered.
**Introduction**

As the United States struggled to quell emerging insurgencies in Iraq and Afghanistan and leave behind a lasting legacy of democracy, it became clear that there was a fundamental lack of understanding of these tribal and often times insular societies. Although the military was well-suited to deal with conventional warfare, the military and intelligence apparatus was not well-suited for nation building and understanding the ever-shifting dynamics of these societies or their “Human Domain.” To combat these problems, the military and intelligence communities came up with novel approaches to help better understand the human population affected by the ongoing conflict and win them over to their side.

Terms and solutions such as Human Terrain Teams, Open Source information, and Activity Based Intelligence soon proliferated and were often presented to a war weary public with a polished public relations touch as the remedy to solve the age-old problem: “know your enemy.” However, what remained unclear was whether this patchwork of proposed solutions was actually useful and provided meaningful understanding to improve the war and nation-building efforts. Reading articles and academic reviews of these efforts from the time present these solutions as the missing link or silver bullet that would solve these problems and were often backed by corporate or governmental interests with ideas and technologies to sell or budgets to grow and defend.

Throughout the post 9-11 conflict period, the military and intelligence community began to shift away from an academic or scholarly understanding of these societies and began to view them through a physical paradigm like “domains” or “terrains” with almost
physical characteristics. While this physical “environment” model took hold, no clear tool or technique arose to assess the impact of these disparate solutions through the lens of a physical environment. This paper will review the use of a modified Leopold Matrix, henceforth referred to as the Leopold-I matrix, to help intelligence experts, war planners, diplomats, policy makers or anyone with a vested interest in an affected society assess the effectiveness of proposed solutions on understanding the Human Domain. This paper will review two proposed solutions for understanding the Human Domain, Open Source Information and Activity Based Intelligence, and submit them to the Leopold-I framework to draw initial conclusions as to their effectiveness.

Given the ongoing societal struggles in Iraq and Afghanistan and their fledgling struggles with democracy and inclusive, representative government, it seems clear that our efforts to understand the Human Domain with the various solutions that were presented were not effective and resulted in wasted resources and energy. As instability throughout the rest of the world continues to grow and larger nations and their allies are brought closer to conflict, the importance of knowing your enemy and the affected populations becomes that much greater. It is the hope of the author that this tool will provide a clear assessment mechanism to do just that and prevent the painful reinvention of solutions to answering this age-old problem.

**Literature Review**

To complete this research, the author has undertaken a literature review of publicly available data relevant to all subject matter previously discussed. This included in depth research related to the Human Domain (and related disciplines), Activity Based Intelligence, and open source information as well as Environmental Impact Assessment.
tools and their traditional uses. The literature review formed the knowledge base the author used for the development, refinement and scoring of Leopold-I matrix. While data related to most of these items was readily available in trade publications, academic journals, essays, and web based material, there were limitations to some source material availability.

The literature review of Activity Based Intelligence was completed using mostly trade publications, academic journals, and web-based content. While this may seem like a representative data set for a literature review, it is important to note that much of the specifics regarding Activity Based Intelligence remain classified and therefore unavailable for full review to the general public. Most publicly available information related to this subject matter was submitted for Government review before it was published in trade publications or academic journals and was subject to censorship to protect classified material. One of the most important articles contributing to the authors understanding of Activity Based Intelligence and Human Domains, Mark Phillips, “A Brief Overview of ABI and Human Domain Analytics,” was approved for public release by the National Geospatial-Intelligence Agency in September 2012. The information that was available to the author did provide a general overview of Activity Based Intelligence and the tools and emerging tradecraft needs. However, it could be argued that lack of full disclosure by Phillips and other authors on this subject matter related to important criteria such as technology and tradecraft could introduce bias into the author’s analytical process.

Whenever possible, the author strived to find additional research that would complete the understanding of the nuances and possibilities related to Activity Based
Intelligence. Most industry specific discussion regarding Activity Based Intelligence provided anecdotal evidence or hypothetical situations to describe the possibilities for the methodology. There are numerous examples from industry contractors heavily involved with the development and refinement of Activity Based Intelligence where it is hailed as being able to “catch bad guys red handed,” and fill intelligence gaps that would normally require the benefit of hindsight and disaster striking (BAE Systems, 2013).

Research related to the Human Domain was conducted using academic journals, web-based content, trade publications and other relevant content. While the term Human Domain is used throughout this paper, the author reviewed multiple related academic and trade specific fields to provide a robust understanding of their relevance to defining the human “environment.” Academic fields and trade specific knowledge such as Anthropology, Human Geography, Human Domain and Human Terrain were consulted and noted for the overlap between some of these disciplines. This knowledge was utilized to refine and narrow the Leopold-I matrix and helped demonstrate the value of the selected elements to accurately define the human “environment” in question.

The author’s focus on open source information predominately related to research on methods of communication and sharing that allowed individuals to express their beliefs, opinions, or research to as wide an audience as possible. To this end, the author prioritized the literature review towards social media due to its explosive growth and the ability of users to communicate in mostly uncensored manners. The author’s research did note however that social media sites such as China’s state sanctioned messaging service Sina Weibo (503 million users) were subject to censorship (Buckley, 2011) and that the
most commonly used social media applications had some form of censorship related to generally accepted public decency (Heins, 2014).

Additional literature review by the author focused on the changing nature of social media usage throughout the areas of unrest in the Middle East, from the Arab Spring in Egypt and Libya, to the rise of the Islamic State (ISIL) in Syria and Iraq. Much attention has been paid to social media’s part in organizing people and communicating views and ideologies throughout affected populations. For example, Lindsey notes in an article for The Small Wars Journal that social media will become increasingly important in understanding future conflicts and revolutionary movements by assessing its impact on organizing and fomenting the Arab Spring. (Lindsey, 2013). The author also reviewed conflicting hypotheses put forward by Berger and Zelin et al. regarding social media’s status and use among terrorist groups. While Berger argued that terrorist groups have turned social media outlets such as Twitter and YouTube into sanctioned propaganda dissemination mechanisms for groups such as ISIL (Berger, 2014), Zelin et al. argued sanctioned online forums would remain the dominant dissemination tool due to its exclusivity and the group’s ability to control the message (Zelin & Fellow, 2013).

In addition to open source information available from social media, the author also reviewed literature related to more traditional methods of communicating information or data such as mass media reporting, blogs, and publicly available research that could help articulate the Human Domain in an area of interest. McQuail demonstrates that “traditional” methods of communication, such as broadcast news reporting, can have a number of effects on societies such as conferring legitimacy on a person or a cause or becoming a channel for persuasion of the society. For example,
McQuail notes mass media reporting on immigrants arriving to an insular societies can serve as the basis for that society’s evaluation of the immigrants versus those who have had personal contact with immigrants (McQuail, 1979).

A literature review of potential Environmental Impact Assessment methodologies and tools was also undertaken by the author. Environmental tools and techniques reviewed included the use of checklists, network diagrams, expert systems, and professional judgments. Each of these tools was assessed to determine whether they could be modified to provide an understanding of the Human Domain and assess the impact of the proposed solutions, Activity Based Intelligence and open source information. After a review of the original Department of Interior Geological Survey Circular from 1971, “A Procedure for Evaluating Environmental Impact,” the Leopold Matrix emerged as the mostly likely solution to the problem that would only require slight changes in approach and definition of a few key terms for the matrix.

**Elements Under Consideration**

The wars in Iraq and Afghanistan brought about a host of Human Domain challenges and technologies and methodologies designed to overcome them. While open source information and Activity Based Intelligence were only two of these proposed solutions, it is important to have a thorough understanding of each. Each of these proposed solutions were conceived to play an important role in the intelligence and war-fighting needs of today and tomorrow, but it is the nuances of these proposed solutions that require full exploration to appreciate their value mapping the Human Domain in times of war and nation-building.
Additionally, an understanding of the use of Leopold Matrices and their role in the Environmental Impact Assessments must be provided. This base knowledge is required to understand the proposed methodology and provide context for the changes that are recommended. This paper will treat the Human Domain under review as the “environment” being studied as a result of the “actions” taken by the use of Activity Based Intelligence and open source information much the same way as the environmental impacts of drilling in the Gulf of Mexico could be assessed using the Leopold Matrix.

**Open Source Information**

For the purposes of this paper, open source information is defined as data available from sources such as social media platforms, mass media reporting, publicly available research and other content easily accessible to anyone with an interest in this data. While this definition may seem relatively simple, there are two distinguishing assumptions that must be noted. First, this paper will treat access to data from social media platforms as “open” even though they may require some form of permission to gain access to an individual or entities data. While large-scale access to social media data may require some subterfuge, the effort required would most likely be minimal and would not prohibit a representative data sample from being acquired. Second, while this paper focuses on elements of the intelligence tradecraft, it is important to note that the focus is on open source information and not open-source intelligence. The distinction is open source information is “unexploited,” or in its most natural state while open-source intelligence has been “exploited” and put through an analytical process to make an assessment (Phillips, 2012). As discussed in more detail later, ABI analysts are expected
to work with unexploited data to avoid the biases that may be introduced by the exploitation process.

While there are many types of open source information available online, the data that may prove most valuable in mapping the Human Domain comes from social media platforms. In 2010, the Office of the Undersecretary of Defense for Intelligence noted in white papers regarding ABI that “Humans, unlike other entities, are inherently self-documenting. Simply being born or going to school, being employed, or traveling creates a vast amount of potentially useful data about an individual” (Miller, 2013) that are often documented in mediums such as social media. A September 2013 survey by the Pew Research Center’s Internet Project Library showed that among the 266,441,302 American internet users (Wikipedia, 2015), 73 percent use social networking sites (Pew Research Center's Internet & American Life Project, 2013). Adoption rates for social media platforms such as Facebook, with more than 150 million American users are high, but a lack of understanding regarding the privacy policies of these sites cause users to share more data than anticipated. It is estimated that of the 150 million American Facebook users, 13 million have never set or reviewed privacy controls and that 28 percent shared wall posts with audiences wider than their friends (Consumer Reports, 2012). Some users may argue that they do not mind the transparency that comes with such data sharing, but few realize what data about them is contained and shared such as basic biographical information, geo-location data and the content posted (Consumer Reports, 2012). Although Americans would not be the intended target of such collection efforts by the intelligence community given restrictions in Executive Order 12333, United States Intelligence Activities, (Reagan, 1981) the ubiquity and widespread American adoption
of social media platforms can be used as a comparison for adoption and utilization among foreign users.

The shift towards mobile platforms for social-networking represents the optimal data available for ABI usage. It is estimated that 40 percent of the 327,577,529 (Wikipedia, 2015) American cell phone users access social media sites from cell phones while 28 percent do so on a daily basis (Pew Research Center's Internet & American Life Project, 2013). Often, social media sites such as Facebook and Twitter provide geo-location data when these platforms are accessed from mobile devices such as cellular phones and tablets (Consumer Reports, 2012). This geo-location data represents a key piece for the “patterns of life” analysis and are easily integrated within the ABI model. Geo-location data from social media platforms was recently used by members of the media to track the movement and (undisclosed) involvement of Russian troops with separatist forces inside of Eastern Ukraine (Szoldra, 2014).

Although social media platforms may provide the best information for use in mapping the Human Domain, other open source information available on the internet could prove just as useful in the ABI model. One of the most relevant alternative sources of open source information outside of social media platforms would be more traditional forums such as blogs or online web forums. These communication methods are usually organized around an individual or groups with common interests and ideologies. In research on jihadist communication methods online, Zelin et al. noted that jihadist preferred the exclusivity that came from sanctioned online web forums where they could “control the message” (Phase 3 of Figure 1 below) versus the use of social media that distributed that control (Phase 4 of Figure 1 below). Zelin et al.’s research showed a shift
towards emerging social media (Twitter, Instagram, etc.) use by online Islamic jihadists, but concluded that sanctioned online web forums would remain the predominant form of terrorist communication and dissemination due to its “exclusivity” through controlled access (Zelin & Fellow, 2013). In addition to blogs, other open source information such as photo-sharing sites and group or special interest web pages could provide viable data for the ABI model.

Figure 1 Phases of Online Jihadist Communication Methods over Time and Information Flow through Those Phases

Human Domain

As the military and intelligence community shifts their focus to asymmetric threats, regional political instability and the activity of non-state actors, the struggle to understand the culture, beliefs, and values that drive these groups and individuals has become a paramount concern. Recognizing the importance of the Human Domain, the Director of National Intelligence tasked the National Geospatial-Intelligence Agency to determine the scope of the intelligence communities efforts related to the Human Domain and lead consolidation efforts (Ghannam, 2012). Currently, there are multiple disciplines
within the intelligence and academic communities such as Human Domain, Human Geography, Anthropology, and Human Terrain that attempt to provide an understanding of human cultures, beliefs and values. While each of these disciplines focus on understanding humans and their cultures, beliefs and values, each are slightly different and have their own unique aspects.

Human Geography represents the most widely known and academically debated methods focused on understanding human behavior and interaction within their environment. Human Geography is defined as a “field of geography that is centrally concerned with the ways in which place, space and environment are both the condition and in part the consequence of human activities.” A large part of the debate regarding Human Geography focuses on whether “spatial-analytical geographies,” or the use of quantitative techniques and geospatial technology, is better than “socio-cultural geographies” or those methods focused on social theory and qualitative methods. In these competing methodologies, spatial-analytical geographies are viewed as producing hard data whose use can be enhanced with geospatial technologies while socio-cultural geographies often produced nuanced verbal accounts of the cultures under study and derive less quantifiable data (Gregory, Johnston, Pratt, Watts, & Whatmore, 2009). Given Activity Based Intelligence’s focus on geospatially linked data, the methodology would be most closely associated with the spatial-analytical methodologies.

The Human Terrain System (HTS) was established by the U.S. Army in May 2007 in response to a Joint Urgent Operational Needs Statement from the wars in Iraq and Afghanistan for a mechanism to address deficiencies in the sociocultural understanding of the tribal populations in both theaters (McFate & Fondacaro, 2011).
The HTS was originally conceived to provide deployed anthropological, cultural and regional expertise at the brigade and division level in both theaters in order to help the military fight a “smarter” war. The Human Terrain System was tasked to “gather, process, and interpret relevant cultural data,” and provide military commanders with geospatially-enabled ethnographic and sociocultural databases that further enabled the Military Decision Making Process (Kipp, Grau, Prinslow, & Smith, 2006). The deployed Human Terrain Teams were viewed as cultural experts and served as custodians of institutional memory on Human Terrain issues within the area of operations as military units rotated in and out of areas of operation (McFate & Fondacaro, 2011).

![Figure 2 Human Terrain Team Members in Discussion with a Local Villager](image)

The HTS emphasis on assisting the military’s decision making process based on relevant socio-cultural understanding is the defining feature of this discipline. While some argue this program had noble intentions, helping coalition forces fight a less lethal and culturally conscientious war, it was the subject of increased scrutiny and academic
debate. The HTS was denounced by the American Anthropological Association in October 2007 as “weaponizing” anthropology and in conflict with their *Statement on Ethics* to “Do no harm” (American Anthropological Association, n.d.). These concerns, along with the rapid expansion and fielding of the program, lead some to question the program’s effectiveness in helping soldiers understand the Human Terrain in both Iraq and Afghanistan. The HTS program was greatly scaled back and ultimately shuttered with the end of combat operations in Afghanistan despite efforts to establish the program on a world-wide basis (Brook, 2015).

The Human Domain is defined as the “presence, activities (including transactions – both physical and virtual), culture, social structure/organization, networks and relationships, motivation, intent, vulnerabilities, and capabilities of humans (single or groups) across all domains of the operational environment (Space, Air, Maritime, Ground, and Cyber)” (Phillips, 2012). While this concept is still evolving, it has been suggested that the Human Domain forms the foundation for all other domains, as seen in Figure 3 below, due to human presence and need to operate in all of these domains (Hoffman & Davies, 2013). However, unlike the geospatially bounded domains of land, sea, air, and space the Human Domain (cyber domain as well) include both “physical and cognitive elements” that influence operations in all other domains (Stewart, 2013).
Throughout this paper, the term Human Domain will be used to represent all the disciplines such as Cultural Anthropology, Ethnography and other closely related fields dedicated to the understanding of human cultures, beliefs, and values. The overlap of these related disciplines is critical to the refinement of the Leopold Matrix and developing a robust understanding for evaluating a proposed solutions impact on understanding the Human Domain “environment.”

Activity Based Intelligence

Activity Based Intelligence traces its roots back to the wars in Iraq and Afghanistan when Special Operations soldiers were tasked with tracking down key insurgents or former regime officials hiding among the population in a war-time environment. In order to plug holes in the tactical level intelligence needs, analysts began to reach back to national-level intelligence community partners to help fill the gaps. The intelligence community began to plug these gaps by taking all known data.
about an entity and geo-referencing it on a map for the Special Operations analysts. This geo-located data product enabled analysts to conduct “pattern of life” analysis on multiple data sets overlaid on a map and target their search for individuals accordingly (Miller, 2013). While this type of multi-source intelligence fusion was not new tradecraft at the time, the addition of automated computing power and the ability to integrate multiple data sets in one program proved an area for further research and development.

In October 2010, the Office of the Under Secretary of Defense for Intelligence (OUSDI) codified the Activity Based Intelligence concept with a classified strategic guidance paper on *Surveillance for Irregular Warfare*. In this guidance paper, Activity Based Intelligence was described as the “intellectual underpinning” of future intelligence analysis efforts and defined as a “discipline of intelligence where the analysis and subsequent collection is focused on the activity and transactions associated with an entity, a population, or an area of interest.” Two building blocks vital to this discipline, activities and transactions, were further defined in this white paper for the analyst and are the driving force for ABI technology innovation and collection efforts. The National Geospatial-Intelligence Agency is the lead agency working with ABI technologies given the inherent geospatial nature of the discipline (Phillips, 2012).

ABI is designed to help the analyst discover “unknown-unknowns” through the activities and transactions of a population over time. Phillips described the five principles of ABI as follows (Phillips, 2012):

- Collect, characterize and locate activities and transactions
- Identify and locate actors and entities conducting the activities and transactions
- Identify and locate networks of actors
- Understand the relationships between networks
- Develop patterns of life
It is important to note that although ABI was conceived to address threats, there is no mention of adversaries within the five principles and therefore can be applied to environments without hostilities (Phillips, 2012). Additionally, ABI recognizes that not all activities and transactions are geospatially oriented and that transactions could be found in the cyber, social, financial and commercial domains among others (Phillips, 2012).

Given the technological component inherent with ABI, there is a movement within the intelligence community to ensure ABI is treated as a new tradecraft with its own unique training requirements. While ABI is similar to all-source analysis, proponents of ABI note that there are many distinctions between the two tradecrafts. All-source intelligence analysis is often completed with a target in mind and uses “all” available data to complete analytical products. ABI analysts are expected to proceed with data collection and characterization efforts without a target or outcome in mind and allow themselves to be surprised by the “unknown-unknowns” within the data. Comparisons are also made with intelligence “fusion” efforts, but the largest difference between the fusion and ABI tradecrafts is that ABI works with raw data and not finished intelligence products that could introduce bias into the process. Experts note that “ABI is a truly different approach to analysis. It invokes different tradecraft, data processing, technology, and thought processes” (Phillips, 2012).

The exact nature of the technology surrounding ABI remains classified, but a review of literature on the topic provides some insight into what ABI may look like for the analyst. ABI software would most likely be a web-based interface that allows analysts to overlay layers of “activity” data on a map. As shown in Figure 4 below, this
interface would allow the analyst to freely access data from multiple classified and unclassified sources such as the military’s Distributed Common Ground System cloud system and open source information and look for connections. The activity layers and data source would then be searched for patterns using algorithms that sift through metadata associated with the activities and transactions (Miller, 2013).

Figure 4 Conceptual Application of ABI for Time-Based Intelligence Using Temporal Digital Asset Management Technology

Additional visualization techniques such as attributed relational graphs have also been mentioned as possible outputs for the system to help the analyst visualize the patterns and connections within the activity set (Coffman, Greenblatt, & Marcus, 2004). As demonstrated in Figure 5, attributed relational graphs could help an analyst decipher the pattern for a potential terrorist attack on a factory by two persons using a fertilizer bomb among the many entities (people, vehicles, physical locations, transactions, communications) that may seem unrelated unless viewed together.
As previously mentioned, ABI tradecraft and technology have a significant requirement for metadata and metadata standardization in order to get the full analytical benefit of this tradecraft. As Keith Barber, the Director of the National System for Geospatial Intelligence Expeditionary Architecture Integrated Program Office noted, “The true promise of associations is only possible in the metadata” (Barber, 2012). Geospatial requirements for ABI are relatively standard, with typical location on earth requirements while metadata, or data about data, requires standardization across the many standard and non-standard data sets an analyst may encounter. Metadata standards will drive the development and refinement of algorithms that can be used to highlight possibly undetected patterns or signatures in the data sets that are not readily evident. The NGA has been assigned the difficult task of establishing metadata standards to ensure that future data collection is tagged, searchable, and accessible by analysts (Barber, 2012) through means such as cloud computing infrastructure.
As the capabilities possible with ABI continue to be refined and explored, there is some debate over whether or not ABI would provide a “predictive” capability. Given the pattern of life data that can be used to detect anomalies or signatures in large data sets, it is not a large reach to assume that ABI could be used to predict future patterns of activity such as the potential attack illustrated in Figure 5 above. Industry experts hesitate to call ABI a “predictive” technology, but note that it may help develop an understanding of the networks where certain threat types arise (Miller, 2013).

**ABI Methodology**

While the technology enabling applications of ABI are truly impressive, it is the methodology of the ABI tradecraft that ensures it could become a vital analytical tool and provide understanding of the Human Domain. The ABI methodology has four “pillars” that ABI analysts must adhere to in order to get the most value from this analytical tradecraft. These four pillars are geo-reference to discover, data integration and association before data exploitation, data neutrality, and sequence neutrality. The geo-reference to discover pillar is an obvious extension of a geospatially-oriented analytical method, but the remaining three pillars represent a serious departure from current intelligence tradecraft.

The Data Integration and Association Before Data Exploitation pillar helps to solidify the ABI methodology as a true multi-intelligence process versus all-source analysis. This pillar ensures that analysts work with the data at the most discoverable level before any analytical process has begun. The analyst is expected to review activities and transactions associated with all data before looking for connections within the data to ensure that no data is lost during exploitation. This process is in stark contrast
to tradecraft such as all source intelligence where finished intelligence products are used for analysis and little consideration is given to the data that could be lost during exploitation (Phillips, 2012).

The next pillar, Data Neutrality, ensures that ABI analysts utilize all data sources and they are treated with no bias due to their provenance, classified or unclassified. This pillar would ensure that open source information from social networking and other open sources would be given just as much credence as data obtained through classified means. Data neutrality requires that the analyst understand the origin and confidence level associated with data and when taken in whole with all other data, it may help overcome problems with other incomplete or partial data sets (Phillips, 2012).

The last pillar of the ABI methodology is the importance of Sequence Neutrality. This pillar establishes that the importance of the information the analyst currently possesses may be unknown until further information becomes available and that all data must be integrated before it is analyzed (Miller, 2013). Analysts are expected to not discard data as it may contain the answer to questions that have yet to be asked (Phillips, 2012). The Sequence Neutrality pillar is one of the driving forces behind the intelligence communities need to ensure they can handle big data storage and manipulation.

Taken together, the pillars of the ABI tradecraft represent a truly unique way of structuring the analytical process. The pillars of the ABI tradecraft such as Data and Sequence Neutrality ensure the demand for as much data as the analyst can access and offer the promise of a system to make sense of it all. ABI tradecraft also forces analysts to re-evaluate their own data biases and to let themselves be surprised by the data whether it comes from classified sources are not. The fundamental shift of ABI
tradecraft is forcing the intelligence community to ensure that they can handle the “big data” requirements of ABI.

**Big Data**

The amount of digital data created each day has grown exponentially over the last few years with roughly 2.5 exabytes (1 exabyte = 1,000,000,000 gigabytes) of data being created every day and more than 90% of stored data in world created in the past two years (Heiss, 2012). Michael Vickers, the Under Secretary of Defense for Intelligence, noted that during the wars in Iraq and Afghanistan, full-motion video alone from manned and unmanned aircraft “gather over 53 terabytes of data every day. This is equivalent to the data in about 2.5 million full-length movies” (Hogan, 2012). As full-motion video is only one of many potential data sources for the ABI analyst, it is clear to see that the intelligence community faces a challenge to ensure they can handle big data.

The formal definition of big data remains an ongoing discussion within the academic and technical fields and attempts to provide a concrete definition have proven elusive. Ward and Baker reviewed commonly cited definitions of big data and noted that all definitions, no matter the source, contained some assertion regarding size (volume of dataset), complexity (structure, behavior, permutations of datasets) and technologies (tool/techniques used on sizable, complex dataset). Based upon these factors, Ward and Baker defined big data as “a term describing the storage and analysis of large and or complex data sets using a series of techniques including, but not limited to: NoSQL, MapReduce and machine learning” (Ward & Barker, 2013).

The creation of social media data also has risen at unprecedented levels in recent years. Social media analysis from 2012 shows that every minute, social media users
create vast amounts of data such as 48 hours of YouTube videos, 100,000 Tweets and share 3,600 Instagram photos (Tepper, 2012). This level of data creation has only accelerated since that time and updated analysis from 2014 now shows those same categories include 72 hours of YouTube videos, 277,000 Tweets and 216,000 Instagram photo shared (James, 2014). This amount of open source information provides analysts concerned with the Human Domain countless amounts of data that can be easily integrated into the Activity Based Intelligence Model.

Figure 6 Data Creation by Social Media Users on a Per Minute Basis as of 2014

Not only has the amount of data being produced increased, but the variety and velocity of data have also increased. The variety of data encountered and the many non-standard formats (movies, images, text strings, geo-location data) represent a huge problem for ABI and create the need for metadata standardization across numerous sources and disciplines. In addition, the velocity, or speed with which the data changes and is processed, has increased along with variety (Heiss, 2012). This vast amount of
exponentially growing data has presented challenges and opportunities for both the private sector and intelligence community to harness this data in a meaningful manner.

**The Leopold Matrix and Environmental Impact Assessments**

The Leopold Matrix was developed in 1971 to serve as a procedure “to assist in developing uniform environmental impact statements” based on a matrix designed as a checklist for the “full range of actions and impacts on the environment that may relate to proposed actions.” Leopold’s matrix is used to create an Environmental Impact Statement that includes the following actions:

- Complete analysis of the need for the proposed action
- Informative description of the environment involved
- Proposed actions and alternatives
- Environmental impact assessment

While this matrix and methodology were not designed to produce an “overall quantitative rating” it was meant to convey the “value judgments” of experts in the field. The matrix was designed to identify environmental impacts and analyze them in regards to their “magnitude” and “importance” to the environment being studied. Leopold used magnitude “in the sense of degree, extensiveness, or scale,” of the impact on the environment being studied while the “importance” or significance “of the particular action on the environmental factor in the specific instance under analysis.” Leopold noted that the matrix provided the experts with a way to distinguish factual magnitude assumptions from more subjective or possibly biased importance criteria (Luna B. Leopold, 1971).

Leopold’s matrix where the environmental impact assessment was completed consisted of three essential elements. The first being an evaluator creates a list of effects on the environment being studied for proposed development followed by an estimate of
the magnitude of each of these changes. Next, the evaluator would be asked to assess the importance of the effects and finally combine the magnitude and importance estimates in a summary evaluation. This evaluation and analysis would be captured in the Leopold matrix with one axis containing the actions that cause environmental impact and the other containing existing environmental conditions that may be affected. Leopold’s original matrix contained 100 actions and 88 environmental characteristics for a total of 8,800 possible interactions. Although this represents a large interaction data set, Leopold noted that in most cases that the matrix would only contain a minimal number of interactions with the magnitude and importance required to warrant comprehensive review and suggested that trials showed only 25 to 50 interactions were worthy of further analysis (Luna B. Leopold, 1971).

To complete the Leopold matrix, a user would highlight each action that results in significant impact for the proposed project and mark these items with a slash from upper right to lower left across the block at the intersection with the relevant environmental factor. Each significant action would then be evaluated in terms of magnitude (upper left-hand corner) and importance (lower right-hand corner), with factual data where possible, and be assigned a score of 1 to 10. In this scoring system, items with a 10 would have the greatest magnitude or importance while those with a score of 1 would represent the lowest magnitude or importance based on the user’s expert opinion. Once the interactions had been identified and scored, the matrix could be simplified to represent only those actions and environmental characteristics required, thus simplifying the matrix (Luna B. Leopold, 1971).
The text accompanying the Leopold Matrix constitutes the Environmental Impact Assessment. It follows the matrix and is intended to discuss higher scoring individual boxes and provide the reasoning behind the numerical values assigned for importance and magnitude. This assessment, along with the three previously discussed items serve as the complete Environmental Impact Statement and are intended for review by all concerned parties (Luna B. Leopold, 1971). Thus, the matrix and accompanying Environmental Impact Statement could be used to discuss possible areas for mitigation of high importance items or items where the magnitude of the impact is the most severe or prolonged.

**Methodology**

While the literature review was important in establishing the author’s baseline understanding of the subject matter related to the Human Domain, Activity Based Intelligence, and open-source information, this knowledge also served as the basis for the creation of the Leopold-I matrix and the scoring values assigned to the matrix. This knowledge was used to assess how Activity Based Intelligence and open-source information “actions” could impact and interact within the Human Domain “environment” as specified with the Leopold-I Matrix. In order to modify the Leopold Matrix to fit the current problem set, slight changes to terminology and a more expansive view of the methodology application was undertaken. The rationale for these decisions will be presented and possible areas for additional scrutiny will be discussed.

In order to use the Leopold-I Matrix to understand the interactions and impacts of concern for the intelligence problems discussed earlier, the matrix was adapted to shift focus away from physical actions and their impact on the environment, to a more
broadened concept of “actions” and “environment.” The original Leopold Matrix was envisioned with the physical attributes of the environment listed on the vertical axis along with the physical actions that were being considered listed on the horizontal axis. Leopold noted that the axes could be changed without impact to the analysis but stressed the importance of ensuring the axes were divided between actions and environmental characteristics. The interaction of the actions and environmental characteristics would then be captured and scored at their intersection within the matrix (Luna B. Leopold, 1971).

For purposes of the proposed adaptation, the configuration of the matrix was changed to demonstrate “actions” on the horizontal axis and the “environmental” characteristics on the horizontal axis. The Leopold-I Matrix considers items related to Activity Based Intelligence and open source information, to be the “action” items in this matrix. Likewise, the “environmental” characteristics listed in the horizontal axis are those that define the Human Domain and are vital to people and their cultures in an area of concern.

Leopold’s original matrix treated “action” items for proposed construction or development as the physical impact to the environment that would take place to accomplish the stated task. The proposed “action” items were usually contained in engineering reports or construction drawings after technological consideration of various alternatives had been completed to best meet the construction or development need (Luna B. Leopold, 1971). The proposed modifications to the Leopold-I matrix require significant change to this traditionally defined usage of “action” items from the physical world into a more figurative world.
In this case, the author will define “actions” for Activity Based Intelligence and open source information as those attributes of each that enable analysis of the Human Domain. While these proposed solutions are not as traditionally “action” oriented, or may not contain traditional action words such as blasting or drilling, they do represent an analysis enabling action such as “characterize activities” for Activity Based Intelligence or “sharing geo-location data via social media” for open source information, that helps the user of the matrix to analyze and understand the Human Domain being studied. The author also segregated the actions contained in the vertical axis between Activity Based Intelligence and open source information for the ease of analysis and the users understanding of the origin of the action under consideration.

While the “environment” proposed for the Leopold-I matrix exists in and is impacted by the physical world, the Leopold-I matrix itself is focused on the figurative aspects that define the Human Domain. Adjusting the understanding of “environment” between the original Leopold matrix and the author’s proposed usage does not require as much subjective interpretation as the use of “actions” previously discussed. Leopold’s matrix was geared towards the physical environment and physical features such as water quality, scenic views, erosion, and specific types of wildlife that would be impacted by proposed development (Luna B. Leopold, 1971). The author defines the Leopold-I environment along the lines of academic and industry subject matters that provide an understanding of societies, their beliefs and behaviors in disciplines such as Sociology, Human Terrain and Cultural Anthropology. The horizontal axis of the Leopold-I matrix is broken down along these academic and industry subject matters for ease of analysis
and the users understanding of the origin of the Human Domain environment being considered.

**Matrix Construction and Refinement**

The Leopold-I matrix aligned the Human Domain “environmental” elements along the horizontal axis of the matrix while the “actions” under consideration and related to Activity Based Intelligence and open source information were aligned on the vertical axis. The Leopold-I matrix was originally constructed to include as large a set of Human Domain, Activity Based Intelligence, and open source information elements as the research warranted and was subjected to further review. The Leopold-I matrix was refined to include 20 possible actions and 18 environmental factors for a total of 360 possible interactions. Leopold noted that although an original matrix may contain a large number of possible interactions and impacts, the number of important interactions on any given program usually ranged from 25-50 and that the categories should be screened for their relevance prior to completing the matrix (Luna B. Leopold, 1971).

The original Activity Based Intelligence “action” section encompassed ten broad categories that related to the subject matter and were further broken down into defining elements. The ten categories considered included:

- Definitions of Activities
- Definition of Transactions
- Principles of ABI
- Domains Present
- Layers of Activity Data
- Pattern Detection
- Metadata Needs
- Technology Required
- Pillars of ABI Tradecraft
- Data Biases
Some of the categories like Definition of Activities and Transactions, the various domains, and data source biases were quickly dismissed due to their lack of a clearly definable action as it related to the Human Domain. The most difficult decisions regarding the refinement of the matrix related to Activity Based Intelligence was the decision to exclude actions related to technology and the pillars of ABI tradecraft. Though both the technology and pillars of the tradecraft are vital to any discussion regarding Activity Based Intelligence, they did not represent “action” items that would shed more light on the environmental elements of the Human Domain. Technology components such as cloud computing or algorithm refinement are important to make ABI work, but by themselves do not represent a direct “action” that will help understand the Human Domain. Likewise, pillars of ABI tradecraft such as data neutrality or geo-reference to discover may have an indirect impact on the understanding of the Human Domain, but they do not represent a clearly definable “action” that enlightens an analyst understanding of the population in question. In the end, the “action” section of Activity Based Intelligence elements was restricted exclusively to the principles that defined the action-oriented items needed to complete this tradecraft.

The refinement of the matrix related to open source information started with six broad categories generally aligned with the data available including social media, blogs, mass media reporting, publicly available research and other easily accessible content. These categories were further refined based on their applicability to understanding the Human Domain and further streamlined to actionable items that reflected the value of their information. In the new application of the Leopold-I matrix, one must move away from a “by-source” configuration (social media, blogs, etc.) of the data to focus on the
types of data that would be disseminated across these mediums. Given the focus on understanding the Human Domain, it was no surprise that data shared by individuals, whether on social media or other mediums would provide the most insight into their “environment.”

The last refinement to the Leopold-I matrix involved environmental elements on the horizontal axis that corresponded with the Human Domain. Academic and trade specific categories originally considered included Human Geography, Human Terrain, Human Domain, Ethnography, Sociology, and Cultural Anthropology. These categories were further refined into component parts and reviewed and eliminated entirely (Human Geography), if necessary, while areas of possible component level duplications across the subject matters were consolidated. The author believes that the remaining items offer a broad understanding of the generic elements that constitute the Human Domain “environment” of interest to an outside observer but could be further refined, as needed.

Refinement Criteria

The refinement to the Leopold-I matrix was substantial and necessary to ensure that the analysis and scoring of the impact and interactions within the matrix were focused on the most important elements. This required many value judgments on the author’s part and is open to interpretation and expert analysis by others in the military and intelligence field. It is also important to note that there was a significant amount of overlap between the various fields related to the Human Domain “environment” and that a number of similar components were consolidated for clarity of the matrix. For example, the author chose the Ethnographic component of “habitat” described as the physical terrain and climate of an area to substitute for the place, space, and environment
elements that are commonly used in the study of Human Geography (Briney, Unknown). While the ethnographic term for habitat may not be the perfect term for the elements of the Human Geography or the physical elements related to Human Domain, the author believed they were representative of the same general principles.

The author’s original Leopold-I matrix can be found in Appendix 1 and included 71 “actions” and 31 “environmental” categories for a total of 2,201 possible interactions. The author refined the final Leopold-I matrix to include only 20 “actions” and 18 “environmental” categories for a total of only 360 possible interactions. Of the 20 proposed actions, 13 relate to Activity Based Intelligence while seven are related to open source information. The environmental axis of this model includes 18 environmental conditions across five related disciplines with Human Domain and Ethnography representing the largest pieces of the “environment” with five components each. The final Leopold-I matrix represents an 83% reduction in the number of possible interaction of elements (360 interactions vs. 2,201) being considered for the matrix.

Matrix Scoring

After the Leopold-I matrix was consolidated the author reviewed the 360 possible interactions and placed diagonal slash marks in the cells to note an impact from an action on the Human Domain environment as shown in Appendix 2. These interactions were then scored according to the magnitude and importance criteria suggested by Leopold on a scale of 1 – 10 with the magnitude score in the upper left while the importance score was recorded in the lower right as shown in Appendix 3.

While Leopold did not propose an in-depth scoring criteria for her matrix, she did note that items scored with a 1 would have the least magnitude or importance while those
with 10 would have the greatest or most important impacts. Similarly, Leopold noted that the scores for magnitude are more easily evaluated based on facts while importance scores represent the “value judgment” of the evaluator. (Luna B. Leopold, 1971). The author struggled with and was ultimately unsuccessful in developing a uniform, fact-based scoring scale for the magnitude and defaulted to a “value judgment” scoring methodology similar to importance. Scoring will be discussed later as an area for further refinement in future research.

Given the author’s refinement of the Leopold-I matrix to only the most relevant elements for Activity Based Intelligence, open source information, and the Human Domain, most of the scores assigned fell in the range of 5 or higher for both magnitude and importance (though some 3’s and 4’s were present). These scores were then reviewed for any interesting trends or data they may represent.

**Initial Statistical Findings**

After the scoring was completed the author compiled various statistical data for review. The following results are not an exhaustive analysis of possible statistical methodologies that could be applied to the matrix, but are intended to initially explore the interactions identified in the matrix and offer a starting point for further research. Some of the findings supported the author’s research assumptions and industry expert’s opinions on Activity Based Intelligence, open source information, and their possible application to understanding the Human Domain. However, the matrix was also helpful in identifying key areas where the interaction of these three elements may not provide the most analytical assistance.
Impact Significance

The first statistical methodology that the author used to evaluate the scoring of the modified Leopold Matrix was to calculate a slightly modified “Impact Significance” score as outlined in the United Nations Environment Programme’s *Environmental Impact Assessment Training Resource Manual*. To calculate the impact significance, the United Nations’ formula takes the product of the “impact characteristic” and the “impact importance.” These elements are also defined by their “magnitude” and “value,” respectively, and were intended to help the user understand and evaluate the “as predicted” and “residual” impacts of the environmental impact being assessed (United Nations Environment Programme, 2002). The UN’s formula for impact significance can be found below.

\[
\text{Impact Significance} = \text{Impact Characteristic} \times \text{Impact Importance}
\]

For the purposes of this analysis, the author chose to characterize the “impact characteristic” as the “magnitude” score assigned to the interactions in the Leopold-I Matrix. The “impact importance” criteria were treated as the “importance” score assigned to the Leopold-I Matrix as well. The product of this revised formula, referenced below, was treated as the “impact significance” score for that interaction and entered into the matrix as found in Appendix 4.

\[
\text{Leopold – I Impact Significance} = \text{Magnitude} \times \text{Importance}
\]

Modifying and utilizing the United Nations’ “impact significance” calculation provides a solid metric that can be used to assess a proposed solutions impact on understanding the Human Domain. The impact significance scores also provide a better understanding of what individual environmental elements in the Human Domain are best
understood using Activity Based Intelligence and open source information. In addition to the significance calculations, a number of statistical calculations were completed, such as totaling and averaging the interactions impact significance and calculating the range of scores to determine the most and least relevant criteria contained in this analysis.

Assessing the aggregate “action” item impact significance score for Activity Based Intelligence and open source information on the vertical axis indicates that “sharing ideology via social media” and “sharing information via social media” have the most impact significance on understanding the Human Domain. Sharing ideology via social media produces the highest aggregate impact significance of 949 (1,800 maximum score per action) followed closely by “sharing information via social media” with an impact significance of 923. Both sharing ideology and information via social media had the highest individual interaction scores (81 out of 100) for providing insight on Societal Norms/Culture, Social Structure/Networks, and finally on Communications throughout the Human Domain. My findings corroborated Lyons work and provide an understanding of why the military see tools like Social Media analytics as a way to help understand the Human Domain (Lyons, 2013).

Additionally, the open source information actions of Sharing Information/Ideology via Social Media scored poorly (30 out of 100) when it came to understanding Human Domain elements such as Habitat, Materiality, Access to Technology and the Economy. The author viewed the poor performance of these interactions as plausible but noted the definition of each environmental element could be subject to various interpretations by other assessors and therefore deemed more relevant to the Human Domain. The impact significance scores for Sharing Information/Ideology can be found in Table 1 below.
The author’s next step was to determine whether Activity Based Intelligence or open source information “action” items had the most impact significance for understanding the Human Domain “environment.” A total of 20 “action” items were included in the Leopold-I Matrix and were split between seven open source information items and 13 Activity Based Intelligence items. To standardize the data, the author chose to review only the seven top aggregate interaction scores for Activity Based Intelligence actions to provide a uniform number of impact significance scores. While selecting only the seven highest aggregate scores could be viewed as biasing the analysis towards Activity Based Intelligence, the results indicate a substantial gap between significance impact with open source information no matter which of the 13 actions are selected.

Paring the matrix down to only seven Activity Based Intelligence and open source information “action” items in the vertical axis and reviewing their aggregate impact significance score as outlined in Appendix 5 suggests that open source information has a greater impact on understanding the Human Domain than Activity Based Intelligence. Out of a maximum impact significance score of 12,600 ((7 action items x 18 environmental factors) x 100 maximum score per interaction), the aggregate impact significance score for the seven open source action items was 4,671 compared with an aggregate score of 3,819 for Activity Based Intelligence. A review of the aggregate

<table>
<thead>
<tr>
<th></th>
<th>Societal Norms/Culture</th>
<th>Social Structure/Networks</th>
<th>Motivation</th>
<th>Incentives</th>
<th>Vulnerabilities</th>
<th>Communications</th>
<th>Habit</th>
<th>Capabilities of Individual/Group</th>
<th>Access to Technology</th>
<th>Religion</th>
<th>Social Classes</th>
<th>Law</th>
<th>Deviance</th>
<th>Economy</th>
<th>Politics</th>
<th>Arts</th>
<th>Myths</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sharing Information via Social Media</td>
<td>81</td>
<td>81</td>
<td>64</td>
<td>56</td>
<td>42</td>
<td>49</td>
<td>81</td>
<td>42</td>
<td>49</td>
<td>30</td>
<td>56</td>
<td>35</td>
<td>56</td>
<td>35</td>
<td>30</td>
<td>64</td>
<td>49</td>
<td>49</td>
</tr>
<tr>
<td>Sharing Ideology via Social Media</td>
<td>81</td>
<td>81</td>
<td>64</td>
<td>56</td>
<td>42</td>
<td>49</td>
<td>81</td>
<td>42</td>
<td>49</td>
<td>30</td>
<td>56</td>
<td>35</td>
<td>56</td>
<td>35</td>
<td>30</td>
<td>64</td>
<td>49</td>
<td>49</td>
</tr>
</tbody>
</table>
impact significance range for open source information action items showed a range of 761 with action items scores as slow as 188 and topping out at 949. Likewise, the review of the aggregate impact significance score for open source information showed a much smaller range of 235 with significance impacts scores more tightly clustered in the 464 to 699 range. A summary of the impact significance scores discussed above can be found in Table 2 below.

<table>
<thead>
<tr>
<th>Impact Significance Scores of Elements Below</th>
<th>TOTAL</th>
<th>AVERAGE</th>
<th>MIN</th>
<th>MAX</th>
<th>RANGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collect Activities</td>
<td>464</td>
<td>33.1</td>
<td>20</td>
<td>42</td>
<td>22</td>
</tr>
<tr>
<td>Characterize Activities</td>
<td>476</td>
<td>29.8</td>
<td>12</td>
<td>49</td>
<td>37</td>
</tr>
<tr>
<td>Identify Actors/Entities Conducting Activities</td>
<td>458</td>
<td>35.2</td>
<td>20</td>
<td>49</td>
<td>29</td>
</tr>
<tr>
<td>Identify Networks of Actors</td>
<td>512</td>
<td>42.7</td>
<td>28</td>
<td>64</td>
<td>36</td>
</tr>
<tr>
<td>Understand Relationships B/W Networks</td>
<td>555</td>
<td>50.5</td>
<td>42</td>
<td>64</td>
<td>22</td>
</tr>
<tr>
<td>Develop Patterns of Life</td>
<td>655</td>
<td>59.5</td>
<td>30</td>
<td>81</td>
<td>51</td>
</tr>
<tr>
<td>Detect Pattern Signatures</td>
<td>699</td>
<td>53.8</td>
<td>35</td>
<td>81</td>
<td>46</td>
</tr>
<tr>
<td>Sharing Information via Social Media</td>
<td>923</td>
<td>51.3</td>
<td>30</td>
<td>81</td>
<td>51</td>
</tr>
<tr>
<td>Sharing Ideology via Social Media</td>
<td>949</td>
<td>52.7</td>
<td>30</td>
<td>81</td>
<td>51</td>
</tr>
<tr>
<td>Sharing Geo-Location Data via Social Media</td>
<td>188</td>
<td>47.0</td>
<td>30</td>
<td>64</td>
<td>34</td>
</tr>
<tr>
<td>Sharing Interests/Ideology via Blogs</td>
<td>838</td>
<td>49.3</td>
<td>30</td>
<td>81</td>
<td>51</td>
</tr>
<tr>
<td>Reporting Provided by Mass Media</td>
<td>642</td>
<td>45.9</td>
<td>25</td>
<td>64</td>
<td>39</td>
</tr>
<tr>
<td>Publicly Available Research</td>
<td>690</td>
<td>43.1</td>
<td>30</td>
<td>64</td>
<td>34</td>
</tr>
<tr>
<td>Accessibility of Other Relevant Content</td>
<td>441</td>
<td>29.4</td>
<td>25</td>
<td>56</td>
<td>31</td>
</tr>
</tbody>
</table>

Table 2: Impact Significance Scores of ABI and OSI Actions.

After review of the aggregate impact significance score, the author sought to determine if any useful insight could be gleaned to further understand the findings. As previously discussed, open source information scores for sharing information (923) and ideology (949) on social media had the highest impact significance score and appear to represent the optimal actions for understanding the Human Domain. However, open source information and specifically, sharing geo-location data on social media, represent
the lowest impact significance score in the pared matrix at 188. The wide range of 761, as demonstrated in Table 2 above, suggest that there is some variability in the usefulness of open source information and the relevance of these items should be assessed individually by the matrix user.

The much tighter range for Activity Based Intelligence action items (236) suggests that although the overall significance impact may not be as high, the contribution they provide in understanding the Human Domain may be more uniform. The uniformity of Activity Based Intelligence significance impact scores make sense when the “action” items considered represent the principles underpinning the tradecraft.

Upon review of the seven highest scoring action items, the author noted that the three “transaction” related actions did not make the top seven and that two of the three “activity” related actions were all that remained.

The author’s assumption before completing the refinement and scoring of the modified Leopold Matrix was that Activity Based Intelligence action items would have the largest impact on understanding the Human Domain environment; however this was not the case. The comparison of aggregate impact scores in the pared matrix of both open source information (4,671) and Activity Based Intelligence (3,819) shows that neither set of actions was decisive in providing a complete understanding of the Human Domain. This further demonstrates that both sets of actions are needed and mutually beneficial to help fill gaps in our understanding of the Human Domain and could be augmented with other proposed solutions.
Human Domain Element Analysis

The aggregate scoring of the 18 elements on the horizontal axis in the Leopold-I Matrix, found in Table 3 below, provide insight into what “environmental” elements of the Human Domain are best understood by the “actions” related to open source information and Activity Based Intelligence. These scores could be used as a comparison for Human Domain elements where there is a serious lack of understanding to further assess “actions” that can be taken to close this gap. The range of 889 for these elements indicate that the “actions” considered have a largely mixed impact on understanding the Human Domain.

<table>
<thead>
<tr>
<th>IMPACT</th>
<th>Societal Norms/Culture</th>
<th>Social Structure / Networks</th>
<th>Motivation</th>
<th>Intent</th>
<th>Vulnerabilities</th>
<th>Capabilities of Individual/Group</th>
<th>Communications</th>
<th>Habitat</th>
<th>Materiality</th>
<th>Access to Technology</th>
<th>Religion</th>
<th>Social Classes</th>
<th>Law</th>
<th>Deviance</th>
<th>Economy</th>
<th>Politics</th>
<th>Arts</th>
<th>Myths</th>
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<tbody>
<tr>
<td>TOTAL</td>
<td>810</td>
<td>1094</td>
<td>365</td>
<td>361</td>
<td>727</td>
<td>703</td>
<td>657</td>
<td>550</td>
<td>322</td>
<td>712</td>
<td>470</td>
<td>527</td>
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<td>521</td>
<td>810</td>
<td>675</td>
<td>281</td>
<td>205</td>
</tr>
<tr>
<td>AVERAGE</td>
<td>57.9</td>
<td>54.7</td>
<td>40.6</td>
<td>36.1</td>
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<td>49.8</td>
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<td>35.1</td>
<td>38.1</td>
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<td>MAX</td>
<td>81</td>
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<tr>
<td>RANGE</td>
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<td>52</td>
<td>42</td>
<td>56</td>
<td>31</td>
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<td>47</td>
<td>39</td>
<td>39</td>
<td>21</td>
<td></td>
</tr>
</tbody>
</table>

Table 3: Impact Significance Scores of Human Domain Environmental Elements

Out of a maximum 2,000 point impact significance score in the complete matrix (20 environmental factors x 100 maximum score per interaction) only one “environmental” element, Social Structure/Networks, breaks the 50% mark at 1,094.
This is followed by two elements, Societal Norms/Culture and the Economy, with a significance score of 810 each as the top three scoring Human Domain elements. Comparing these three elements and related impact significance scores offers unique insight into the importance of the open source information and Activity Based Intelligence “actions” taken. The first interesting finding was that the highest scoring Human Domain “environmental” element, Social Structures/Networks, had an interaction and impact significance score across all 20 “action” items and was the only element to accomplish this distinction. This fact, coupled with a range of 51 (maximum 100) found in Table 3, suggests that although the interactions in each cell are important, there is a wide variance of these actions contribution to the understanding of the social structure/networks.

The second interesting finding related to these three Human Domain elements was that even though the Economy and Social Structure/Networks had 19 or 20 interactions respectively (20 maximum), Societal Norms/Culture was tied for the second highest aggregate impact significance score with only 14 interactions. While the range of 51 for Societal Norms/Culture suggests a large swing in the “actions” importance to the understanding of the norms and culture, it is the five highest scoring “actions” (81 out of 100) that drive the aggregate impact significance score for this Human Domain element. The five impact significance scores of 81 are the most for any of the top three Human Domain elements and include two Activity Based Intelligence actions (Develop Patterns of Life, Detect Pattern Signature) and three open source information actions (Sharing Information via Social Media, Sharing Ideology via Social Media, Sharing Interests/Ideology via Blogs). These five actions account for half of the aggregate impact
significance score for the Societal Norms/Culture Human Domain elements and provide a clear picture of open source information and Activity Based Intelligence action items that provide the best understanding of societal norms and culture. The interactions and impact scores mentioned above can be found in Appendix 4.

**Discussion**

Based on the breadth of statistical data and the initial observations the author was able to draw from them, a Leopold-I Matrix is useful for assessing a potential solutions impact on understanding the Human Domain “environment.” The statistical data generated by assessing the impact of potential solutions shows areas of both strength and weakness when it comes to understanding the Human Domain. This data enabled the author to assess some of the assumptions related to these subject matters or anecdotal suggestions of their capabilities. The Leopold-I matrix could also be used by war or diplomatic planners as they reviewed a Human Domain of concern and sought to characterize it’s most important attributes and determine what tools would be the most beneficial in answering this question.

The first noteworthy observation of the fully scored matrix in Appendix 4 is Activity Based Intelligence “actions” did not provide a good understanding of the Human Domain “environment” on more subjective elements such as Arts or Myths. This observation is evident when reviewing the matrix and the lack of scoring in 25 of the 26 interactions between Activity Based Intelligence “actions” and the Human Domain elements of Arts and Myths. While a lack of interactions would suggest that Arts and Myths may not be a good environmental element for understanding the Human Domain,
the scoring of 10 out of 14 possible interactions for open source information suggests the importance of these elements.

Upon review of the selection criteria for the “actions” and “environmental” elements included in the matrix, the author noted that Activity Based Intelligence “actions” generally did not perform well with “environmental” elements that were not easily defined around concrete activities and transactions. In addition to Arts and Myths, the matrix showed a lower number of interactions related to Activity Based Intelligence actions for environmental elements such as Religion, Materiality and Motivation and lower overall impact significance scores ranging from 12 – 49 (out of 100) when there were interactions. Conversely, Activity Based Intelligence actions performed well in Human Domain elements such as the Economy, Access to Technology and Social Structure/Networks that can easily be shaped in terms of activities and transactions. These findings suggest that the Activity Based Intelligence model will struggle to provide insight into the Human Domain when the element being considered is not easily defined by actions and transactions. In this case, anthropological research methods, such as those used in the Human Terrain System (Gezari, 2013), would be required to collect data needed for the metadata intensive Activity Based Intelligence model (Phillips, 2012) that sometimes comes with disastrous consequences (Shachtman, 2008).

Throughout the literature review, the author found numerous suggestions that Activity Based Intelligence could help develop “predictive” capabilities as it focused on identifying “unknown unknowns” (Phillips, 2012). These suggestions were grounded on finding abnormal activity within various “activity” and “transaction” data sets and being able to analyze the meaning of this anomaly and its likely outcome or event. However,
the discussions of these “predictive capabilities” were not focused on their understanding of the Human Domain in question. Based on the scoring of the matrix, the author reviewed the Activity Based Intelligence scores for their impact on understanding the Human Domain and whether they offered any “predictive capabilities.”

In order to review the “predictive capability” of Activity Based Intelligence in regards to the Human Domain, the author chose the environmental elements Motivation and Intent as the most closely related to any type of “predictive capability.” These elements were viewed through a military-centric interpretation as the military focuses on understanding the Motivation and Intent of their adversaries and seek to use this information to predict their next possible move (Scales, 2004). Of the 26 possible interactions between the Human Domain elements and actions, only eleven were scored by the author in the full matrix with Intent registering seven of those interactions. The range of impact significance scores for the “predictive” Human Domain elements was 12 – 49 with a mean score between the two elements of only 33 out of a maximum 100.

The low impact significance scores for the “predictive” elements defined above suggest that Activity Based Intelligence has a low predictive quality. In this scenario, Activity Based Intelligence “actions” provide the best “predictive” quality when it comes to identifying and understanding relationships between networks as indicated by their mean impact significance score of 42.5 and 49 respectively. Although experts are hesitant to label Activity Based Intelligence as “predictive,” the scoring of the author’s matrix suggests that two of the biggest elements that drive human behavior, their Motivation and Intent, are not clearly impacted by the methodology.
The last noteworthy observation made was the lack of location related “action” impacts on understanding the Human Domain. While there was only one location related action for open source information, Sharing Geo-Location Data via Social Media, the low number of scored interactions across the four Activity Based Intelligence “actions” was more troublesome. Given that the Activity Based Intelligence pillar of, “geo-reference to discover,” is key in mapping “activities” and “transactions,” this is especially worrisome.

Of the four interactions related to open source information and the Sharing of Geo-Location Data via Social Media, the biggest impact significance on the Human Domain was in understanding the Social Structure/Network and Vulnerabilities with a score of 64 each as shown in Table 4 below. While someone’s physical location would help to understand their social structure and possible limitation of their network, the scoring of Vulnerabilities may cause some to question its validity. The author scored this interaction highly after reviewing the integration of social media with conventional mass media reporting on platforms such as CNN’s iReport or Twitter hashtag “campaigns” that are often used to share photographs and geo-location data of significant natural disasters or weather events that make these populations vulnerable.

<table>
<thead>
<tr>
<th>Impact</th>
<th>Human Terrain</th>
<th>Human Domain</th>
<th>Ethnography</th>
<th>Sociology</th>
<th>Cultural Anthropology</th>
</tr>
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<tbody>
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<td>64</td>
<td>30</td>
<td>30</td>
<td>188</td>
</tr>
</tbody>
</table>

Table 4: Impact Significance Score of Sharing Geo-Location Data via Social Media.

The author did note that the four Human Domain elements that were scored for the open source information action of Sharing Geo-Location Data via Social Media
(Social Structure/Networks, Vulnerabilities, Habitat, and Access to Technology) were also scored for the four Activity Based Intelligence “location” actions. This suggests that there is a relationship between geo-location data shared by social media and the “location” activities associated with Activity Based Intelligence. Some experts believe that the geo-location provided by social media and Activity Based Intelligence’s location based methodology represent the ideal blend of data for this tradecraft (Harris, 2011).

**Areas for Further Refinement**

Although the impact significance score provides a good framework for assessing any proposed solutions impact on understanding the Human Domain, there are areas of the matrix and proposed methodology that could be considered for further refinement. While the selection and modification of the Leopold Matrix were deemed representative by the author, the selection also included numerous value judgments that could be subjected to further scrutiny. In order to provide a fair basis for analysis and refinement of the Leopold-I matrix, the author will suggest some possible areas for refinement of the matrix or further research and analysis for any concerned party.

**Elements Chosen**

To refine the matrix, the author was forced to make many value judgments to determine what “actions” and “environmental” elements were to be considered in the matrix. Although these selections were informed by the literature review, the environmental elements that define the Human Domain and the actions related to open source information and Activity Based Intelligence could be viewed critically by other assessors of the Leopold-I methodology. The author’s original matrix included 49 possible Activity Based Intelligence actions, eight possible open source information
actions, and 31 possible Human Domain elements spread across six academic and professional disciplines as shown in Appendix 1. The paring of the final matrix to only 20 actions and 18 environmental elements that were deemed optimum for interactions represent the largest area for dispute alternative interpretation by other researchers.

The refinement of the 31 Human Domain “environmental” elements into the final 18 selected for the matrix by the author are indicative of the struggle that comes with clearly defining the Human Domain and the overlap of the disciplines that can be used to study its elements. At the outset of the matrix refinement, the author sought to maintain at least one environmental element from each of the six disciplines, Human Terrain, Human Domain, Ethnography, Sociology, Cultural Anthropology and Human Geography, to represent a comprehensive understanding of humans and their conditions. While this may seem straightforward, the overlap of the closely related disciplines and their environmental elements lead to the elimination of Human Geography from the matrix all together.

For example, the author initially defined the Human Geography as three high level elements, Place, Space, and Environment, which was a succinct and easily relatable definition provided in the literature review (Gregory, Johnston, Pratt, Watts, & Whatmore, 2009). Upon review, the author noted that the majority of the related disciplines presented some element related to the physical environment that humans occupy, such as the Human Domain’s delineation of domains (Air, Space, Maritime, Ground, Cyber) (Hoffman & Davies, 2013) or Cultural Anthropology’s focuses on the Resource availability of the population in question (American Anthropological Association, n.d.). In order to narrow the environmental elements down, the author chose
to use the Ethnographic term of Habitat to be an all-encompassing catch all for the physical characteristics of the places people occupy. For simplicity sake, the author also assumed that all Ethnographic, Anthropological and Human Domain elements related to human’s physical environment fell into the consideration of Habitat.

The author also had to greatly simplify the “action” items considered for Activity Based Intelligence and pare the actions considered down from the original 49 possibilities to the 13 included in the final revised Leopold Matrix. To accomplish this, the author chose to focus on the “principles” of Activity Based Intelligence versus actions related to metadata requirements, technological considerations, or algorithm refinement that did not provide much insight into the Human Domain. The author also reluctantly chose to omit the “pillars” of Activity Based Intelligence (geo-reference to discover, data integration and association before data exploitation, data neutrality, sequence neutrality) as these pillars did not directly contribute to the understanding of the Human Domain (Phillips, 2012).

While all of the potential “action” items above are important to understanding the full potential and value of Activity Based Intelligence, they were ultimately eliminated because there was no direct impact on the elements of the Human Domain. While these items facilitated the use and expanded the possibilities of Activity Based Intelligence, they did not provide the “action” needed to interact with the environmental elements. However, it could be argued that without the pillars, technology, or metadata requirements that facilitate Activity Based Intelligence, the “principles” and their related actions would not provide as robust an impact on the understanding of the Human Domain.
The selection of which “environmental” elements to consider and the related “action” items that they interact with is a valid criticism or area for alternative interpretation using the Leopold-I methodology. However, this also proves a strong suit for the Leopold-I matrix and its ability to be tailored to suit the understanding of a specific Human Domain under consideration. For example, the use of the Ethnographic element of Habitat mentioned earlier could be further delineated to include environmental elements from other disciplines that provide a more granular view on specific items of concern, such as Resources. Or, the Leopold-I matrix could be modified to include a more detailed look at Activity Based Intelligence and open source information’s impact on understanding the tribal, religious, or secular cultures and organizational structures that underpin a Human Domain of concern.

**Subjective Scoring**

The magnitude and importance scores entered in the author’s modified Leopold Matrix represent the author’s value judgment based upon a detailed literature review on the subjects of this paper. The author struggled to create a uniform scoring methodology for magnitude, as inventorying and quantifying the Human Domain to assess magnitude of the proposed change was outside of the scope of this work. In this case, the author had to default to the value judgment methodology used for scoring importance and assign the magnitude scores in the same manner. The judgments related to the interactions and impacts contained in the author’s Leopold-I matrix were intended to provide the reader with a demonstration of the proposed methodology and to put forward the author’s findings on the matter. If this methodology were adopted, there would likely be a wide
range of opinions and scoring as it relates to the 360 possible interactions contained in the matrix and the scores related to magnitude and importance for each.

The author views the Leopold-I matrix and proposed methodology as a data collection tool that could be used to poll intelligence professionals, policy makers, war planners, or diplomats to determine what are the important elements of the Human Domain and what impact proposed solutions such as Activity Based Intelligence and open source information could have on its understanding. The aggregate impact significance scores for the matrix interactions could be used to assess areas of investment with regard to proposed technologies and methodologies. The environmental elements of the Human Domain could be reviewed on a case by case basis by regional or cultural analysts to refine the elements necessary to provide the best understanding of an area or people of interest. While the professional opinions related to the scoring of the interactions and impact significance of the matrix may vary, the collective wisdom and insight of this large all-encompassing group would help drive improvements in the understanding of a variety of Human Domains.

Other Research Limitations

Effective research of the elements critical to the Leopold-I Matrix was subject to the limitations inherent in the availability and quality of data related to the item under consideration. For example, research into academic fields that were considered for the Human Domain such as Sociology and Cultural Anthropology were readily available to the author in many different formats including academic journals, textbooks, and other online publications. Whereas data for Human Terrain and Activity Based Intelligence were not widely available for public consumption and often took the biased form of
industry promotional material and publications or defense sponsored academic research. The use of this material could introduce bias into the author’s analysis and is recognized as a research limitation that cannot be overcome with only publicly available information.

Additionally, the classified nature of elements of these programs meant that the data available was subject to censorship and often provided no in depth discussion of specific elements or technological capabilities that were critical to their function. While the literature review did provide a solid understanding of the intent and conceptual functioning of these classified programs, it did not provide a comprehensive review of the programs capabilities or technologies. The author believes that the use of the modified Leopold matrix by intelligence and policy making professionals with full access to the programs and related research and development could address the shortcomings inherent in this analysis.

The author also noted that the time-bound construct of the matrix made the magnitude and importance scoring for the non-physical Human Domain difficult. Leopold originally intended the matrix to focus on “first-order effects of specific actions” with the users focus on short or long-term impacts being articulated in the text of the Environmental Impact Assessment (Luna B. Leopold, 1971). While this time-bound construct is ideal for Environmental Impact Assessments, the author had to make some general assumptions regarding first-order impacts outside of this construct. The author chose to consider first-order effects as those that presented the most likely impact or plausible scenario for the interaction of the action and environmental element without regard to time. While this assumption may seem simple, it could be considered by some
studying the Leopold-I matrix and methodology as not clearly delineating between first, second, and third-order effects of the interaction being scored.

The problem with time-bound construct of the matrix became evident when considering “actions” related to Activity Based Intelligence and open source information. To consider the impact or plausible scenario for Activity Based Intelligence’s use, the author had to consider the effect of collection, characterization and location of activities and transactions over a long period of time and the impact they would have on understanding the Human Domain. As suggested in the literature review, the value of these Activity Based Intelligence actions would come through the aggregation of as wide and varied a data set as possible over as long a period of time as possible (Atwood, 2015). Some may argue that this cumulative understanding is representative of second or third-order effects of Activity Based Intelligence and therefore not in line with the original intent of Leopold’s matrix.

This long term outlook was contrasted with the open source information action items that could have an impact or plausible scenario for understanding the Human Domain in the short term. A good example of this would be the recent use of social media and other open source platforms by the U.S. Government to document and distribute information related to aggressions by Russia over disputes in Eastern Europe. The Government’s use of social media posts to highlight the movement of Russian anti-aircraft missiles after the downing of Malaysia Airlines Flight 17 over Ukraine (Miller, 2014) and the recent posting of a You Tube video of the aggressive fly-by of the USS Ross in the Black Sea (Sputnik News, 2015) show the short term impact open source
information can provide to understand the Human Domain elements of Motivation, Intent, and Capabilities of Individual/Group.

**Figure 7: Social Media Posts Provided by the Office of the Director of National Intelligence**

**Conclusion**

As the security situation for the United States continues to become more fractured and unpredictable with the rise of threats from both state and non-state actors, an understanding of the Human Domain in the areas of potential conflict is of utmost importance. Throughout the last decade of conflict, the military and intelligence community have committed serious resources to understanding the Human Domain, with programs such as the $726,000,000 Human Terrain System (Brook, 2015), providing mixed results. While the experts and industry partners’ attempt to fill this knowledge gap
and tout its application to defusing future conflicts (Hodges, 2012), they have largely been viewed as a failure and have been shuttered along with the end of combat operations in Afghanistan (Brook, 2015).

During this period, the military and intelligence communities have also dedicated large amounts of resources to refining the use of open source information to help fill intelligence gaps and provide data directly to the public. Open source information sharing on social media platforms have helped transform the way news is accessed and reported, helped foment social change in places such as Egypt (Lindsey, 2013) and document the buildup of Russian forces in Syria (Groll, 2015). Activity Based Intelligence has also taken an old intelligence tradecraft, patterns of life, and used technological advances and the flood of “big data” from source such as social media to create an entirely new tradecraft focused on spotting “unknown unknowns.” While the specifics of this intelligence capability remain largely classified, it is sure to take a prominent position among more traditional intelligence trade crafts when fully developed and embraced by the intelligence community.

The findings of this paper suggest that the Leopold-I Matrix is a worthy assessment tool when considering the impact of potential solutions such as Activity Based Intelligence and open source information on our understanding of the Human Domain and offers a framework to collect professional input regarding this matter. The suggested modification and use of the Leopold-I Matrix detailed in this paper provide a detailed look at the areas of interaction and the impact that any proposed solution may have on understanding the Human Domain “environment.” The modification and use of impact significance scores for the interactions contained in the matrix provide empirical
data that can be analyzed by experts and used to assess areas where potential solutions to our Human Domain issue provide clarity or only marginal benefit. It is the author’s hope that the Leopold-I matrix and proposed methodology could be more fully researched and used to better understand the Human Domain in areas of civil engagement or military conflict.
## Appendixes

### Appendix 1 – Original Leopold-I Matrix

## Appendix 2 – Refined Leopold-I Matrix with Interactions Marked

<table>
<thead>
<tr>
<th>Human Domain</th>
<th>Ethnography</th>
<th>Sociology</th>
<th>Cultural Anthropology</th>
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<tbody>
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<td>Characterize Activities</td>
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<td>Locate Activities</td>
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<td>Locate Actors/Entities Conducting Activities</td>
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<td>Understand Relationships B/W Networks</td>
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<td>Develop Patterns of Life</td>
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<td>Detect Pattern Signatures</td>
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### Appendix 3 – Leopold-I Matrix Scored by Magnitude & Importance

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<th>Access to Technology</th>
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## Appendix 4 – Impact Significance Scores for Leopold-I Matrix

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## Appendix 5 – Pared Impact Significance Scores for Leopold-I Matrix

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**Human Domain**
- Ethnography
- Sociology
- Cultural Anthropology

**Societal Norms/Culture**
- Social Classes
- Religion
- Access to Technology
- Materiality
- Habitat

**Arts**
- Individual/Group

**Communications**
- Capabilities of Individual/Group
- Vulnerabilities
- Intent
- Motivation

**Social Structure / Networks**
- Social Norms/Culture
References


Consumer Reports. (2012, June). Facebook & your privacy: Who sees the data you share on the biggest social network. Retrieved from Consumer Reports:


